3.3 Unified Recording Forms (Action S2)

Holding Company for water and wastewater
Sharkiay Potable water and Sanitation Company

Abu Hammad Sector
Abbasa water treatment plant

Raw water pump operation record

Day / / 200

Shift…… .From hr…… to hr ……..

ITEM	Flow l/s	Av. Ampere	Av. Dich. head	Prev. Work hours	Shift working hours								shift Work hours	total. Work hours	Operation opsevation				
					1	2	3	4	5	6	7	8			sund	viab.	temp	Evac.	other
Pump No 1	250																		
Pump No 2	250																		
Pump No 3	250																		
Pump No 4	250																		
Pump No 5	750																		
Pump No 6	750																		
Pump No 7	500																		
Pump No 8	500																		
Pump No 9	500																		

Flow meter Reading

Shift beginning	1	2	3	4	
Shift End					
Total flow m3					Total

chief of the plant
Name
Signature

operation manager
Name
Signature

shift manager
Name
Signature

Data recording by
Name
Signature

Holding Company for water and wastewater
Sharkiay Potable water and Sanitation Company

Abu Hammad Sector

Abbasa water treatment plant

Treated water pump operation record

Day / / 200

Shift…… .From hr…… to hr ……..

ITEM	Flow l/s	Av. Ampere	Av. Dich. head	Prev. Work hours	Shift working hours								shift Work hours	total. Work hours	Operation opsevation				
					1	2	3	4	5	6	7	8			sund	viab.	temp	Evac.	other
Pump No 1	240																		
Pump No 2	240																		
Pump No 3	240																		
Pump No 4	240																		
Pump No 5	750																		
Pump No 6	500																		
Pump No 7	500																		
Pump No 8	500																		
Pump No 9	500																		
Pump No 10	500																		

Flow meter Reading

Shift beginning	1	2	3	4	
Shift End					
Total flow m3					Total

chief of the plant
Name
Signature

operation manager
Name
Signature

shift manager
Name
Signature

Data recording by
Name
Signature

3.3-2

Holding Company for water and wastewater
Sharkiay Potable water and Sanitation Company

Abu Hammad Sector
Abbasa water treatment plant

Sludge water pump operation record

Day / / 200

Shift…….. .From hr…….. to hr ……..

ITEM	Flow l/s	Av. Ampere	Av. Dich. head	Prev. Work hours	Shift working hours								shift Work hours	total. Work hours	Operation opsevation				
					1	2	3	4	5	6	7	8			sund	viab.	temp	Evac.	other
Pump No 1	100																		
Pump No 2	50																		
Pump No 3	50																		
Pump No 4	25																		
Pump No 5	250																		
Pump No 6	250																		
Pump No 7	250																		

chief of the plant
Name
Signature

operation manager
Name
Signature

shift manager
Name
Signature

Data recording by
Name
Signature

Holding Company for water and wastewater
Sharkiay Potable water and Sanitation Company

Abu Hammad Sector
Abbasa water treatment plant

Consumables

Day / / 200

Shift……. .From hr…… to hr ……..

1. Alum

Alum tanks	Tank 1	Tank 2			Total consumption in the shift
Level at the shift beginning (m)					
Level at the shift end (m)					
Level difference (m)					
Alum quantity = K X level difference					……..kg

2. Chlorine

Common chlorine line	Line 1	Line 2		Total consumption in the shift
Chlorine drum weigh at beginning (kg)				
Chlorine drum weigh at end (kg)				
Chlorine drum weight difference (kg)				
Total chlorine used = wX number of drums				……..kg

3. Power

Main feeders	Feeder 1	Feeder 1	Total consumption in the shift
KWH at shift beginning			
KWH at shift end			
Consumption in the shift			…….KWH

Data recording by	shift manager	operation manager	chief of the plant
Nam	Name	Name	Name
Signature	Signature	Signature	Signature

Holding Company for water and wastewater
Sharkiay Potable water and Sanitation Company

Abu Hammad Sector
Abbasa water treatment plant

Monthly Record

Month Year 200

Day	RW Quantity M3	TW Quantity M3	Inside loss M3	Loss %	Chl. Used kg	Chlorine dose ppm			Alum. Used kg	Alum. dose ppm			Power used KWH	Power per m3
						Actual	Lab.	Dev.%		Actual	Lab.	Dev.%		
1														
2														
3														
4														
5														
6														
7														
8														
9														
10														
11														
12														
13														
14														
15														
16														
17														
18														
19														
20														
21														
22														
23														
24														
25														
26														
27														
28														
29														
30														
31														

Approved by Chief of the plant
Name
Signature

Data collected by
Name
Signature

Holding Company for water and wastewater
Sharkia Potable water and Sanitation Company

Abu Hammad Sector
Abbasa water treatment plant

Filter backwashing record
Day / / 200

Filter	start		End		Time	Filter	start		End		Time
	m	hr	m	hr	Min.		m	hr	m	hr	Min.
F1						F9					
F2						F10					
F3						F11					
F4						F12					
F5						F13					
F6						F14					
F7						F15					
F8						F16					

Filter	start		End		Time	Filter	start		End		Time
	m	hr	m	hr	Min.		m	hr	m	hr	Min.
F1						F7					
F2						F8					
F3						F9					
F4						F10					
F5						F11					
F6						F12					
Total backwashing time in minutes											

Total backwash water used = 0.6 X total backwash time X backwash pump discharge (m3/minutes) = …… m3
Backwash percentage = backwash water / raw water X 100 = ……%

Data recording by	shift manager	operation manager	chief of the plant
Name	Name	Name	Name
Signature	Signature	Signature	Signature

Daily Operation Record for Well and Transfer Pumps
Fe/Mn Removal Plant Kafr Farag, Menia Alqamah
/ 06 /2007

Time of operation	Estimated total discharge (m3/h)	Transfer Pump							
		Pump 1		Pump 2		Pump 3		Pump 4	
		Pump Ampere (A)	Estimated discharge (m3/h)	Pump Ampere (A)	Estimated discharge (m3/h)	Pump Ampere (A)	Estimated discharge (m3/h)	Pump Ampere (A)	Estimated discharge (m3/h)
6:00									
7:00									
8:00									
9:00									
10:00									
11:00									
12:00									
13:00									
14:00									
15:00									
16:00									
17:00									
18:00									
19:00									
20:00									
21:00									
22:00									
23:00									
0:00									
1:00									
2:00									
3:00									
4:00									
5:00									

Daily Operation Record for Well and Transfer Pumps
Fe/Mn Removal Plant Kafr Farag, Menia Alqamah
/ 06 /2007

Time of operation	Estimated total discharge (m3/h)	Well Pump							
		Pump 1		Pump 2		Pump 3		Pump 4	
		Pump Ampere (A)	Estimated discharge (m3/h)	Pump Ampere (A)	Estimated discharge (m3/h)	Pump Ampere (A)	Estimated discharge (m3/h)	Pump Ampere (A)	Estimated discharge (m3/h)
6:00									
7:00									
8:00									
9:00									
10:00									
11:00									
12:00									
13:00									
14:00									
15:00									
16:00									
17:00									
18:00									
19:00									
20:00									
21:00									
22:00									
23:00									
0:00									
1:00									
2:00									
3:00									
4:00									
5:00									

Sharqiya Economical General
Authority for Water & Sanitary Drainage

Branch:……
Local Unit:……..
Station: …… **/ / 200**

Operational records for booster pump station

Pump	Pump 1		Pump 2		Pump 3		Pump 4		Notes
Time	operated	stopped	operated	stopped	operated	stopped	operated	stopped	
	hr. min.	hr.min.	hr. min.	hr.min.	hr. min.	hr.min.	hr. min.	hr.min.	
First shift									
Second shift									
Third shift									
Total hours									

Water meter readings…….m3 Produced water quantity……m3/day
Diesel Consumption…….l / day oil Consumption…….l / day
Meter reading in the beginning of the shift…….kilowatt
Electric Consumption……..kilowatt / day

Shift Supervisor ……..
Station manager…….

Daily Operation Record for Well Pumps
Zeraa Well Station
/ 06 /2007

Time of operation	Estimated total discharge (m3/h)	Pump House 1			Pump House 2			Pump House 3				Pump House 1 for Elevated Tank		Pump House 2 for Elevated Tank	
		P1	P2	P3	P1	P2	P3	P1	P2	P3	P4	P1	P2	P1	P2
		Pump Ampere (A)	Pump Ampere (A)	Pump Ampere (A)	Pump Ampere (A)	Pump Ampere (A)	Pump Ampere (A)	Pump Ampere (A)	Pump Ampere (A)	Pump Ampere (A)	Pump Ampere (A)	Pump Ampere (A)	Pump Ampere (A)	Pump Ampere (A)	Pump Ampere (A)
6:00															
7:00															
8:00															
9:00															
10:00															
11:00															
12:00															
13:00															
14:00															
15:00															
16:00															
17:00															
18:00															
19:00															
20:00															
21:00															
22:00															
23:00															
0:00															
1:00															
2:00															
3:00															
4:00															
5:00															

New Recording Sheet

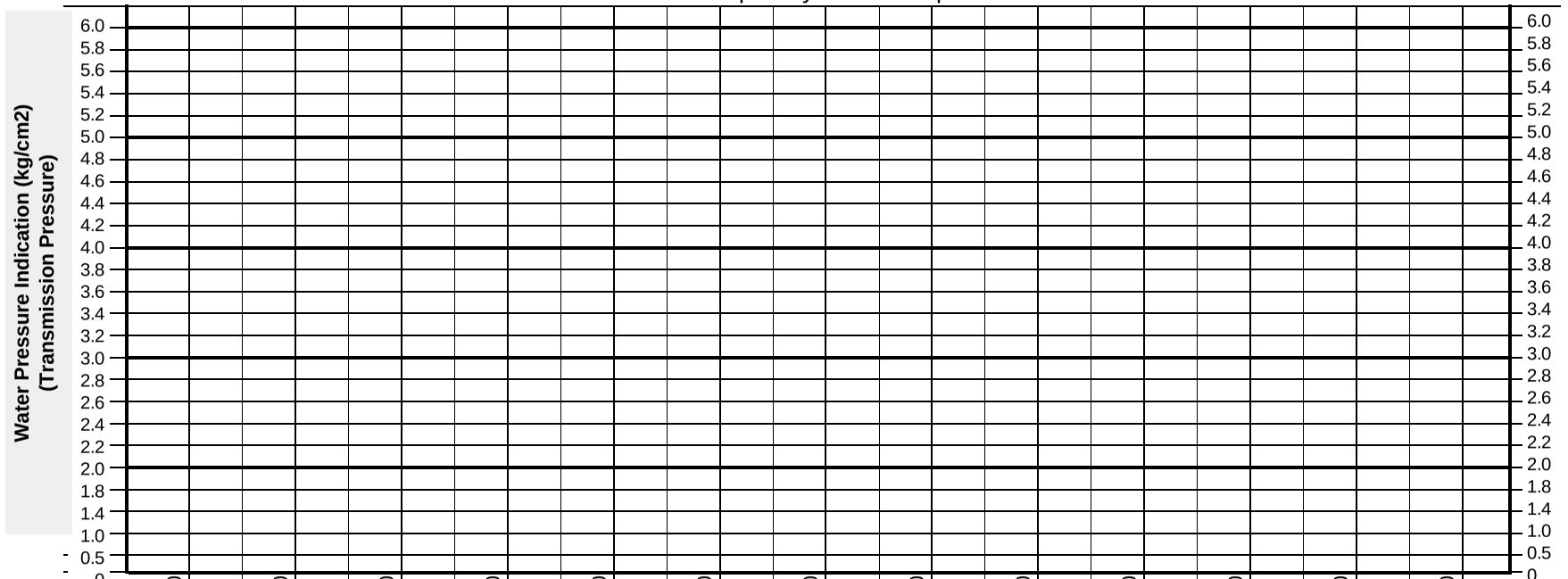
3.3-11

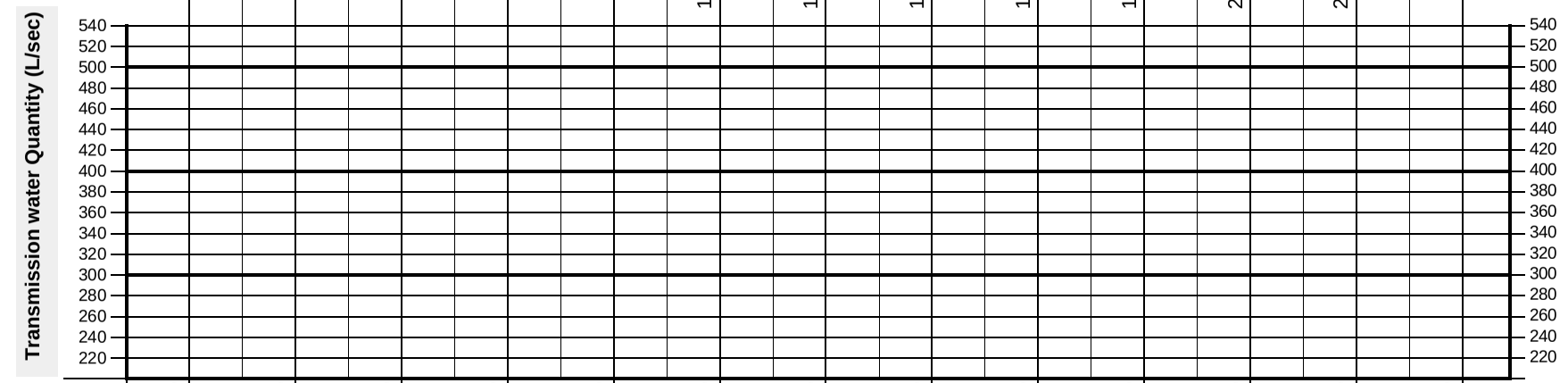
Zagazig Water Treatment Plant

Transmission water quantity and Water pressure in the network

Date ( )/ /2008

Sharkia Potable Water and Sanitation Company





TR	RW	TR	RW	TR	RW	TR	RW	TR	RW	TR	RW	TR	RW	TR	RW	TR	RW	TR	RW	TR	RW	TR	RW
No.1	No.1	No.1	No.1	No.1	No.1	No.1	No.1	No.1	No.1	No.1	No.1	No.1	No.1	No.1	No.1	No.1	No.1	No.1	No.1	No.1	No.1	No.1	No.1
No.2	No.2	No.2	No.2	No.2	No.2	No.2	No.2	No.2	No.2	No.2	No.2	No.2	No.2	No.2	No.2	No.2	No.2	No.2	No.2	No.2	No.2	No.2	No.2
No.3	No.3	No.3	No.3	No.3	No.3	No.3	No.3	No.3	No.3	No.3	No.3	No.3	No.3	No.3	No.3	No.3	No.3	No.3	No.3	No.3	No.3	No.3	No.3
No.4	No.4	No.4	No.4	No.4	No.4	No.4	No.4	No.4	No.4	No.4	No.4	No.4	No.4	No.4	No.4	No.4	No.4	No.4	No.4	No.4	No.4	No.4	No.4
No.5	No.5	No.5	No.5	No.5	No.5	No.5	No.5	No.5	No.5	No.5	No.5	No.5	No.5	No.5	No.5	No.5	No.5	No.5	No.5	No.5	No.5	No.5	No.5

Zagazig water treatment plant
Working time in a day
transmission pump and Raw water pump

	day	month	year
Date			

Transmission pump

	No.1	No.2	No.3	No.4	No.5
0:00					
2:00					
4:00					
6:00					
8:00					
10:00					
12:00					
14:00					
16:00					
18:00					
20:00					
22:00					
total					

Raw water pump

	No.1	No.2	No.3	No.4	No.5
0:00					
2:00					
4:00					
6:00					
10:00					
12:00					
14:00					
16:00					
18:00					
20:00					
22:00					
total					

	date	month	year
Date			

	Quantity (l/sec)		Water pressure (kg/sm2)
	Transmission	**Raw water**	**Transmission**
0:00			
2:00			
4:00			
6:00			
8:00			
10:00			
12:00			
14:00			
16:00			
18:00			
20:00			
22:00			

	date	month	year
Date			

	Quantity (l/sec)		Water pressure (kg/sm2)
	Transmission	**Raw water**	**Transmission**
0:00			
2:00			
4:00			
6:00			
8:00			
10:00			
12:00			
14:00			
16:00			
18:00			
20:00			
22:00			

3.4 SOP Document “First English Version” (Action S4)

SOP Head Line

SOP for surface water treatment plants

Activity code	Activity description	Activity code	Activity discretion
WTP01	**Raw water intake**	WTP12	Chlorination facility
WTP02	Raw water pump/motor	WTP13	Transmission pump
WTP03	Receiving well	WTP14	Drainage facility
WTP04	Flocculation basin	WTP15	Piping & valve
WTP05	Sedimentation basin	WTP16	Monitoring room and instrumentation
WTP06	Sludge collector	WTP17	Electrical power supply
WTP07	Sludge drainage	WTP18	Diesel generator
WTP08	Rapid sand filter	WTP19	Crane facility
WTP09	Filter washing facility	WTP20	Laboratory
WTP10	Clear water reservoir	WTP21	Coordination with booster pump station
WTP11	Alum dosing facility		

Facility : Raw water sumps, intake gates, and fixed screen bars

Crew size	Equipment	Material
Supervisor + Chemist + 2 labors	Garbage collection vessel, hand cleaning fork, truck and drain pump	Calcium hypochlorite

Activities to complete	Time to complete each Activity
Daily : cleaning and mentoring	30 minutes
Monthly : intake gate clearing	1houer, 30 minutes
Yearly : gates polishing, repair and paint	3 hours
Emergency : disinfection	30 minutes

Work method

Daily:
1- Check water level in the raw water sump and notice any decrease
2- Check water level behind fixed screen to check any blocking in raw water pipes
3- Notice any sounds or water vortex in front of fixed bar screen as indication for block
4- Clean the bar screen to ensure enough water for raw water sump

Monthly:
1- Raise all intake gates and clean them
2- Re install the gates after cleaning

Yearly:
1- Raise all intake gates, polish, repair and paint them and drain all sumps
2- Re install the gates after painting

Emergency:
1- Disinfect intake area using Calcium hypochlorite in case of sign of pollution

Holding Company for water and wastewater
Sharkia Potable water and Sanitation Company

SOP for surface water treatment plants

Activity code	Activity description	Activity code	Activity discretion
WTP01	Raw water intake	WTP12	Chlorination facility
WTP02	**Raw water pump/motor**	WTP13	Transmission pump
WTP03	Receiving well	WTP14	Drainage facility
WTP04	Flocculation basin	WTP15	Piping & valve
WTP05	Sedimentation basin	WTP16	Monitoring room and instrumentation
WTP06	Sludge collector	WTP17	Electrical power supply
WTP07	Sludge drainage	WTP18	Diesel generator
WTP08	Rapid sand filter	WTP19	Crane facility
WTP09	Filter washing facility	WTP20	Laboratory
WTP10	Clear water reservoir	WTP21	Coordination with booster pump station
WTP11	Alum dosing facility		

Facility : pumping units (pump + motor), valves and electric panels

Crew size	Equipment	Material
Supervisor + 2 technician + 2 labors	Manual tools + lubricator	Stuffing box sealing material + grease

Activities to complete	Time to complete each Activity
Daily : check and operation mentoring	8 hours
Monthly : greasing and stuffing box check	Additional 4 hours
Yearly : annual overall and change defect parts	As per overall required works

Work method

Daily:
1- Check pump operation and record operational data and any up normal condition
2- Do general cleaning for all pump house building and equipment
3- Check the routine balanced operating time between units
4- Check stuffing box and be sure of water drops (about twenty drop per minute)
5- Record Ampere and Volts and assure that they are in the permissible limits

Monthly:
1- Check pump bearing oil or grease and add the necessary amounts
2- Check stuffing box gland backing and repair
3- Monthly cleaning and remove excess grease and dirt

Yearly:
1- Do annual overall for pumps and replace defected parts
2- Check all valves and replace stuffing box packing and repaint
3- Check pump and motor alignment and do necessary adjustment
4- Check unit fixation and adjust all fixing bolts

Holding Company for water and wastewater
Sharkia Potable water and Sanitation Company

SOP for surface water treatment plants

Activity code	Activity description	Activity code	Activity discretion
WTP01	Raw water intake	WTP12	Chlorination facility
WTP02	Raw water pump/motor	WTP13	Transmission pump
WTP03	**Receiving well**	WTP14	Drainage facility
WTP04	Flocculation basin	WTP15	Piping & valve
WTP05	Sedimentation basin	WTP16	Monitoring room and instrumentation
WTP06	Sludge collector	WTP17	Electrical power supply
WTP07	Sludge drainage	WTP18	Diesel generator
WTP08	Rapid sand filter	WTP19	Crane facility
WTP09	Filter washing facility	WTP20	Laboratory
WTP10	Clear water reservoir	WTP21	Coordination with booster pump station
WTP11	Alum dosing facility		

Facility : receiving well + weirs + valves and gates

Crew size	Equipment	Material
Supervisor + 1 labor	NA	Calcium hypochlorite

Activities to complete	Time to complete each Activity
Daily : check water distribution and scum	15 minutes
Monthly : check valves and drain valve chamber	one and have hour
Yearly : drain, clean and disinfection	two hours

Work method

Daily:
1- Check water level in the receiving well to ensure equal distribution
2- Remove the scum in the water surface

Monthly:
1- Check inlet and outlet valves
2- Drain valve chambers

Yearly:
1- Repair or replace gland backing
2- Drain the receiving well and remove all mud and disinfect
3- Put into operation after be ready

SOP for surface water treatment plants

Activity code	Activity description	Activity code	Activity discretion
WTP01	Raw water intake	WTP12	Chlorination facility
WTP02	Raw water pump/motor	WTP13	Transmission pump
WTP03	Receiving well	WTP14	Drainage facility
WTP04	**Flocculation basin**	WTP15	Piping & valve
WTP05	Sedimentation basin	WTP16	Monitoring room and instrumentation
WTP06	Sludge collector	WTP17	Electrical power supply
WTP07	Sludge drainage	WTP18	Diesel generator
WTP08	Rapid sand filter	WTP19	Crane facility
WTP09	Filter washing facility	WTP20	Laboratory
WTP10	Clear water reservoir	WTP21	Coordination with booster pump station
WTP11	Alum dosing facility		

Facility : flocculation basin

Crew size	Equipment	Material
Supervisor + 1 labor	NA	Calcium hypochlorite

Activities to complete	Time to complete each Activity
Daily : check floc formation and mixers	15 minutes
Monthly : oil and grease mixers	30 minutes
Quarter Yearly : drain, clean and disinfection	twelve hours
Yearly : mixers repair	two days

Work method

Daily:
1- Check floc formation in the flocculation basin
2- Operate the slow mixers

Monthly:
1- Check oil and grease for the mixer
2- Clean and maintain mixers

Quarter Yearly:
1- Drain the flocculation basin and remove all mud and disinfect
2- Repair and maintain the slow mixers
3- Put into operation after be ready

Yearly:
1- Clean and polish the mixer parts and repaint
2- Put into operation after be ready

Holding Company for water and wastewater
Sharkia Potable water and Sanitation Company

SOP for surface water treatment plants

Activity code	Activity description	Activity code	Activity discretion
WTP01	Raw water intake	WTP12	Chlorination facility
WTP02	Raw water pump/motor	WTP13	Transmission pump
WTP03	Receiving well	WTP14	Drainage facility
WTP04	Flocculation basin	WTP15	Piping & valve
WTP05	**Sedimentation basin**	WTP16	Monitoring room and instrumentation
WTP06	Sludge collector	WTP17	Electrical power supply
WTP07	Sludge drainage	WTP18	Diesel generator
WTP08	Rapid sand filter	WTP19	Crane facility
WTP09	Filter washing facility	WTP20	Laboratory
WTP10	Clear water reservoir	WTP21	Coordination with booster pump station
WTP11	Alum dosing facility		

Facility : sedimentation basin +bridge +outlet weirs +sludge outlet valves

Crew size	Equipment	Material
Supervisor + 1 labor	NA	Calcium hypochlorite

Activities to complete	Time to complete each Activity
Daily : check floc sedimentation	45 minutes
Monthly : oil and grease bridge	30 minutes
Quarter Yearly : drain, clean and disinfection	twelve hours
Yearly : bridge maintenance and repair	two days

Work method

Daily:
1- Check floc sedimentation in the sedimentation basin
2- Check water above weir and notice any flocs escaping
3- Open sluge drain valves every two houres
4- Remove all floating material and scum

Monthly:
1- Check oil and grease for the bridge motors and wheels
2- Clean and bridge gear box

Quarter Yearly:
1- Drain the sedimentation basin and remove all mud and disinfect
4- Repair and maintain the bridge components
5- Put into operation after be ready

Yearly:
2- Clean and polish the bridge parts and repaint
3- Put into operation after be ready

Holding Company for water and wastewater
Sharkia Potable water and Sanitation Company

SOP for surface water treatment plants

Activity code	Activity description	Activity code	Activity discretion
WTP01	Raw water intake	WTP12	Chlorination facility
WTP02	Raw water pump/motor	WTP13	Transmission pump
WTP03	Receiving well	WTP14	Drainage facility
WTP04	Flocculation basin	WTP15	Piping & valve
WTP05	Sedimentation basin	WTP16	Monitoring room and instrumentation
WTP06	**Sludge collector**	WTP17	Electrical power supply
WTP07	Sludge drainage	WTP18	Diesel generator
WTP08	Rapid sand filter	WTP19	Crane facility
WTP09	Filter washing facility	WTP20	Laboratory
WTP10	Clear water reservoir	WTP21	Coordination with booster pump station
WTP11	Alum dosing facility		

Facility : sludge collection pipes and manholes

Crew size	Equipment	Material
Supervisor + 2 labors	Manual tools	NA

Activities to complete	Time to complete each Activity
Daily : check sludge telescopic valve	15 minutes
Monthly : clean and maintain the telescopic valve	one and have hour
Yearly : clean and maintain all valves and gates	two hours

Work method

Daily:
1- Check all telescopic valves and observe sludge drainage
2- Check wash water drain valves in filters -no leak must be observed
3- Check all over flow points – no overflow must be observed
4- Check all manholes for blocking

Monthly:
1- Clean and maintain all telescopic valves
2- Repair all valves and gates

Yearly:
4- Repair or replace gland backing for valves
5- Clean manholes and remove all mud
6- Put into operation after be ready

Holding Company for water and wastewater
Sharkia Potable water and Sanitation Company

SOP for surface water treatment plants

Activity code	Activity description	Activity code	Activity discretion
WTP01	Raw water intake	WTP12	Chlorination facility
WTP02	Raw water pump/motor	WTP13	Transmission pump
WTP03	Receiving well	WTP14	Drainage facility
WTP04	Flocculation basin	WTP15	Piping & valve
WTP05	Sedimentation basin	WTP16	Monitoring room and instrumentation
WTP06	Sludge collector	WTP17	Electrical power supply
WTP07	**Sludge drainage**	WTP18	Diesel generator
WTP08	Rapid sand filter	WTP19	Crane facility
WTP09	Filter washing facility	WTP20	Laboratory
WTP10	Clear water reservoir	WTP21	Coordination with booster pump station
WTP11	Alum dosing facility		

Facility : sludge collection basin

Crew size	Equipment	Material
Supervisor + 1 labors	Manual tools	NA

Activities to complete	Time to complete each Activity
Daily : monitor operation and water level	3 hours
Monthly : maintain the inlet gates	four hours
Yearly : repair and paint gates	as per required work

Work method

Daily:
1- Check water level in the collecting sump
2- Assure pump operation at high water level
3- Assure pump stop at low water level
5- Clean all floating material in the sump for safe operation

Monthly:
1- Clean and remove mud from sludge sump
2- Grease the gate spindle and gears

Yearly:
1- Repair , polish and repaint all gates
2- Remove all mud
3- Put into operation after be ready

SOP for surface water treatment plants

Activity code	Activity description	Activity code	Activity discretion
WTP01	Raw water intake	WTP12	Chlorination facility
WTP02	Raw water pump/motor	WTP13	Transmission pump
WTP03	Receiving well	WTP14	Drainage facility
WTP04	Flocculation basin	WTP15	Piping & valve
WTP05	Sedimentation basin	WTP16	Monitoring room and instrumentation
WTP06	Sludge collector	WTP17	Electrical power supply
WTP07	Sludge drainage	WTP18	Diesel generator
WTP08	**Rapid sand filter**	WTP19	Crane facility
WTP09	Filter washing facility	WTP20	Laboratory
WTP10	Clear water reservoir	WTP21	Coordination with booster pump station
WTP11	Alum dosing facility		

Facility : filter basin + filter media + operating panels

Crew size	Equipment	Material
Supervisor + 4 labors	Hand tools	Sand + calcium hypochlorite

Activities to complete	Time to complete each Activity
Daily : filter backwashing on request	8 hours
Monthly : cleaning and disinfection	four hours for each filter
Yearly : media backup and disinfection	eight hours for each filter

Work method

Daily:
1- Observe filtration process
2- Assure at least 60cm of water above filter media
3- Assure equal water level in the two halves of filter
4- Follow backwashing process as per details

Monthly:
1- Clean filter media and remove mud balls if exist
2- Clean and disinfect interior walls of filter

Yearly:
1- Back up filter media to the designed level
2- Repair filter under drain (nozzles or M blocks)
3- Disinfect all walls and media under laboratory control
4- Put into operation after be ready

Holding Company for water and wastewater
Sharkia Potable water and Sanitation Company

SOP for surface water treatment plants

Activity code	Activity description	Activity code	Activity discretion
WTP01	Raw water intake	WTP12	Chlorination facility
WTP02	Raw water pump/motor	WTP13	Transmission pump
WTP03	Receiving well	WTP14	Drainage facility
WTP04	Flocculation basin	WTP15	Piping & valve
WTP05	Sedimentation basin	WTP16	Monitoring room and instrumentation
WTP06	Sludge collector	WTP17	Electrical power supply
WTP07	Sludge drainage	WTP18	Diesel generator
WTP08	Rapid sand filter	WTP19	Crane facility
WTP09	**Filter washing facility**	WTP20	Laboratory
WTP10	Clear water reservoir	WTP21	Coordination with booster pump station
WTP11	Alum dosing facility		

Facility

Crew size	Equipment	Material
Supervisor + 2 technician + 2 labors	Manual tools + lubricator	Stuffing box sealing material + grease

Activities to complete	Time to complete each Activity
Daily : check and operation mentoring	8 hours
Monthly : greasing and stuffing box check	Additional 4 hours
Yearly : annual overall and change defect parts	As per overall required works

Work method

Daily:
1- Check pump and air blower operation and record operational data
2- Do general cleaning for the building and equipment
3- Check the routine balanced operating time between units
4- Check stuffing box and be sure of water drops (about twenty drop per minute)
5- Record Ampere and Volts and assure that they are in the permissible limits

Monthly:
1- Check pump bearing oil or grease and add the necessary amounts
2- Check stuffing box gland backing and repair
3- Monthly cleaning and remove excess grease and dirt

Yearly:
1- Do annual overall for pumps and air blowers and replace defected parts
2- Check all valves and replace stuffing box packing and repaint
3- Check pump or air blowers and motor alignment and do necessary adjustment
4- Check unit fixation and adjust all fixing bolts

Holding Company for water and wastewater
Sharkia Potable water and Sanitation Company

SOP for surface water treatment plants

Activity code	Activity description	Activity code	Activity discretion
WTP01	Raw water intake	WTP12	Chlorination facility
WTP02	Raw water pump/motor	WTP13	Transmission pump
WTP03	Receiving well	WTP14	Drainage facility
WTP04	Flocculation basin	WTP15	Piping & valve
WTP05	Sedimentation basin	WTP16	Monitoring room and instrumentation
WTP06	Sludge collector	WTP17	Electrical power supply
WTP07	Sludge drainage	WTP18	Diesel generator
WTP08	Rapid sand filter	WTP19	Crane facility
WTP09	Filter washing facility	WTP20	Laboratory
WTP10	**Clear water reservoir**	WTP21	Coordination with booster pump station
WTP11	Alum dosing facility		

Facility : clear water reservoir + valves

Crew size	Equipment	Material
Supervisor + 1 labors	Manual tools	Calcium hypochlorite

Activities to complete	Time to complete each Activity
Daily : monitor operation and water level	3 hours
Monthly : maintain the inlet gates	four hours
Yearly : repair and paint gates	10 days per reservoir

Work method

Daily:
1- Check water level in the treated water reservoir
2- Assure treated water pump stop at low water level
3- Assure no water go to the overflow pipe

Monthly:
1- Clean the air vent pipes
2- Grease the valve spindle

Yearly:
1- Repair , polish and repaint all valves
2- Remove all mud from reservoir
3- Disinfect the reservoir under laboratory control
4- Put into operation after be ready

Holding Company for water and wastewater
Sharkia Potable water and Sanitation Company

SOP for surface water treatment plants

Activity code	Activity description	Activity code	Activity discretion
WTP01	Raw water intake	WTP12	Chlorination facility
WTP02	Raw water pump/motor	WTP13	Transmission pump
WTP03	Receiving well	WTP14	Drainage facility
WTP04	Flocculation basin	WTP15	Piping & valve
WTP05	Sedimentation basin	WTP16	Monitoring room and instrumentation
WTP06	Sludge collector	WTP17	Electrical power supply
WTP07	Sludge drainage	WTP18	Diesel generator
WTP08	Rapid sand filter	WTP19	Crane facility
WTP09	Filter washing facility	WTP20	Laboratory
WTP10	Clear water reservoir	WTP21	Coordination with booster pump station
WTP11	**Alum dosing facility**		

Facility : alum dissolving tanks + mixers + injection pumps or alum distributer

Crew size	Equipment	Material
Supervisor + 1 labors	Manual tools	NA

Activities to complete	Time to complete each Activity
Daily : check alum injection system	3 hours
Monthly : clean dissolving tanks and pumps	8 hours
Yearly : repair and paint dissolving tank walls	10 days per tank

Work method

Daily:
1- Check dissolving tanks and mixer or air mixing system
2- Assure alum concentration 10% for solid alum and 20% for liquid alum
3- Observe liquid alum level in operating tank
4- Assure second tank ready for use when reach minimum level in operating tank

Monthly:
1- Clean the bottom of the dissolving tank
2- Clean feeding pumps or gravity diustributer

Yearly:
1- Complete drainage of dissolving tank
2- Repair wall cracks and paint by isolation compound
3- Clean and repair feeding pumps
4- Put into operation after be ready

SOP for surface water treatment plants

Activity code	Activity description	Activity code	Activity discretion
WTP01	Raw water intake	**WTP12**	**Chlorination facility**
WTP02	Raw water pump/motor	WTP13	Transmission pump
WTP03	Receiving well	WTP14	Drainage facility
WTP04	Flocculation basin	WTP15	Piping & valve
WTP05	Sedimentation basin	WTP16	Monitoring room and instrumentation
WTP06	Sludge collector	WTP17	Electrical power supply
WTP07	Sludge drainage	WTP18	Diesel generator
WTP08	Rapid sand filter	WTP19	Crane facility
WTP09	Filter washing facility	WTP20	Laboratory
WTP10	Clear water reservoir	WTP21	Coordination with booster pump station
WTP11	Alum dosing facility		

Facility : chlorine storage + chlorinators + injectors + safety equipment

Crew size	Equipment	Material
Supervisor + chlorine tec. + 2 labors	Manual tools + lubricator	Stuffing box sealing material + grease

Activities to complete	Time to complete each Activity
Daily : check and control dose	4 hours
Monthly : repair chlorine injection equipment	16 hours
Yearly : check and test pipes and fittings	As per required works

Work method

Daily:
1- Check and adjust injection points
2- Assure no chlorine leakage
3- Assure that chlorine drum are not empty
4- Assure that second line is ready in case of chorine finished in the working line

Monthly:
1- Repair all injection system
2- Repair and maintain injector booster pump
3- Monthly cleaning and remove excess grease and dirt

Yearly:
1- Complete repair for the whole system
2- Repair ventilators
3- Clean all pipes and change any fittings
4- Put into operation after be ready

Holding Company for water and wastewater
Sharkia Potable water and Sanitation Company

SOP for surface water treatment plants

Activity code	Activity description	Activity code	Activity discretion
WTP01	Raw water intake	WTP12	Chlorination facility
WTP02	Raw water pump/motor	**WTP13**	**Transmission pump**
WTP03	Receiving well	WTP14	Drainage facility
WTP04	Flocculation basin	WTP15	Piping & valve
WTP05	Sedimentation basin	WTP16	Monitoring room and instrumentation
WTP06	Sludge collector	WTP17	Electrical power supply
WTP07	Sludge drainage	WTP18	Diesel generator
WTP08	Rapid sand filter	WTP19	Crane facility
WTP09	Filter washing facility	WTP20	Laboratory
WTP10	Clear water reservoir	WTP21	Coordination with booster pump station
WTP11	Alum dosing facility		

Facility : pumping units (pump + motor), valves and electric panels

Crew size	Equipment	Material
Supervisor + 2 technician + 2 labors	Manual tools + lubricator	Stuffing box sealing material + grease

Activities to complete	Time to complete each Activity
Daily : check and operation mentoring	8 hours
Monthly : greasing and stuffing box check	Additional 4 hours
Yearly : annual overall and change defect parts	As per overall required works

Work method

Daily:
5- Check pump operation and record operational data and any up normal condition
6- Do general cleaning for all pump house building and equipment
7- Check the routine balanced operating time between units
8- Check stuffing box and be sure of water drops (about twenty drop per minute)
9- Record Ampere and Volts and assure that they are in the permissible limits

Monthly:
10- Check pump bearing oil or grease and add the necessary amounts
11- Check stuffing box gland backing and repair
12- Monthly cleaning and remove excess grease and dirt

Yearly:
13- Do annual overall for pumps and replace defected parts
14- Check all valves and replace stuffing box packing and repaint
15- Check pump and motor alignment and do necessary adjustment
16- Check unit fixation and adjust all fixing bolts

Holding Company for water and wastewater
Sharkia Potable water and Sanitation Company

SOP for surface water treatment plants

Activity code	Activity description	Activity code	Activity discretion
WTP01	Raw water intake	WTP12	Chlorination facility
WTP02	Raw water pump/motor	WTP13	Transmission pump
WTP03	Receiving well	**WTP14**	**Drainage facility**
WTP04	Flocculation basin	WTP15	Piping & valve
WTP05	Sedimentation basin	WTP16	Monitoring room and instrumentation
WTP06	Sludge collector	WTP17	Electrical power supply
WTP07	Sludge drainage	WTP18	Diesel generator
WTP08	Rapid sand filter	WTP19	Crane facility
WTP09	Filter washing facility	WTP20	Laboratory
WTP10	Clear water reservoir	WTP21	Coordination with booster pump station
WTP11	Alum dosing facility		

Facility : pumping units (pump + motor), valves and electric panels

Crew size	Equipment	Material
Supervisor + 2 technician + 2 labors	Manual tools + lubricator	Stuffing box sealing material + grease

Activities to complete	Time to complete each Activity
Daily : check and operation mentoring	8 hours
Monthly : greasing and stuffing box check	Additional 4 hours
Yearly : annual overall and change defect parts	As per overall required works

Work method

Daily:
1- Check pump operation and record operational data and any up normal condition
2- Do general cleaning for all pump house building and equipment
3- Check the routine balanced operating time between units
4- Check stuffing box and be sure of water drops (about twenty drop per minute)
5- Record Ampere and Volts and assure that they are in the permissible limits

Monthly:
1- Check pump bearing oil or grease and add the necessary amounts
2- Check stuffing box gland backing and repair
3- Monthly cleaning and remove excess grease and dirt

Yearly:
1- Do annual overall for pumps and replace defected parts
2- Check all valves and replace stuffing box packing and repaint
3- Check pump and motor alignment and do necessary adjustment
4- Check unit fixation and adjust all fixing bolts

Holding Company for water and wastewater
Sharkia Potable water and Sanitation Company

SOP for surface water treatment plants

Activity code	Activity description	Activity code	Activity discretion
WTP01	Raw water intake	WTP12	Chlorination facility
WTP02	Raw water pump/motor	WTP13	Transmission pump
WTP03	Receiving well	WTP14	Drainage facility
WTP04	Flocculation basin	**WTP15**	**Piping & valve**
WTP05	Sedimentation basin	WTP16	Monitoring room and instrumentation
WTP06	Sludge collector	WTP17	Electrical power supply
WTP07	Sludge drainage	WTP18	Diesel generator
WTP08	Rapid sand filter	WTP19	Crane facility
WTP09	Filter washing facility	WTP20	Laboratory
WTP10	Clear water reservoir	WTP21	Coordination with booster pump station
WTP11	Alum dosing facility		

Facility : all interconnecting pipes and valves

Crew size	Equipment	Material
Supervisor + 4 labors	Manual tools + lubricator	Stuffing box sealing material + grease

Activities to complete	Time to complete each Activity
Daily : check all valves	2 hours
Monthly : greasing and stuffing box check	6 hours
Yearly : polish and repaint all valves	6 days

Work method

Daily:
1- Check all valves and valve chambers
2- Assure no leakage out of valve glands
3- Drain all valve chambers
4- Clean valve chambers and remove dirts

Monthly:
1- Repair or replace all backing
2- Grease valve spindles and pinpoints

Yearly:
1- Polish and repaint valves
2- Drain and clean valve chambers
3- Repair wall cracks and isolate walls using paints compound

SOP for surface water treatment plants

Activity code	Activity description	Activity code	Activity discretion
WTP01	Raw water intake	WTP12	Chlorination facility
WTP02	Raw water pump/motor	WTP13	Transmission pump
WTP03	Receiving well	WTP14	Drainage facility
WTP04	Flocculation basin	WTP15	Piping & valve
WTP05	Sedimentation basin	**WTP16**	**Monitoring room and instrumentation**
WTP06	Sludge collector	WTP17	Electrical power supply
WTP07	Sludge drainage	WTP18	Diesel generator
WTP08	Rapid sand filter	WTP19	Crane facility
WTP09	Filter washing facility	WTP20	Laboratory
WTP10	Clear water reservoir	WTP21	Coordination with booster pump station
WTP11	Alum dosing facility		

Facility : measuring equipment and control panels

Crew size	Equipment	Material
technician + 1 labors	Manual tools	NA

Activities to complete	Time to complete each Activity
Daily : check instruments functions	one hour
Monthly : check measured data	2 hours
Yearly : recalibration all instruments	As per overall required works

Work method

Daily:
1- Record all measurements and observe measuring instruments
2- Test all instruments function
3- Check alarm system in all instruments
4- Repair and replace all necessary items

Monthly:
1- Adjust all measuring instrumentation
2- Check collected measuring data and analyse
3- Clean all instrumentation

Yearly:
1- Calibrate all instruments
5- Repair and replace all necessary items
2- Check pump and motor alignment and do necessary adjustment

Holding Company for water and wastewater
Sharkia Potable water and Sanitation Company

SOP for surface water treatment plants

Activity code	Activity description	Activity code	Activity discretion
WTP01	Raw water intake	WTP12	Chlorination facility
WTP02	Raw water pump/motor	WTP13	Transmission pump
WTP03	Receiving well	WTP14	Drainage facility
WTP04	Flocculation basin	WTP15	Piping & valve
WTP05	Sedimentation basin	WTP16	Monitoring room and instrumentation
WTP06	Sludge collector	**WTP17**	**Electrical power supply**
WTP07	Sludge drainage	WTP18	Diesel generator
WTP08	Rapid sand filter	WTP19	Crane facility
WTP09	Filter washing facility	WTP20	Laboratory
WTP10	Clear water reservoir	WTP21	Coordination with booster pump station
WTP11	Alum dosing facility		

Facility : Electric panels + transformers

Crew size	Equipment	Material
Supervisor + 2 technician + 2 labors	Manual tools + measuring instruments	spares

Activities to complete	Time to complete each Activity
Daily : check and operation mentoring	one hour
Monthly : repair and adjust all relays	6 hours
Yearly : measuring transformer oil properties	7 days

Work method

Daily:
1- Check transformer and electric panel function
2- Assure tight closing of all front and back doors of the electric panels
3- Test all indicating lamps
4- Check electric measuring instruments
5- Repair or replace necessary items

Monthly:
1- Adjust all measuring instruments
2- Clean inside the panels from dust
3- Check wiring and cable end fixing

Yearly:
1- Annual maintenance and transformer oil change if necessary
2- Repair and adjust all relays

Holding Company for water and wastewater
Sharkia Potable water and Sanitation Company

SOP for surface water treatment plants

Activity code	Activity description	Activity code	Activity discretion
WTP01	Raw water intake	WTP12	Chlorination facility
WTP02	Raw water pump/motor	WTP13	Transmission pump
WTP03	Receiving well	WTP14	Drainage facility
WTP04	Flocculation basin	WTP15	Piping & valve
WTP05	Sedimentation basin	WTP16	Monitoring room and instrumentation
WTP06	Sludge collector	WTP17	Electrical power supply
WTP07	Sludge drainage	**WTP18**	**Diesel generator**
WTP08	Rapid sand filter	WTP19	Crane facility
WTP09	Filter washing facility	WTP20	Laboratory
WTP10	Clear water reservoir	WTP21	Coordination with booster pump station
WTP11	Alum dosing facility		

Facility : Diesel generators and accessories

Crew size	Equipment	Material
Supervisor + technician + 2 labors	Manual tools + lubricator	Lubricants + spares

Activities to complete	Time to complete each Activity
Daily : check machine condition	one hour
Monthly : run at full load	3 hours
Yearly : annual overall and change defect parts	8 hours

Work method

Daily:
1- Check the machine parts and all connections
2- Check fuel tank and be sure that there is sufficient fuel for operation
3- Check oil level
4- Check cooling system components

Monthly:
1- Run the machine at full load for at least one hour
2- Observe the machine and record all data during operation
3- Make all necessary repairs

Yearly:
1- Do annual overall change oil, oil filters and all required parts
2- Check the electric panel and all relays
3- Do cleaning for fuel tanks and fuel pumps
4- Do necessary maintenance for cooling system

Holding Company for water and wastewater
Sharkia Potable water and Sanitation Company

SOP for surface water treatment plants

Activity code	Activity description	Activity code	Activity discretion
WTP01	Raw water intake	WTP12	Chlorination facility
WTP02	Raw water pump/motor	WTP13	Transmission pump
WTP03	Receiving well	WTP14	Drainage facility
WTP04	Flocculation basin	WTP15	Piping & valve
WTP05	Sedimentation basin	WTP16	Monitoring room and instrumentation
WTP06	Sludge collector	WTP17	Electrical power supply
WTP07	Sludge drainage	WTP18	Diesel generator
WTP08	Rapid sand filter	**WTP19**	**Crane facility**
WTP09	Filter washing facility	WTP20	Laboratory
WTP10	Clear water reservoir	WTP21	Coordination with booster pump station
WTP11	Alum dosing facility		

Facility

Crew size	Equipment	Material
Supervisor + crane driver + 2 labors	Manual tools + lubricator	oil + grease

Activities to complete	Time to complete each Activity
Daily : check crane conditions	one hour
Monthly : oiling and greasing bearings	3 hours
Yearly : annual check for gears and wires	6 hours

Work method

Daily:
1- Check the proper operation for overhead and movable cranes
2- Check movement at no load for
3- Make all necessary fast repair

Monthly:
1- Oiling and greasing all bearings and movable parts
2- Check all gears and wires and do necessary repair
3- Check proper movement of cranes

Yearly:
1- Do annual repair and change all grease and oil
2- Do necessary repairs and maintenance for driving motors
3- Do cleaning for all wires and gears and change all defected parts

SOP for surface water treatment plants

Activity code	Activity description	Activity code	Activity discretion
WTP01	Raw water intake	WTP12	Chlorination facility
WTP02	Raw water pump/motor	WTP13	Transmission pump
WTP03	Receiving well	WTP14	Drainage facility
WTP04	Flocculation basin	WTP15	Piping & valve
WTP05	Sedimentation basin	WTP16	Monitoring room and instrumentation
WTP06	Sludge collector	WTP17	Electrical power supply
WTP07	Sludge drainage	WTP18	Diesel generator
WTP08	Rapid sand filter	WTP19	Crane facility
WTP09	Filter washing facility	**WTP20**	**Laboratory**
WTP10	Clear water reservoir	WTP21	Coordination with booster pump station
WTP11	Alum dosing facility		

Facility

Crew size	Equipment	Material
chemist + technician + labors	Glassware + equipment	chemicals

Activities to complete	Time to complete each Activity
Daily : samples collection, check and fix dose	8 hours
Weekly : do complete samples analysis	10 hours
Monthly : evaluate all analysis results	12 hours
Yearly : calibrations and annual lab requirement	6 days

Work method

Daily:
1- Collect samples from all treatment stages
2- Do all analysis required as per holding company forms
3- Recommend the dose required based on raw water quality (Jar test)
4- Follow laboratory dose recommendation in the plant operation

weekly:
1- Do complete analysis as per holding company forms
2- Evaluate the results

Monthly:
3- Do complete analysis as per holding company forms
1- Check standard solutions

Yearly:
1- Do annual overall for laboratory equipment calibration
2- Check and recommend annual consumables for laboratory

Activity	Activity description	Activity code	Activity discretion

Holding Company for water and wastewater
Sharkia Potable water and Sanitation Company

SOP for surface water treatment plants

code			
WTP01	Raw water intake	WTP12	Chlorination facility
WTP02	Raw water pump/motor	WTP13	Transmission pump
WTP03	Receiving well	WTP14	Drainage facility
WTP04	Flocculation basin	WTP15	Piping & valve
WTP05	Sedimentation basin	WTP16	Monitoring room and instrumentation
WTP06	Sludge collector	WTP17	Electrical power supply
WTP07	Sludge drainage	WTP18	Diesel generator
WTP08	Rapid sand filter	WTP19	Crane facility
WTP09	Filter washing facility	WTP20	Laboratory
WTP10	Clear water reservoir	**WTP21**	**Coordination with booster pump station**
WTP11	Alum dosing facility		

Facility

Crew size	Equipment	Material
Supervisor	NA	NA

Activities to complete	Time to complete each Activity
Daily : coordinate with boosters related	one hours
Monthly : check flow and pressure meters	2 hours
Yearly : maintain flow and pressure meters	8 hours or as per condition

Work method

Daily:
1- Direct coordination with booster pump operation
2- Record water quantity and pressure head
3- Do fast action in case of high or low demand

Monthly:
1- Check booster records with treatment plant record
2- Check and repair measuring equipment

Yearly:
1- Do annual maintenance for measuring equipment
2- Check all measuring equipment in booster pump station
3- Repair or replace all necessary parts

Holding Company for water and wastewater
Sharkia Potable water and Sanitation Company

SOP for Fe/Mn Removable Plants

Activity code	Activity description	Activity code	Activity discretion
FMR01	**Water well**	FMR07	Chlorination facility
FMR02	Well pumps	FMR08	Drainage facility
FMR03	Oxidization tower	FMR09	Piping and valves
FMR04	Sedimentation basin	FMR10	Instrumentation
FMR05	Filter	FMR11	Electrical power supply
FMR06	Filter pumps	FMR12	Laboratory

Facility : Production wells

Crew size	Equipment	Material
Supervisor + Chemist + 1 labor	Manual tools & water level meters	Bolts and gaskets

Activities to complete	Time to complete each Activity
Daily : Check water level	30 minutes
Monthly: Cleaning site and sampling	When needed
Yearly : Repair and paint	3 hours
Emergency : disinfection	30 minutes

Work method

Daily:
1- Check water level in the well and report any decrease
2- Check well site

Monthly:
1- Clean the well site

Yearly:
1- Check water level in the well and make a report about the condition
2- Repair and paint well casing and rainwater drain system

Emergency:
1- Disinfect well area using Calcium hypochlorite in case of sign of pollution

Holding Company for water and wastewater
Sharkia Potable water and Sanitation Company

SOP for Fe/Mn Removable Plants

Activity code	Activity description	Activity code	Activity discretion
FMR01	Water well	FMR07	Chlorination facility
FMR02	**Well pumps**	FMR08	Drainage facility
FMR03	Oxidization tower	FMR09	Piping and valves
FMR04	Sedimentation basin	FMR10	Instrumentation
FMR05	Filter	FMR11	Electrical power supply
FMR06	Filter pumps	FMR12	Laboratory

Facility : pumping units (pump + motor), valves and electric panels

Crew size	Equipment	Material
Supervisor + 1 technician + 1 labors	Manual tools + lubricator	Stuffing box sealing material + grease

Activities to complete	Time to complete each Activity
Daily : check and operation monitoring	1 hour
Monthly : greasing and stuffing box check	Additional 2 hours
Yearly : annual overhaul and change defect parts	As per overhaul required works

Work method

Daily:
1- Check pump operation and record operational data and any abnormal condition
2- Do general cleaning for all pump house building and equipment
3- Check the routine balanced operating time between units
4- Check stuffing box and be sure of water drops (about twenty drop per minute)
5- Record Ampere and Volts and assure that they are in the permissible limits
6- Record pump operation and estimate flow rates. *1

Monthly:
1- Check pump bearing oil or grease and add the necessary amounts
2- Check stuffing box gland backing and repair
3- Monthly cleaning and remove excess grease and dirt
4- Prepare monthly O&M report

Yearly:
1- Do annual overhaul for pumps and replace defected parts
2- Check all valves and replace stuffing box packing and repaint
3- Check pump and motor alignment and do necessary adjustment
4- Check unit fixation and adjust all fixing bolts
5- Prepare maintenance plan for next year

***1** Method of estimation shall be studied during SOP activity.

SOP for Fe/Mn Removable Plants

Activity code	Activity description	Activity code	Activity discretion
□ FMR01	Water well	□ FMR07	Chlorination facility
□ FMR02	Well pumps	□ FMR08	Drainage facility
□ **FMR03**	**Oxidization tower**	□ FMR09	Piping and valves
□ FMR04	Sedimentation basin	□ FMR10	Instrumentation
□ FMR05	Filter	□ FMR11	Electrical power supply
□ FMR06	Filter pumps	□ FMR12	Laboratory

Facility : oxidization tower

Crew size	Equipment	Material
Supervisor + 1 labor	Cleaning tools	30 %Diluted Sulpheric acid

Activities to complete	Time to complete each Activity
□ **Daily :** Monitoring falling of water from the sprinkling holes in each floor	30 minutes
□ **Monthly :** Cleaning	4 hours
□ **Yearly :** General Maintenance	5 days

Work method

Daily:
1- Check the water falling uniformly from the sprinkling holes to continue oxidation process

Monthly:
1- Stopping the plant
2- Clean the tower from any iron and manganese remaining adhering with walls by the acid and the cleaning tools

Yearly:
1- Repair sprinkling openings and replace broken tiles.
2- Check, repair and paint reinforced concrete structure and steel ladders

SOP for Fe/Mn Removable Plants

Activity code	Activity description	Activity code	Activity discretion
□ FMR01	Water well	□ FMR07	Chlorination facility
□ FMR02	Well pumps	□ FMR08	Drainage facility
□ FMR03	Oxidization tower	□ FMR09	Piping and valves
□ **FMR04**	**Sedimentation basin**	□ FMR10	Instrumentation
□ FMR05	Filter	□ FMR11	Electrical power supply
□ FMR06	Filter pumps	□ FMR12	Laboratory

Facility : sedimentation basin

Crew size	Equipment	Material
Supervisor + 8 labors	Cleaning tools	30 % diluted sulpheric acid

Activities to complete	Time to complete each Activity
□ **Daily :** Monitoring basin level	30 minutes
□ **Monthly :** Cleaning	6 hours
□ **Yearly :** General Maintenance	2 days

Work method

Daily:
1- Check the operation of weirs inside the basins

Monthly:
1- Stopping the plant
2- Clean the basin from any iron and manganese remaining adhering with walls by the acid and the cleaning tools

Yearly:
1- Repair sprinkling openings and replace broken tiles.
2- Check, repair and paint reinforced concrete structure and steel ladders

SOP for Fe/Mn Removable Plants

Activity code	Activity description	Activity code	Activity discretion
□ FMR01	Water well	□ FMR07	Chlorination facility
□ FMR02	Well pumps	□ FMR08	Drainage facility
□ FMR03	Oxidization tower	□ FMR09	Piping and valves
□ FMR04	Sedimentation basin	□ FMR10	Instrumentation
□ **FMR05**	**Filter**	□ FMR11	Electrical power supply
□ FMR06	Filter pumps	□ FMR12	Laboratory

Facility : sedimentation basin +bridge +outlet weirs +sludge outlet valves

Crew size	Equipment	Material
Supervisor + 1 labor	Manual tools	Calcium hypochlorite

Activities to complete	Time to complete each Activity
□ **Daily :** Automatic or Manual backwash	1.5 hours
□ **Monthly :** Disinfection according reproduction of precipitations in the filter	2 hours
□ **Yearly :** Polishing and painting filters , valves and pipes	2 days

Work method

Daily:
1- Adjust the backwash period for automatic backwash for 15 minutes for each filter
2- Record period and frequencies of backwashing operations
3- Estimate and record water volume used for backwashing.*1

Monthly:
1- Adding chlorine to make activation for the anthracite layer
2- Summarize the backwashing records

Yearly:
1- Polish and paint all filters , piping and valves
2- Check the condition of the filter media and refill as required
3- Prepare maintenance plan for the next year

***1** Method of estimation shall be studied during SOP activity.

SOP for Fe/Mn Removable Plants

Activity code	Activity description	Activity code	Activity discretion
□ FMR01	Water well	□ FMR07	Chlorination facility
□ FMR02	Well pumps	□ FMR08	Drainage facility
□ FMR03	Oxidization tower	□ FMR09	Piping and valves
□ FMR04	Sedimentation basin	□ FMR10	Instrumentation
□ FMR05	Filter	□ FMR11	Electrical power supply
□ **FMR06**	**Filter pumps**	□ FMR12	Laboratory

Facility : pumping units (pump + motor), valves and electric panels

Crew size	Equipment	Material
Supervisor + 2 technician + 2 labor	Manual tools + lubricator	Stuffing box sealing material + grease

Activities to complete	Time to complete each Activity
□ **Daily :** check and operation mentoring	1 hour
□ **Monthly :** greasing and stuffing box check	Additional 2 hours
□ **Yearly :** annual overhaul and change defect parts	As per overhaul required works

Work method

Daily:
1- Check pump operation and record operational data and any up normal condition
2- Do general cleaning for all pump house building and equipment
3- Check the routine balanced operating time between units
4- Check stuffing box and be sure of water drops (about twenty drop per minute
5- Record Ampere and Volts and assure that they are in the permissible limits
6- Record the pump operation and estimate flow rates every hour. *1

Monthly:
1- Check pump bearing oil or grease and add the necessary amounts
2- Check stuffing box gland backing and repair
3- Monthly cleaning and remove excess grease and dirt
4- Summarize pump operation records and flow rates estimates

Yearly:
1- Do annual overhaul for pumps and replace defected parts
2- Check all valves and replace stuffing box packing and repaint
3- Check pump and motor alignment and do necessary adjustment
4- Check unit fixation and adjust all fixing bolts
5- Prepare maintenance plan for the next year

***1** Method of estimation shall be studied during SOP activity.

SOP for Fe/Mn Removable Plants

Activity code	Activity description	Activity code	Activity discretion
□ FMR01	Water well	□ **FMR07**	**Chlorination facility**
□ FMR02	Well pumps	□ FMR08	Drainage facility
□ FMR03	Oxidization tower	□ FMR09	Piping and valves
□ FMR04	Sedimentation basin	□ FMR10	Instrumentation
□ FMR05	Filter	□ FMR11	Electrical power supply
□ FMR06	Filter pumps	□ FMR12	Laboratory

Facility : chlorine storage + chlorinators + injectors + safety equipment

Crew size	Equipment	Material
Supervisor + chlorine tec.	Manual tools + lubricator	Ammonia sulphate

Activities to complete	Time to complete each Activity
□ **Daily :** check and control dose	4 hours
□ **Monthly** : repair chlorine injection equipment	16 hours
□ **Yearly** : check and test pipes and fittings	As per required works

Work method

Daily:
1- Check and adjust injection points
2- Assure no chlorine leakage. *1
3- Assure that chlorine drum are not empty
4- Assure that second line is ready in case of chorine finished in the working line
5- Record chlorine injection rate hourly and consumption daily. *2

Monthly:
1- Repair all injection system
2- Repair and maintain injector booster pump
3- Monthly cleaning and remove excess grease and dirt
4- Summarize chlorine injection records and consumption.

Yearly:
1- Complete repair for the whole system
2- Clean all pipes and change any fittings
3- Put into operation after be ready
4- Prepare maintenance plan for the next year.
5- Prepare estimate of chlorine consumption for the next year*3

Emergency:
1- Follow the safety procedures in case of chlorine leakage.

***1** Method of leakage detection of chlorine gas shall be studied during SOP activity.
***2** Weighing equipment of chlorine gas cylinder shall be arranged before SOP activity.
***3** Detailed procedures shall be established during SOP activity

Holding Company for water and wastewater
Sharkia Potable water and Sanitation Company

SOP for Fe/Mn Removable Plants

Activity code	Activity description	Activity code	Activity discretion
□ FMR01	Water well	□ FMR07	Chlorination facility
□ FMR02	Well pumps	□ **FMR08**	**Drainage facility**
□ FMR03	Oxidization tower	□ FMR09	Piping and valves
□ FMR04	Sedimentation basin	□ FMR10	Instrumentation
□ FMR05	Filter	□ FMR11	Electrical power supply
□ FMR06	Filter pumps	□ FMR12	Laboratory

Facility : filter basin + filter media + operating panels

Crew size	Equipment	Material
Supervisor + 1 labors	Hand tools	

Activities to complete	Time to complete each Activity
□ **Daily :** drainage point	30 minutes
□ **Monthly :** cleaning	two hours
□ **Yearly :** check and test pipes and fittings	four hours

Work method

Daily:
1- Observe drainage condition

Monthly:
1- Clean drainage point

Yearly:
1- Check and repair drainage piping

Holding Company for water and wastewater
Sharkia Potable water and Sanitation Company

SOP for Fe/Mn Removable Plants

Activity code	Activity description	Activity code	Activity discretion
□ FMR01	Water well	□ FMR07	Chlorination facility
□ FMR02	Well pumps	□ FMR08	Drainage facility
□ FMR03	Oxidization tower	□ **FMR09**	**Piping and valves**
□ FMR04	Sedimentation basin	□ FMR10	Instrumentation
□ FMR05	Filter	□ FMR11	Electrical power supply
□ FMR06	Filter pumps	□ FMR12	Laboratory

Facility: interconnecting piping and valves

Crew size	Equipment	Material
Supervisor + 2 labors	Manual tools + lubricator	Stuffing box sealing material + grease

Activities to complete	Time to complete each Activity
□ **Daily :** check all valves	1 hours
□ **Monthly :** greasing and stuffing box check	6 hours
□ **Yearly :** polish and repaint all valves	6 days

Work method

Daily:
1- Check all valves and valve chambers
2- Assure no leakage out of valve glands
3- Drain all valve chambers
4- Clean valve chambers and remove dirts

Monthly:
1- Repair or replace all backing
2- Grease valve spindles and pinpoints

Yearly:
1- Polish and repaint valves
2- Drain and clean valve chambers
3- Repair wall cracks and isolate walls using paints compound
4- Prepare maintenance plan for the next year

Holding Company for water and wastewater
Sharkia Potable water and Sanitation Company

SOP for Fe/Mn Removable Plants

Activity code	Activity description	Activity code	Activity discretion
□ FMR01	Water well	□ FMR07	Chlorination facility
□ FMR02	Well pumps	□ FMR08	Drainage facility
□ FMR03	Oxidization tower	□ FMR09	Piping and valves
□ FMR04	Sedimentation basin	□ **FMR10**	**Instrumentation**
□ FMR05	Filter	□ FMR11	Electrical power supply
□ FMR06	Filter pumps	□ FMR12	Laboratory

Facility : measuring equipment

Crew size	Equipment	Material
technician + 1 labor	Manual tools	NA

Activities to complete	Time to complete each Activity
□ **Daily :** check instruments functions	one hour
□ **Monthly :** check measured data	2 hours
□ **Yearly :** recalibration all instruments	As per overhaul required works

Work method

Daily:
1- Record all measurements and observe measuring instruments
2- Test all instruments function
3- Check alarm system in all instruments
4- Repair and replace all necessary items

Monthly:
1- Adjust all measuring instrumentation
2- Check collected measuring data and analysis
3- Clean all instrumentation

Yearly:
1- Calibrate all instruments
2- Repair and replace all necessary items

SOP for Fe/Mn Removable Plants

Activity code	Activity description	Activity code	Activity discretion
□ FMR01	Water well	□ FMR07	Chlorination facility
□ FMR02	Well pumps	□ FMR08	Drainage facility
□ FMR03	Oxidization tower	□ FMR09	Piping and valves
□ FMR04	Sedimentation basin	□ FMR10	Instrumentation
□ FMR05	Filter	□ **FMR11**	**Electrical power supply**
□ FMR06	Filter pumps	□ FMR12	Laboratory

Facility : Electric panels + transformers

Crew size	Equipment	Material
Supervisor + 1 technician+1 labors	Manual tools+ measuring instruments	spares

Activities to complete	Time to complete each Activity
□ **Daily :** check and operation mentoring	one hour
□ **Monthly :** repair and adjust all relays	6 hours
□ **Yearly :** measuring transformer oil properties	7 days

Work method

Daily:
1- Check transformer and electric panel function
2- Assure tight closing of all front and back doors of the electric panels
3- Test all indicating lamps
4- Check electric measuring instruments
5- Repair or replace necessary items
6- Record daily electricity consumption.

Monthly:
1- Adjust all measuring instruments
2- Clean inside the panels from dust
3- Check wiring and cable end fixing
4-.Summarize electricity consumption records.

Yearly:
1- Annual maintenance and transformer oil change if necessary
2- Repair and adjust all relays
3- Prepare estimate of electricity consumption for the next year operation

Holding Company for water and wastewater
Sharkia Potable water and Sanitation Company

SOP for Fe/Mn Removable Plants

Activity code	Activity description	Activity code	Activity discretion
□ FMR01	Water well	□ FMR07	Chlorination facility
□ FMR02	Well pumps	□ FMR08	Drainage facility
□ FMR03	Oxidization tower	□ FMR09	Piping and valves
□ FMR04	Sedimentation basin	□ FMR10	Instrumentation
□ FMR05	Filter	□ FMR11	Electrical power supply
□ FMR06	Filter pumps	□ **FMR12**	**Laboratory**

Facility : testing equiment

Crew size	Equipment	Material
From the branch	Glassware + equipment	chemicals

Activities to complete	Time to complete each Activity
□ **Daily :** samples collection, check and fix dose	Time of shift
□ **Monthly :** evaluate all analysis results	Time of shift
□ **Yearly :** calibrations and annual lab requirement	Time is according companies make calibration

Work method

Daily:
1- Collect samples from all treatment stages, i.e. well water, chlorine injection at oxidization tower and treated water after filtration including residual chlorine.
2- Do all analysis required as per holding company forms
3- Recommend the require dosage based on well water quality if necessary.
4- Follow laboratory dose recommendation in the plant operation
5- Record daily analysis results

Monthly:
1- Do complete analysis as per holding company forms
2- Check standard solutions
3- Review the chlorine injection rate and recommend the change as required.
4- Summarize analyses and recommendations

Yearly:
1- Do annual overhaul for laboratory equipment calibration
2- Check and recommend annual consumables for laboratory
3- Prepare maintenance plan for the next year

Holding Company for water and wastewater
Sharkia Potable water and Sanitation Company

SOP for Booster Pump Stations

Activity code	Activity description	Activity code	Activity discretion
□ **BPS01**	**Clear water reservoir**	□ BPS06	Electrical power supply
□ BPS02	Booster Pump	□ BPS07	Diesel generator
□ BPS03	Chlorination Facility	□ BPS08	Crane facility
□ BPS04	Piping & valve	□ BPS09	Elevated tank
□ BPS05	Instrumentation		

Facility : Clear water reservoir + valves

Crew size	Equipment	Material
Supervisor + 1 labor	Manual tools	Calcium hypochlorite

Activities to complete	Time to complete each Activity
□ **Daily :** monitor operation and water level	3 hours
□ **Monthly :** maintain the inlet valves	4 hours
□ **Yearly :** repair and paint valves	10 days
□ **Emergency :** disinfection	3 hours

Work method

Daily:
1- Check and record water level in the treated water reservoir
2- Assure treated water pump stop at low water level
3- Assure no water go to the overflow pipe

Monthly:
1- Clean the air vent pipes
2- Grease the valve spindle
3- Summarize daily records

Yearly:
1- Repair , polish and repaint all valves
2- Remove all mud from reservoir
3- Disinfect the reservoir under laboratory control
4- Put into operation after be ready

Emergency:
1- Disinfect intake area using Calcium hypochlorite in case of sign of pollution
2- Communicate to Abbasa WTP/Sector office for over flow and shortage of water *1

*1 Communication method shall be studied during SOP activity.

Holding Company for water and wastewater
Sharkia Potable water and Sanitation Company

SOP for Booster Pump Stations

Activity code	Activity description	Activity code	Activity discretion
□ BPS01	Clear water reservoir	□ BPS06	Electrical power supply
□ **BPS02**	**Booster Pump**	□ BPS07	Diesel generator
□ BPS03	Chlorination Facility	□ BPS08	Crane facility
□ BPS04	Piping & valve	□ BPS09	Elevated tank
□ BPS05	Instrumentation		

Facility : pumping units (pump + motor), valves and electric panels

Crew size	Equipment	Material
Supervisor + 2 technician + 2 labors	Manual tools + lubricator	Stuffing box sealing material + grease

Activities to complete	Time to complete each Activity
□ **Daily :** check and operation mentoring	8 hours
□ **Monthly :** greasing and stuffing box check	Additional 4 hours
□ **Yearly :** annual overall and change defect parts	As per overall required works

Work method

Daily:
1- Check pump operation and record operational data and any up normal condition
2- Do general cleaning for all pump house building and equipment
3- Check the routine balanced operating time between units
4- Check stuffing box and be sure of water drops (about twenty drop per minute)
5- Record Ampere and Volts and assure that they are in the permissible limits
6- Record pump operation and estimate flow rates. *1

Monthly:
1- Check pump bearing oil or grease and add the necessary amounts
2- Check stuffing box gland backing and repair
3- Monthly cleaning and remove excess grease and dirt
4- Prepare monthly O&M report

Yearly:
1- Do annual overall for pumps and replace defected parts
2- Check all valves and replace stuffing box packing and repaint
3- Check pump and motor alignment and do necessary adjustment
4- Check unit fixation and adjust all fixing bolts
5- Prepare maintenance plan for next year

***1** Method of estimation shall be studied during SOP activity.

SOP for Booster Pump Stations

Activity code	Activity description	Activity code	Activity discretion
□ BPS01	Clear water reservoir	□ BPS06	Electrical power supply
□ BPS02	Booster Pump	□ BPS07	Diesel generator
□ **BPS03**	**Chlorination Facility**	□ BPS08	Crane facility
□ BPS04	Piping & valve	□ BPS09	Elevated tank
□ BPS05	Instrumentation		

Facility : chlorine storage + chlorinators + injectors + safety equipment

Crew size	Equipment	Material
Supervisor + chlorine tec. + 2labors	Manual tools + safety masks	Ammonia sulphate

Activities to complete	Time to complete each Activity
□ **Daily :** check and control dose	4 hours
□ **Monthly :** repair chlorine injection equipment	16 hours
□ **Yearly :** check and test pipes and fittings	As per required works

Work method

Daily:
1- Check and adjust injection points
2- Assure no chlorine leakage *1
3- Assure that chlorine drum are not empty
4- Assure that second line is ready in case of chorine finished in the working line
5- Record chlorine injection rate hourly and consumption daily. *2

Monthly:
1- Repair all injection system
2- Repair and maintain injector booster pump
3- Monthly cleaning and remove excess grease and dirt
4- Summarize chlorine injection records and consumption.

Yearly:
1- Complete repair for the whole system
2- Repair ventilators
3- Clean all pipes and change any fittings
4- Put into operation after be ready
5- Prepare estimate of chlorine consumption for the next year

Emergency:
1- Follow the safety procedures in case of chlorine leakage. *3

***1** Method of leakage detection of chlorine gas shall be studied during SOP activity.
***2** Weighing equipment of chlorine gas cylinder shall be arranged before SOP activity.
***3** Detailed procedures shall be established during SOP activity

Holding Company for water and wastewater
Sharkia Potable water and Sanitation Company

SOP for Booster Pump Stations

Activity code	Activity description	Activity code	Activity discretion
□ BPS01	Clear water reservoir	□ BPS06	Electrical power supply
□ BPS02	Booster Pump	□ BPS07	Diesel generator
□ BPS03	Chlorination Facility	□ BPS08	Crane facility
□ **BPS04**	**Piping & valve**	□ BPS09	Elevated tank
□ BPS05	Instrumentation		

Facility : interconnecting pipes and valves

Crew size	Equipment	Material
Supervisor + 4labors	Manual tools + lubricator	Stuffing box sealing material + grease

Activities to complete	Time to complete each Activity
□ **Daily :** check all valves	2 hours
□ **Monthly :** greasing and stuffing box check	6 hours
□ **Yearly :** polish and repaint all valves	6 days

Work method

Daily:
1- Check all valves and valve chambers
2- Assure no leakage out of valve glands
3- Drain all valve chambers
4- Clean valve chambers and remove dirts

Monthly:
1- Repair or replace all backing
2- Grease valve spindles and pinpoints

Yearly:
1- Polish and repaint valves
2- Drain and clean valve chambers
3- Repair wall cracks and isolate walls using paints compound
4- Prepare maintenance plan for the next year

Holding Company for water and wastewater
Sharkia Potable water and Sanitation Company

SOP for Booster Pump Stations

Activity code	Activity description	Activity code	Activity discretion
□ BPS01	Clear water reservoir	□ BPS06	Electrical power supply
□ BPS02	Booster Pump	□ BPS07	Diesel generator
□ BPS03	Chlorination Facility	□ BPS08	Crane facility
□ BPS04	Piping & valve	□ BPS09	Elevated tank
□ **BPS05**	**Instrumentation**		

Facility : measuring equipment

Crew size	Equipment	Material
technician + 1 labor	Manual tools	NA

Activities to complete	Time to complete each Activity
□ **Daily :** check instruments functions	one hour
□ **Monthly :** check measured data	2 hours
□ **Yearly :** recalibration all instruments	As per overall required works

Work method

Daily:
1- Record all measurements and observe measuring instruments
2- Test all instruments function
3- Check alarm system in all instruments
4- Repair and replace all necessary items

Monthly:
1- Adjust all measuring instrumentation
2- Check collected measuring data and analysis
3- Clean all instrumentation

Yearly:
1- Calibrate all instruments
2- Repair and replace all necessary items

Holding Company for water and wastewater
Sharkia Potable water and Sanitation Company

SOP for Booster Pump Stations

Activity code	Activity description	Activity code	Activity discretion
□ BPS01	Clear water reservoir	□ **BPS06**	**Electrical power supply**
□ BPS02	Booster Pump	□ BPS07	Diesel generator
□ BPS03	Chlorination Facility	□ BPS08	Crane facility
□ BPS04	Piping & valve	□ BPS09	Elevated tank
□ BPS05	Instrumentation		

Facility : Electric panels + transformers

Crew size	Equipment	Material
Electric Supervisor + 2 technician+ labors	Manual tools+ measuring instruments	NA

Activities to complete	Time to complete each Activity
□ **Daily :** check and operation mentoring	one hour
□ **Monthly :** repair and adjust all relays	6 hours
□ **Yearly :** measuring transformer oil properties	7 days

Work method

Daily:
1- Check transformer and electric panel function
2- Assure tight closing of all front and back doors of the electric panels
3- Test all indicating lamps
4- Check electric measuring instruments
5- Repair or replace necessary items
6- Record daily electricity consumption.

Monthly:
1- Adjust all measuring instruments
2- Clean inside the panels from dust
3- Check wiring and cable end fixing
4- Summarize electricity consumption records.

Yearly:
1- Annual maintenance and transformer oil change if necessary
2- Repair and adjust all relays
3- Prepare estimate of electricity consumption for the next year operation

SOP for Booster Pump Stations

Activity code	Activity description	Activity code	Activity discretion
BPS01	Clear water reservoir	BPS06	Electrical power supply
BPS02	Booster Pump	**BPS07**	**Diesel generator**
BPS03	Chlorination Facility	BPS08	Crane facility
BPS04	Piping & valve	BPS09	Elevated tank
BPS05	Instrumentation		

Facility : Diesel generators and accessories

Crew size	Equipment	Material
Supervisor+ 2 technician + 2 labors	Manual tools	Lubricants + spares

Activities to complete	Time to complete each Activity
Daily : check machine condition	one hour
Monthly : run at full load	3 hours
Yearly : annual overall and change defect parts	8 hours

Work method

Daily:
1- Check the machine parts and all connections
2- Check fuel tank and be sure that there is sufficient fuel for operation
3- Check oil level
4- Check cooling system components
5- Record O&M activity

Monthly:
1- Run the machine at full load for at least one hour
2- Observe the machine and record all data during operation
3- Make all necessary repairs
4- Summarize daily operation

Yearly:
1- Do annual overall change oil, oil filters and all required parts
2- Check the electric panel and all relays
3- Do cleaning for fuel tanks and fuel pumps
4- Do necessary maintenance for cooling system
5- Prepare maintenance plan for the next year

Holding Company for water and wastewater
Sharkia Potable water and Sanitation Company

SOP for Booster Pump Stations

Activity code	Activity description	Activity code	Activity discretion
BPS01	Clear water reservoir	BPS06	Electrical power supply
BPS02	Booster Pump	BPS07	Diesel generator
BPS03	Chlorination Facility	**BPS08**	**Crane facility**
BPS04	Piping & valve	BPS09	Elevated tank
BPS05	Instrumentation		

Facility : Crane + accessories

Crew size	Equipment	Material
Supervisor + crane driver + 2 labor	Manual tools	oil + grease

Activities to complete	Time to complete each Activity
Daily : check crane conditions	one hour
Monthly : oiling and greasing bearings	3 hours
Yearly : annual check for gears and wires	6 hours

Work method

Daily:
1- Check the proper operation for overhead and movable cranes
2- Check movement at no load for
3- Make all necessary fast repair

Monthly:
1- Oiling and greasing all bearings and movable parts
2- Check all gears and wires and do necessary repair
3- Check proper movement of cranes

Yearly:
1- Do annual repair and change all grease and oil
2- Do necessary repairs and maintenance for driving motors
3- Do cleaning for all wires and gears and change all defected parts
4- Prepare maintenance plan for the next year

Holding Company for water and wastewater
Sharkia Potable water and Sanitation Company

SOP for Booster Pump Stations

Activity code	Activity description	Activity code	Activity discretion
BPS01	Clear water reservoir	BPS06	Electrical power supply
BPS02	Booster Pump	BPS07	Diesel generator
BPS03	Chlorination Facility	BPS08	Crane facility
BPS04	Piping & valve	**BPS09**	**Elevated tank**
BPS05	Instrumentation		

Facility: Elevated tank + piping + level indicator

Crew size	Equipment	Material
Supervisor + 1 technician + 2 labor	Manual tools + lubricator	Stuffing box sealing material + grease

Activities to complete	Time to complete each Activity
Daily : operation and water level monitoring	1 hour
Monthly : maintain valves and level indicator	4 hours
Yearly : repair and paint valves	10 days

Work method

Daily:
1- Check water level in the water tank
2- Assure no water go to the overflow pipe

Monthly:
1- Grease the valve spindle

Yearly:
1- Repair , polish and repaint all valves
2- Remove all mud from tank
3- Disinfect the tank
4- Put into operation after be ready

Holding Company for water and wastewater
Sharkia Potable water and Sanitation Company

SOP for Well Stations (El Aslougi)

Activity code	Activity description	Activity code	Activity discretion
WPS01	**Water well**	WPS05	Instrumentation
WPS02	Motor well pumps	WPS06	Chlorination facility
WPS03	Diesel well pumps	WPS07	Electrical power supply
WPS04	Piping and valves	WPS08	Elevated Tank

Facility : Production wells + well casing

Crew size	Equipment	Material
Chemist + 1 labor	Manual tools	Bolts and gaskets

Activities to complete	Time to complete each Activity
Daily : Check water level	30 minutes
Monthly: Cleaning site and sampling	1hour
Yearly : Repair and paint the well casting	3 hours
Emergency : disinfection or decrease of ground water level	30 minutes

Work method

Daily:
1- Check water level in the observation well and report any decrease
2- Check all well sites
3- Check non return valves

Monthly:
1- Adjust the quantity of chlorine powder determined by the chemist and mix it with water then put the mix in the well
2- Preparing water sample for analysis

Yearly:
1- Repair , polish and repaint all valves
2- Painting of the well casing

Emergency:
1- Disinfect well area using Calcium hypochlorite in case of sign of pollution

SOP for Well Stations (El Aslougi)

Activity code	Activity description	Activity code	Activity discretion
WPS01	Water well	WPS05	Instrumentation
WPS02	Motor well pumps	WPS06	Chlorination facility
WPS03	Diesel well pumps	WPS07	Electrical power supply
WPS04	Piping and valves	WPS08	Elevated Tank

Facility : pumping units (pump + motor), valves and electric panels

Crew size	Equipment	Material
Supervisor + 1 technician + 1 labor	Manual tools + lubricator	Stuffing box sealing material + grease

Activities to complete	Time to complete each Activity
Daily : check and operation monitoring	1 hour
Monthly : greasing and stuffing box check	Additional 2 hours
Yearly : annual overhaul and change defect parts	As per overhaul required works

Work method

Daily:
1- Check pump operation and record operational data and any abnormal condition
2- Do general cleaning for all pump house building and equipment
3- Check the routine balanced operating time between units
4- Check stuffing box and be sure of water drops (about twenty drop per minute)
5- Record Ampere and Volts and assure that they are in the permissible limits

Monthly:
1- Check pump bearing oil or grease and add the necessary amounts
2- Check stuffing box gland backing and repair
3- Monthly cleaning and remove excess grease and dirt

Yearly:
1- Do annual overhaul for pumps and replace defected parts
2- Check all valves and replace stuffing box packing and repaint
3- Check pump and motor alignment and do necessary adjustment
4- Check unit fixation and adjust all fixing bolts

Holding Company for water and wastewater
Sharkia Potable water and Sanitation Company

SOP for Well Stations (El Aslougi)

Activity code	Activity description	Activity code	Activity discretion
WPS01	Water well	WPS05	Instrumentation
WPS02	Motor well pumps	WPS06	Chlorination facility
WPS03	Diesel well pumps	WPS07	Electrical power supply
WPS04	Piping and valves	WPS08	Elevated Tank

Facility : diesel pump (engine +pump)

Crew size	Equipment	Material
Supervisor + 1 technician + 1 labor	Manual tools + lubricator	Stuffing box sealing material + grease

Activities to complete	Time to complete each Activity
Daily : check and operation monitoring	1 hour
Monthly : greasing and stuffing box check	Additional 2 hours
Yearly : annual overhaul and change defect parts	As per overhaul required works

Work method

Daily:
1- Check fuel and lubrication oil of engines.
2- Check pump operation and record operational data and any abnormal condition
3- Do general cleaning for all pump house building and equipment
4- Check the routine balanced operating time between units
5- Check stuffing box and be sure of water drops (about twenty drop per minute)

Monthly:
1- Check air cleaner unit and exhaust gas pipes
2- Check pump bearing oil or grease and add the necessary amounts
3- Check stuffing box gland backing and repair
4- Monthly cleaning and remove excess grease and dirt

Yearly:
1- Do annual overhaul for pumps and diesel engine and replace defected parts
2- Check all valves and replace stuffing box packing and repaint
3- Check pump and engine shaft alignment and do necessary adjustment
4- Check unit fixation and adjust all fixing bolts

Holding Company for water and wastewater
Sharkia Potable water and Sanitation Company

SOP for Well Stations (El Aslougi)

Activity code	Activity description	Activity code	Activity discretion
WPS01	Water well	WPS05	Instrumentation
WPS02	Motor well pumps	WPS06	Chlorination facility
WPS03	Diesel well pumps	WPS07	Electrical power supply
WPS04	Piping and valves	WPS08	Elevated Tank

Facility : interconnecting piping and valves

Crew size	Equipment	Material
Supervisor + 1 technician + 1 labor	Manual tools + lubricator	Stuffing box sealing material + grease

Activities to complete	Time to complete each Activity
Daily : check all valves and make preventive maintenance	1 hours
Monthly : greasing and stuffing box check	6 hours
Yearly : polish and repaint all valves	6 days

Work method

Daily:
1- Check all valves and valve chambers
2- Assure no leakage out of valve glands
3- Drain all valve chambers
4- Clean valve chambers and remove dirts

Monthly:
1- Repair or replace all backing
2- Grease valve spindles and pinpoints

Yearly:
1- Polish and repaint valves
2- Drain and clean valve chambers
3- Repair wall cracks and isolate walls using paints compound

Holding Company for water and wastewater
Sharkia Potable water and Sanitation Company

SOP for Well Stations (El Aslougi)

Activity code	Activity description	Activity code	Activity discretion
WPS01	Water well	WPS05	Instrumentation
WPS02	Motor well pumps	WPS06	Chlorination facility
WPS03	Diesel well pumps	WPS07	Electrical power supply
WPS04	Piping and valves	WPS08	Elevated Tank

Facility : measuring equipment

Crew size	Equipment	Material
technician + 1 labor	Manual tools	NA

Activities to complete	Time to complete each Activity
Daily : check instruments functions	one hour
Monthly : check measured data	2 hours
Yearly : recalibration all instruments	As per overhaul required works

Work method

Daily:
1- Record all measurements and observe measuring instruments
2- Test all instruments function
3- Repair and replace all necessary items

Monthly:
1- Check collected measuring data and analysis
2- Clean all instrumentation

Yearly:
1- Calibrate all instruments
2- Repair and replace all necessary items

SOP for Well Stations (El Aslougi)

Activity code	Activity description	Activity code	Activity discretion
□ WPS01	Water well	□ WPS05	Instrumentation
□ WPS02	Motor well pumps	□ WPS06	Chlorination facility
□ WPS03	Diesel well pumps	□ WPS07	Electrical power supply
□ WPS04	Piping and valves	□ WPS08	Elevated Tank

Facility : chlorine storage + chlorinators + injectors + safety equipment

Crew size	Equipment	Material
Supervisor + chlorine tec. + 2labor	Manual tools + lubricator	Stuffing box sealing material + grease

Activities to complete	Time to complete each Activity
□ **Daily :** check and control dose	4 hours
□ **Monthly :** repair chlorine injection equipment	16 hours
□ **Yearly :** check and test pipes and fittings	As per required works

Work method

Daily:
1- Check and adjust injection points
2- Assure no chlorine leakage
3- Assure that chlorine drum are not empty
4- Assure that second line is ready in case of chorine finished in the working line

Monthly:
1- Repair all injection system
2- Repair and maintain injector booster pump
3- Monthly cleaning and remove excess grease and dirt

Yearly:
1- Complete repair for the whole system
2- Repair ventilators
3- Clean all pipes and change any fittings
4- Put into operation after be ready

Holding Company for water and wastewater
Sharkia Potable water and Sanitation Company

SOP for Well Stations (El Aslougi)

Activity code	Activity description	Activity code	Activity discretion
□ WPS01	Water well	□ WPS05	Instrumentation
□ WPS02	Motor well pumps	□ WPS06	Chlorination facility
□ WPS03	Diesel well pumps	□ WPS07	Electrical power supply
□ WPS04	Piping and valves	□ WPS08	Elevated Tank

Facility : Electric panels + transformers

Crew size	Equipment	Material
Supervisor + 1 technician+1 labor	Manual tools+ measuring instruments	spares

Activities to complete	Time to complete each Activity
□ **Daily :** check and operation mentoring	30 minutes
□ **Monthly :** repair and adjust all relays	1 hours
□ **Yearly :** measuring transformer oil properties	7 days

Work method

Daily:
1- Check electric panel function
2- Assure tight closing of all front and back doors of the electric panels
3- Test all indicating lamps
4- Check electric measuring instruments
5- Repair or replace necessary items

Monthly:
1- Adjust all measuring instruments
2- Clean inside the panels from dust
3- Check wiring and cable end fixing

Yearly:
1- Check annual maintenance and transformer oil change by the Electricity Company
2- Repair and adjust all relays

Holding Company for water and wastewater
Sharkia Potable water and Sanitation Company

SOP for Well Stations (El Aslougi)

Activity code	Activity description	Activity code	Activity discretion
□ WPS01	Water well	□ WPS05	Instrumentation
□ WPS02	Motor well pumps	□ WPS06	Chlorination facility
□ WPS03	Diesel well pumps	□ WPS07	Electrical power supply
□ WPS04	Piping and valves	□ WPS08	Elevated Tank

Facility : Elevated tank + piping + level indicator

Crew size	Equipment	Material
Supervisor + 1 technician + 1 labor	Manual tools + lubricator	Stuffing box sealing material + grease

Activities to complete	Time to complete each Activity
□ **Daily :** operation and water level monitoring	1 hour
□ **Monthly :** maintain valves and level indicator	4 hours
□ **Yearly :** repair and paint valves	10 days

Work method

Daily:
1- Check water level in the water tank
2- Assure transfer pump stop at low water level
3- Assure no water go to the overflow pipe

Monthly:
1- Clean the air vent pipes
2- Grease the valve spindle

Yearly:
1- Repair , polish and repaint all valves
2- Remove all mud from tank
3- Disinfect the tank
4- Put into operation after be ready

SOP for Abbasa WTP

1- Water Sources

Generally, water sources are classified as two sources; surface water source and underground water source. The surface water source includes rivers, water passes, lakes or water behind dams. The ground water source include wells and springs.

Ismailia Canal is the water source for ABBASA WTP

Raw water must be in good quality and sufficient quantity to guarantee production of safe and acceptable water after treatment, and the water source should be capable to provide sufficient quantity at continues rate. Generally it is preferred to secure good raw water quality in order to treat the water with a minimum cost

2- Raw water intake

Water intake is used to draw water from the river or canals and deliver it to the water treatment plant. The ideal intake is the one capable to draw water from suitable locations and can prevent algae, wastes, suspended material, trees or fish from going to the plant

3- Operation steps

Operation steps is the sum of activities through the different operation process, this activities are divided to 21 as detailed starting from **ABS-WTP01-OP** up to **ABS-WTP21-OP,** this activities shall be explained in normal conditions or emergency cases

3-1- Operation in normal condition

Operation under normal conditions shall be explained in details for each activity in the standard operation procedures SOP

3-2- Operation in emergency cases

Operation under emergency cases includes up normal conditions such in case of sudden pollution of raw water or power cut or work stop in major treatment facility …….etc

3-2-1- Expected problems and trouble shooting

The expected problems can be easily known from the past operating records and operators experiences analysis

3-2-2- Analysis of past problems, causes, and remedy actions

Study and analysis of some problems happened in past will help to solve existing problems and this will help to reach to the following occlusions ;

- ✓ Detect the weak points due to operation
- ✓ Detect the weak points due to design
- ✓ Detect the weak points in operation and maintenance
- ✓ Detect the weak points due to technical conditions for equipment
- ✓ Reference to problem analysis procedure
- ✓ Reference to what we need to reach to the cause of the problem
- ✓ Reference to what is not allowed to avoid the problem
- ✓ Etc.

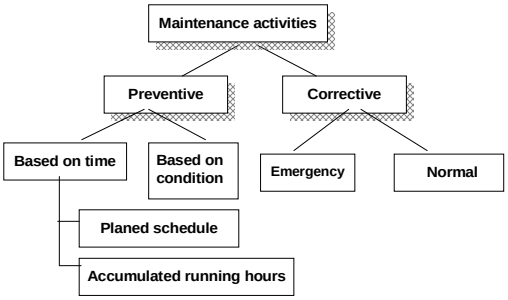
All data and actions related to the problem must be collected and recorded in one file as a reference to avoid repeating the problem

4- Maintenance activities

4-1 Maintenance activities references

4-1-1 General idea

Maintenance references are used to show the impotence of the activity including maintenance, replacement, check, for all or part of equipment. It is divided to preventive maintenance and corrective maintenance as shown in the following figure



The preventive maintenance is divided into two types, one of them based on time and the other is based on technical condition of equipment. There is a difficulty to evaluate the depreciation rate of the equipment

Time based maintenance either to be according the planned schedule or based on actual accumulated working hours for the equipment

The corrective maintenance is divided into two types, one of them is emergency corrective maintenance and normal corrective maintenance. In normal corrective maintenance good monitoring and periodic check for equipment should be applied to detect any up normal condition for the equipment

The classification of the maintenance and which type shall be applied should be based on activity and related equipment

Maintenance activities include monitoring, check and recommended action either by change, repair or improvement. The maintenance activities include four actions as following:

1. Mentoring of the equipment condition and performance
2. periodical check
3. analysis and evaluation
4. repair after check

4-1 mentoring of the equipment condition and performance

Mentoring and check shall be based on time schedule for operation and maintenance

4-2 periodical check

Periodical check shall be for all equipment in the external exposed parts as well as internal parts to be sure that the equipment is suitable and capable to perform well and the number of check and period shall be based on each equipment function and should be scheduled and documented

4-3 analysis and evaluation

The importance of repair is related to the importance of equipment and operation condition and the condition of parts and if it is subject to wear or rust.

The analysis of repair should include cost and risk and time required for maintenance and spare parts availability before the starting of maintenance activity

Discover the problems in early time and repair shall make long lifetime for equipment

4-4 repair after check

Replacement, repair or change the equipment depends on the spare parts availability. Sometimes only greasing and cleaning are only required

5- Quality control

Water quality control should be effectively applied and data analysis are required to forecast any future problem and review treatment process

It is important to monitor and check all water process steps for economic operation and prevent any of the process function from being overloaded due to improper operation for previous step

6- Records and Reports

Records and reports is one of the important activity which help in analysis and considered as on of the very important documents for personnel communications inside or outside the plant

These records will help in improvement of operation and maintenance and avoid repeating of problems

Plant Name: ABBASA W.T.P.	Title: **Overview for ABBASA Water Treatment Plant**	SOP TAG No. ABS-WTP00-OV

Issued		Developed by		Signature	
Revised		Approved by		Signature	

1. General information of the plant

1-1. General information

(1) Location
(2) Construction Phases
(3) Source of raw water
(4) Type treatment process
(5) Nominal and current treatment capacities
(6) General layout
(7) General flow diagram
(8) Service areas and connections to the distribution network
(9) Organization and staff formation

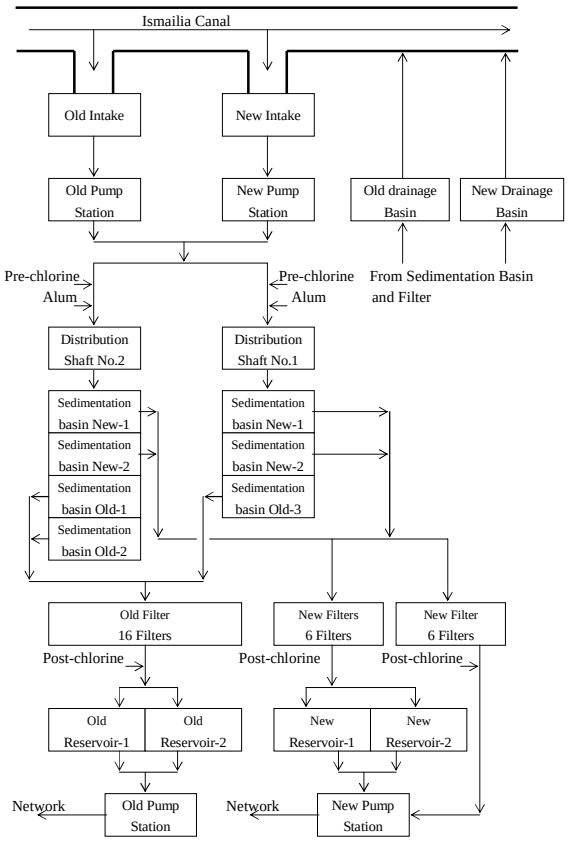
1-2. Components of process and facility in water treatment plant

- There are relations and connections between each process in the overall water treatment process and facilities in each process.
- Water treatment plant works properly by using functions of water treatment process.
- Water treatment process consists of plural processes.
- Water treatment process works by using functions of each process.
- Each process consists of many facilities.
- Each process works by using functions of many facilities.
- Water treatment process works reciprocally with each process.
- Each process works reciprocally by using functions of many facilities.

1-2-1. Components of unit process

There are seven (7) unit processes in ABBASA water treatment plant as follows:
(1) Raw water intake, transfer and distribution process
(2) Coagulation process
(3) Sedimentation process
(4) Filtering process
(5) Disinfection process
(6) Clear water storage and distribution process
(7) Sludge drainage process

1-2-2. General flow diagram



1-2-3. Components of facility in each process

Components of facility in unit process are the following:

(1) Raw water intake, transfer and distribution process
This process includes the following:
- Raw water intake area and canal
- Raw water intake gate, channel and screen
- Raw water basin facility
- Raw water pump facility
- Raw water receiving well (or distribution shaft) facility
- Water sampling facility

(2) Coagulation and sedimentation process
This process includes the following:
- Mixing basin
  - Rapid mixing facility (Flush mixer)
  - Flocculation basin
  - Slow mixing facilities (Flocculator)
- Aluminum sulfate dosing facility
  - Aluminum sulfate storage tank (Rental facility from manufacture)
  - Aluminum sulfate transfer pump (Rental facility from manufacture)
  - Aluminum sulfate dosing tank
  - Aluminum sulfate dosing device
  - Compressor for aluminum sulfate solution mixing

(3) Sedimentation process
This process includes the following;
- Sedimentation basin with effluent trough
- Sludge collector
- Sludge drainage facilities
- Water sampling facility

(4) Filtering process
This process includes the following;
- Filter basin with filter media and under train facility
- Filter control facility with compressor facility
- Filter monitoring facility
- Filter washing facility
- Water sampling facility

(5) Disinfection and chlorination process
This process includes pre-chlorine and post-chlorine facility as follows;
- Chlorine storage facility
- Chlorine gas evaporator

- Chlorine gas piping and valve
- Pre-chlorinator and post-chlorinator
- Chlorine neutralization facility with chlorine leakage detector

(6) Clear water storage and distribution process
- Underground reservoir
- Clear water basin
- Transmission pump facility
- Water sampling facility

(7) Sludge drainage process
- Sludge drainage basin
- Sludge drainage pump facility

1-2-4. Specifications of machines and devices in each facility

Refer to attached facility list in APPENDIX.

1-3. Basic system on facility operating and process control

1-3-1. Basic system on unit process control

(1) Water treatment plant type
- Conventional filtration treatment plant
- Coagulation/ordinal sedimentation/rapid sand filter type

(2) Process control
All unit processes are controlled manually by chemists

(3) Water quality control
Water quality analyses are carried out periodically in the plant laboratory by chemists. There are no water quality items monitored continuously by monitoring instrument.

1-3-2. System description

(1) Basic system
- Operation of facility: Manual operation for all the facilities
- Control of process: Manual control for all the process
- Monitoring of water quality: Not continuous monitoring

(2) System of each process
- Raw water transfer
  Individual pump stations are available for old and new plant. Raw water is drawn into raw water basin by gravity from canal
- Distribution of raw water
  - Discharge pipes from old raw water pumps and new raw water pumps are

connected each other.
  - After connected, raw water is transferred to two raw water pipes and flown into two distribution shafts.
  - The raw water is distributed to mixing, flocculation and sedimentation basin by two distribution shafts. One raw water line distributes the raw water to two (2) old plant lines and two (2) new plant lines by 1st distribution shaft. The other raw water line distributes it to one (1) old plant line and two (2) new plant lines by 2nd distribution shaft.
- Control of raw water quantity
  Total flow rate of raw water of WTP is controlled manually by working numbers of raw water pumps in old and new pump stations.
- Operation of facility: Manual operation for all facilities basically
- Aluminum dosing facility: Common use for both of old and new plant
- Aluminum sulfate dosing method: By gravity
- Aluminum sulfate dosing control: By manual control
- Aluminum sulfate specifications for operation
  - Receiving and storage: Liquid aluminum sulfate
  - Solution concentration for receiving and storage: 8 (w/w%) as Al_2O_3 contained
  - Solution concentration of aluminum sulfate dosing: 1 (W/V%) solution concentration
  - Aluminum sulfate dosing point: At raw water pipes before distribution shafts.
  - Alum dosing equipment by solid alum is available for emergency use only.
- Rapid mixing
  - Old plant line: Mixed by water flow energy without flush mixer
  - New plant line: Mechanical mixing by flush mixer for each sedimentation basin
- Slow mixing
  - Old plant line: Mixed by mechanical Flocculator and rotation number is fixed
  - New plant line: Mixed by mechanical Flocculator and rotation number is fixed
  - Sedimentation basin
  - Circular shaped and up-stream flow type for old and new plant
- Sludge collector
  - Mechanical sludge collector type for old and new plant
- Sludge drainage from sedimentation basin
  - Operation: Manual operation for both old and new plant lines
  - Old plant line: Gravity flow assisted by injector
  - New plant line: Gravity flow without assists
- Filtration
  - Type of filter: Rapid sand filter by gravity
  - Control of filtering: Constant flow rate filtration
  - Filter media: Single media filtration
  - Filter washing method: Air washing and backwashing
  - Supply for backwashing water

  - Old plant: Supplied from head tank
  - New plant: Supplied from back wash pump
- Filtered water basin
  - Old plant: Not available
  - New plant: Available
- Chlorination
  - Store of chlorine: 1 ton container
  - Chlorine taken out from container: Gas chlorine only
  - Chlorinator: Pre-chlorinators and post-chlorinators are available at both old and new plant. Pre-chlorine is dosed into 2 raw water pipes by pre-chlorinator in new plant and pre-chlorinators in old plant are as stand-by. Post-chlorine is dosed into filtered water individually by old and new chlorinator.
    - Type of chlorinator: Injector vacuum type
    - Type of operation: Manual operation
    - Type of dosing flow rate control: Manual control
  - Drainage facility: Type of operation for drainage pump: Manual operation
    Drainage facilities are available individually for old and new plant each. Drainage basin receives drained sludge from sedimentation basin and waste water from filters. Drainage sludge and waste water are mixed in drainage basin and all of mixed waste drainage water is drained out to canal by drainage pumps.

2. Overview of the SOPs of the Plant

2-1. Purpose of SOPs

Purpose of SOPs is to provide assistance to the water supplier in the operation & maintenance (O&M) and water quality control (WQC) procedures for each facility or process in water treatment plant.

2-2. Application of SOPs

SOPs should be applied surely to actual O&M and WQC. However, SOPs are not necessarily constant and subject to change. SOPs should not only be kept as documents but also be utilized as tools for O&M and WQC activities. Since SOPs must be utilized in actual activities, they should be reviewed and revised so that they can be suitable and useful anytime in any situation for water supplier according to evaluation of utilized results. We should find improved results of O&M and WQC activities whenever we review and revise SOPs.

2-3. Component of SOPs

SOPs for WTP consist of twenty-one (21) SOPs component units and these components are shown in “SOPs Headline”. Each SOP consists of three (3) SOPs packages as follows:

- SOPs for operation
- SOPs for maintenance
- SOPs for water quality control

2-3-1. SOPs for Operation

Documents which require criteria and procedures for operation and control activities of facility are provided in this SOPs and include the following:

- Explanation of process and relation between other process
- Criteria for operation activity and design
- Operation and control procedures for facility in normal condition and unusual condition
- Monitoring and visual check items for facility
- Reporting and recording system

2-3-2. SOPs for Maintenance

Documents which require criteria and procedures for maintenance activities of facility are provided in this SOPs and include the following:

- Criteria for maintenance activity
- Maintenance procedures for facility in normal condition and unusual condition
- Monitoring and visual check items for facility
- Reporting and record system

2-3-3. SOPs for Water Quality Control

Documents which require criteria and procedures for water quality control and process control are provided in this SOPs and include the following:

- Criteria for water quality control activity
- Water quality control and process control procedures in normal condition and unusual condition
- Monitoring and visual check items for water quality and process
- Reporting and record system

2-4. Review of SOPs and O&M plan

SOPs is one of tools to perform optimum O&M and WQC activities and results and as the result to improve management of water treatment plant operation. We can realize and find in our O&M activities should be modified or arranged for improvement such as more simple, effective or suitable method, by utilizing of SOPs. When we find part to be modified or

arranged for improvement in SOPs, we should approach to review SOPs to be proper according to prepared procedures, as soon as possible if necessary.

2-4-1. Review of O&M and WQC activities

Review of SOPs should be carried out periodically not less than once a year and properly if necessary. After review of SOPs, SOPs should be updated to revised version. Records of SOPs review and histories of review must be required to issue and keep them. Records of view should include the following:

- Activities before review and after review and reviewed reasons
- Signatures of approved persons, date of review
- Results of review
- Marking of reviewed part and description of reviewed histories in revised SOPs documents

2-5. Preparation for making of O&M plan

O&M plan is developed to provide a material that can be easily referred to for guidance in operating a water system. The O&M plan will also provide ready reference for following;

- All equipment data which is necessary for performing normal maintenance
- Ordering replacement parts and supplies
- Organized system for keeping records of O&M of the system
- Water sampling, analysis and testing which required for compliance with regulations
- Monitoring of the treatment process for compliance with accepted waterworks procedures.
- Information regarding start-up and normal operating procedures and emergency operating procedures

O&M plan will become a training manual to provide personnel which handy source reference while they learn to operate the facilities. The experienced operator will usually refer to the O&M plan for confirmation of normal operation and maintenance procedures and as a reference guide for unusual operating conditions. The entry level operator should frequently refer to the O&M plan for guidance and instruction.

Plant Name: ABBASA W.T.P.	Title: Raw Water Intake	SOP TAG No. ABS-WTP01-OP

Issued	09/oct/07	Developed by		Signature	
Revised		Approved by		Signature	

1. Introduction

In general, water sources for water treatment plant consist of surface water, groundwater or bulk water purchased from another water supply utilities. Surface water source will be from rivers, streams, lakes, or impoundments and groundwater will be from wells or springs.

For ABBASA water treatment plant (WTP), the water source is surface water from the Ismailia canal.

Water quality of raw water must be acceptable as a safe drinking water when treated, and the quantity must be constantly sufficient for the water demand of the target areas to be supplied by the plant. In many cases, after raw water has been contaminated, it is a better solution to protect the quality of the raw water than to treat it.

There are some possibilities that water from the contaminated water sources contains chemical, microbiological or radiological substances which may be harmful for human health.

Intake facility has a function of withdrawing water from canal or river and conveying it to water treatment plant. The ideal intake facility will be capable of taking raw water from various distances and screening it to prevent algae scum, trash, logs, or fish from entering the plant.

2. Features of process

2-1. Function of process

(1) Taking water from the canal and conveying it to water treatment plant
(2) Prevention of algae scum, trash, logs, or fish from entering the plant
(3) Prevention of harmful substances such as oil from entering the treatment process of the plant

2-2 Impacts of process

(1) The first stage of water treatment plant
(2) Initial cleaning by removing trashes, logs, or suspended materials
(3) Critical situation in water treatment plant should be avoided by shutdown of water intake.

2-3. Relations between other processes

Raw water quality may be affected by this process, so that it will influence on many other supply elements, especially treatment processes.

3. Criteria for operation

3-1. Frequency of monitoring and visual check

Monitoring and visual check should be conducted by routine work twice a day or more. And information of the canal condition in upstream should be collected when the Ministry of Irrigation will disinfect the canal and monitoring any emergency change.

3-2. Frequency of cleaning of screen in the intake channel

Cleaning of the screen in the intake channel will be conducted as a routine work twice or three times a day.

4. Operation under normal condition

4-1. Start-up and shutdown procedures

4-1-1. Start-up

The canal water should be withdrawn from intake and led into the raw water basin through two lines of the raw water pipe by the gravity. Main gate is installed at the inlet of intake channel and the raw water valve is installed at the end of the intake channel. The intake channel of the raw water is installed 2 sets individually. The raw water from the canal should be able to lead into the raw water basin by the following steps:

1st: Intake channel No.1 or No.2 or both should be chosen.
2nd: Main gate will be opened for the chosen intake channel according to the required amount of water for treatment.
3rd: Raw water pipe No.1 or No.2 or both should be chosen.
4th: Raw water valve in the chosen raw water pipe should be opened.

Activities around the raw water basin

5th: The raw water valve in the raw water basin should be opened.
The raw water will be flown into the raw water basin.

Start-up precautions

1) Main gates should be opened but not fully. Substances on the water surface should be prevented from entering into the raw water channel.
2) Raw water valves in the channels should be opened fully. When they are opened not fully, mud or algae in the raw water will be precipitated in the raw water pipes.

4-1-2. Shutdown

There are two (2) kinds of activities for shutdown. The first one is the planned shutdown and the other is the emergency shutdown.

(1) Planned shutdown
For periodical cleaning or inspection of the raw water channel, shutdown of the intake will be planned. In this shutdown, the main gate and the raw water valve will be closed. And the raw water in the raw water channel will be drained out as needed.

(2) Emergency shutdown
In this case, situation is critical. Therefore, the raw water must be avoided to enter into the water treatment plant. Shutdown of the intake means shutdown of water treatment plant.

Hence, this decision must be done by the person-in-charge at the water treatment plant.

1st: The raw water pump must be stopped.
2nd: The raw water valve in the raw water channels and the raw water basin must be closed. Simultaneously, the main gate for the raw water channel must be closed.

Note
1) Person-in-charge should be appointed beforehand who can make a decision for shutdown of the intake under the emergency situation.
2) Plan of activity in emergency case should be prepared.
   - Communication action
   - Organization of the team for aid
   - Steps of the activity to avoid expansion of damage
   - Steps of the activity for recovery

4-2. Monitoring and visual check of facility

Monitoring and visual check of the intake area is very important activity. It should be conducted more than twice every day by prepared check list ABS-WTP01-OPSC. If unusual condition will be found, corrective action should be conducted immediately. Especially accidents related to water source contamination must be listed beforehand to avoid.

4-3. Operation procedures for control of facility

Quantity of raw water from the intake will be controlled to avoid precipitation of muddy substances in the raw water. This will be conducted by fully opening of the raw water valve.

5. Operation under unusual condition

5-1. Expected troubles and trouble shootings

- Clogging in the intake screen
- Bad affect substances such as toxic substances or oil and so, in source water
- Increase of settled mud or floating substances around intake
- Damage of intake screen

5-2. Troubles in the past, causes, backgrounds and events for recovery

Trouble history
Examples of troubles in the past will be useful for solution of the troubles to be happened. Trouble history, the data of troubles in the past, should be applied to the following jobs:

- Recognition of weak point of facility
- Recognition of weak point of facility
- Recognition of weak point of activity of operation and maintenance
- Recognition of wear of facility or part of facility
- Reference for approaching ways and procedures to the trouble
- Reference for “Need to know” to approach the trouble
- Reference for “Prohibit to do” to approach the trouble

Information for trouble history should be recorded and filled in form sheet. Trouble history shall be referred to ABS-WTP01-OPTS-01.

6. Report and record

In order to perform a reasonable activity in O&M of WTP, it should be carried out based upon not only our experiences and instincts but also utilization of statistical and mathematical approaches by prediction, analysis and trial action aiming at optimum results.

Hence, the record or report is one of essential and fundamental documents in O & M of WTP. Reporting is the activity of preparing documents and making communication with staff inside and outside of WTP by utilization of records, reports, data and other facts. Reports include periodical reports such as monthly report or annual report and report on recovery activities against troubles or unusual conditions.

6-1. Record

Record for operation of raw water intake facilities should require as follows:

6-1-1. Record of monitoring and visual check

Monitoring and visual check list should be required. When unusual conditions are found,

they should be corrected, and noted in check list sheet. Monitoring and check items are the following:

- Gate and lifting device
- Raw water channel
- Screen
- Raw water valve
- Condition of the canal in the upper stream
- Condition of the canal around inlet of the intake
- Environment around the intake channel

Activity of monitoring and visual check should be recorded according to O&M schedule, ABS-WTP01-OPSC-01.

6-2. Report

Reports for operation of raw water intake should include as follows:

- Recommendation
- Review of O&M plan
- Review of contents for monitoring and visual check
  - Frequency
  - Check item

Plant Name: **ABBASA W.T.P.**	Title of SOP: **Raw Water Intake - O&M Schedule**	SOP TAG No. **ABS-WTP01-OPSC**

Issued		Developed by		Signature	
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O&M Schedule for Raw Water Intake

D: Daily, W: weekly, M: Monthly, 3M: Each 3 month, 6M: Each 6 month, Y: Yearly, AN: As needed

Name of Facility	Frequency						
	D	W	M	3M	6M	Y	AN
1. Intake gate							
1-1. Condition of opening	○						
1-2. Suspended substances around the gate	○						
1-2. Damage and corrosion					○		
1-3. Water seal						○	
1-4. Damage of frame						○	
1-5. Condition of lifting hook			○				
2. Lifting device of gate							
2-1. Condition of lifting chain	○						
2-2. Condition of operation			○				
2-3. Lubrication			○				
2-4. Condition of lifting hook			○				
2-5. Damage and corrosion			○				
3. Intake channel							
3-1. Condition of waste such as mud or algae growth	○						
3-2. Suspended substances in the channel	○						
3-3. Precipitation in the channel		○					
4. The raw water valve							
4-1. Condition of opening	○						
4-2. Damage and corrosion							○
4-3. Water seal					○		
4-4. Clogging	○						
5. Screen							
5-1. Clogging	○						
5-2. Damage and corrosion			○				
6. The canal around inlet of the intake							
6-1. Waste	○						
6-2. Foreign substances such as body of animals	○						
6-3. Growth of mud, algae or water plant	○						

Name of Facility	Frequency						
	D	W	M	3M	6M	Y	AN
6-4. Color and odor of water	○						
6-5. Water level of canal	○						
6-6. Speed of the stream	○						
6-7. Removal of settled mud around intake						○	
7. Environment around the intake channel							
7-1. Foreign substances such as chemical waste	○						
7-2. Waste and trash	○						
7-3. Smell	○						

Plant Name: **ABBASA W.T.P.**	Title **Raw Water Intake**	SOP TAG No. **ABS-WTP01-MT**

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1. Introduction

Facilities for raw water intake consist of the following.

(1) Intake gate and lifting device
(2) Intake channel
(3) Screen
(4) Raw water valve in the intake channel
(5) Dewatering pumps

2. Criteria for maintenance

Maintenance activity should be conducted according to O&M schedule, ABS-WTP01-OPSC.

2.1 Maintenance activities

Examples of recovery for the raw water intake are shown below:

- Supplying oil or grease
- Repainting
- Removing mud, water grass and floating substances in the raw water channel and canal
- Removing harmful substances or waste around the intake area
- Replacing the whole facility or a part of it

2.2 Recovery to unusual condition

Expected unusual conditions are shown as follows:

- Foreign substances flow into the raw water pipe.
- Raw water flow rate is reduced.
- Mud in the raw water precipitates in the raw water pipe.
- Raw water valve can not be opened fully.
- Raw water intake can not be stopped.

3. Report and record

In order to perform a reasonable activity in O&M of WTP, it should be carried out based upon

not only our experiences and instincts but also utilization of statistical and mathematical approaches by prediction, analysis and trial action aiming at optimum results.

Hence, the record or report is one of essential and fundamental documents in O & M of WTP. Reporting is the activity of preparing documents and making communication with staff inside and outside of WTP by utilization of records, reports, data and other facts. Reports include periodical reports such as monthly report or annual report and report on recovery activities against troubles or unusual conditions.

3-1. Record

Record for maintenance of raw water intake facilities should require as follows:

6-1-1. Record of monitoring and visual check

Inspection and visual check list should be required. When unusual conditions are found, they should be corrected, and noted in check list sheet. Inspection and check items are the following:

- Gate and lifting device
  1. Damage and deterioration
  2. Corrosion
  3. Periodical operation
  4. Greasing
  5. Smooth opening and close
- Raw water channel
  1. Amount of settled mud and removal of mud and floating substances
- Screen
  1. Damage and deterioration
  2. Corrosion
  3. Clogging
- Raw water valve
  1. Damage and deterioration
  2. Corrosion
  3. Clogging
  4. Periodical operation
  5. Greasing
  6. Smooth opening and close
- Condition of the canal in the upper stream
- Condition of the canal around inlet of the intake
- Environment around the intake channel

Activity of monitoring and visual check should be recorded according to O&M schedule, ABS-WTP01-MTSC-01.

6-2. Report

Reports for operation of raw water intake should include as follows:

- Recommendation
- Review of O&M plan
- Review of contents for monitoring and visual check
  - Frequency
  - Check item

Plant Name: **ABBASA W.T.P.**	Title **Raw Water Intake**	SOP TAG No. **ABS-WTP01-QC**

Issued		Developed by		Signature	
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1. Introduction

Water sources can be monitored for a change of condition, but not be able to be controlled by water supply utilities. Raw water intake is the first stage of water treatment. Hence, for early detection of change of raw water quality, monitoring should be conducted periodically. The monitoring should be conducted continuously, if possible.

The quality of the canal water will be changed in the upstream of rivers such as the Nile River. The quality of the canal water will also be changed by the water flow rate of the canal and seasonable fluctuation of physical characteristics of the water such as pH, alkalinity and water temperature.

The trend of the change regarding water quality should be grasped as daily, weekly, monthly or seasonal change. For example, in summer season, water temperature, algae account and turbidity will be higher in comparison with winter season.

Effectiveness of water treatment process is much affected by the above factors. Water quality control should be performed by the effective process control utilizing information about the prediction of change in the raw water quality.

2. Criteria for Water Quality Control

Criteria for water quality control are as follows:

- Frequency of monitoring of the raw water quality
- Items of analysis for the raw water quality
- Acceptable limit of above for intake
- Sampling point of the raw water intake

3. Activity of the water quality control

3-1. Monitoring and visual check

Monitoring and visual check of the intake area is very important activity. It should be conducted more than twice every day by prepared check list.

If unusual condition is found, corrective action should be conducted immediately. Especially, accident of water source contamination must be listed beforehand to avoid it.

3-2. Water quality control

Activity of water quality control in the intake area may be called it water quality management or management of the raw water intake.

Information about the raw water quality in the raw water intake is essential to control of the whole of water treatment process.

Quantity or quality of the raw water can not be changed by the raw water intake facility. In the process of the raw water intake, shutdown of raw water intake into the water treatment is the only one and serious activity for the water quality control.

Criteria for shut down of the raw water intake should be determined.

4. Recovery from Unusual Condition:

Expected unusual conditions are shown below:

- The water level of the canal will be decrease unusually
- A big amount of mud will flow into the intake
- Foreign substances such as body of animal will flow in the canal
- Contamination such as oil waste in the upstream flow of the canal

5. Report and record

5-1. Record

Record for water quality control of the raw water intake should include the following:
(1) Record of water quality of the raw water intake
(2) Record of monitoring and visual check

5-2.Report

Report for water quality control of the raw water intake should include the following:

5-2-1. Trend of the canal water quality

(1) Monthly
(2) Annual
(3) Seasonal

5-2-2. Recommendation on the raw water intake

(1) Safety and security
(2) Improvement
(3) Research on the upstream area

Plant Name: ABBASA W.T.P.	Title: Raw Water Pump	SOP TAG No. ABS-WTP02-OP

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1. Introduction

Raw water pump facility consists of the following equipment:
(1) Raw water basin
(2) Raw water pumps
(3) Vacuum pumps
(4) Pipes and valves
(5) Sampling pump
(6) Dewatering pumps
(7) Crane

ABBASA WTP has two pump stations and two raw water intakes. Raw water from the intake is led into the raw water pit and suction tank through two raw water pipes. Raw water in the raw water suction tank is sucked by the raw water pumps and transferred to distribution shaft though a raw water pipe.

Discharge pipes from the raw water pumps of old and new plants are connected each other, and after that separated to two pipelines for the two distribution shafts.

2. Features of process

2-1. Function of process

Function of the raw water facility is to transfer the raw water into the distribution shaft with the required quantity.

2-2. Impacts of process

For the correct starting for production process adjustment, the raw water flow rate shall be adjusted by the required chemical calculation. Chemical devices shall also be adjusted so that they can supply the dosage determined in the laboratory which are proportional to the raw water flow rate.

2-3 Relations between other processes

2-3-1. Raw water intake

Raw water intake is a preceding step of the raw water basin. Raw water is flown into the raw water basin by gravity. Water level and water quality in the raw water basin will be

almost the same as the water level and water quality of canal.

2-3-2. Receiving well (called as "Distribution shaft" in Egypt)

The distribution shaft is located after the raw water pump facility. The required quantity of the raw water should be fed from the raw water pump to the distribution shaft under controlled condition and required quantities.

3. Criteria for operation

3-1. Schedule for pump operation

Raw water pumps should be operated according to the operation schedule. Usually, one pump will be operated for 24 hours and after that stand-by pump is operated alternately so that operating hours can be evenly distributed to all the pumps.

3-2. Preparation to start operating the pump

Prior to start a pump, air in the casing of the pump should be evacuated by vacuum pump. After water is filled in the pump casing, a pump will be able to start. Vacuum pressure indicator requires minus 0.3 bar or more to start a pump.

3-3. Proper working number of raw water pump based on water level in clear water reservoir

Required number of raw water pumps should be operated according to water level in the clear water reservoir.

4. Operation under normal condition

4-1. Startup and shutdown procedures

4-1-1. Pre-start check

Pump operated should be selected and the following should be checked:
(1) Water level in the raw water basin
Water level should be sufficient for operating pump.
(2) Valves on suction pipeline
Valves in suction pipeline should be opened fully.
(3) Valves on discharge pipeline
Valves in discharge pipeline should be closed before starting operation.
(4) Valve for air evacuation by vacuum pump
Valve for air evacuation by vacuum pump should be opened fully.
(5) Electrical switch board
Power should be supplied.

4-1-2. Startup

(1) Operate vacuum pump to start
Vacuum pressure indicator should require minus 0.3 bar or more.
(2) Close valve for air evacuation and stop vacuum pump
(3) Operate start switch on switch board to start pump
(4) Confirm pressure gauge of discharge pipeline to be fully loaded
Indication of pressure gauge should be (1-1.6) bar or more
(5) Check indicator of current meter on switch board to be fully loaded
Electrical current should be as per the rated ampere
(6) Check unusual noise, vibration, temperature arise and water leakage
(7) Check condition of water leakage from part of gland packing in stuffing box
(8) Adjust tightening of gland packing as required

4-1-3. Shutdown

(1) Push stop button on switch board to stop pump
(2) Close discharge valve

4-2. Monitoring and visual check during operation

Monitoring and visual check of the intake area is very important activity. It should be conducted more than twice a day by the prepared check list. If unusual condition is found, corrective action should be immediately conducted especially in case of vibration, unusual noise and considerable decrease of pump flow rate due to the clogging caused by plastic bags.

5. Operation under unusual condition

5-1 Expected troubles and trouble shooting

- Clogging in the suction pipe or the discharge pipe
- Discharge pressure is not enough
- Discharge quantity is not enough
- The water level in the raw water basin is not enough
- Mechanical or physical trouble of the pump

Trouble shootings are shown in ABS-WTP02-OPTS.

6. Report and record

6-1. Record

Record for the raw water pump operation should include the following:

6-1-1. Record of pump operation

- Operation hours of each pump
- Operation condition
- Discharge pressure, quantity, electrical current, etc.
- Water level in the raw water basin
- Unusual condition of pump

6-1-2. Record of vacuum pump operation

- Operation hours of each pump
- Operation condition
- Vacuum pressure, electrical current, etc.

6-2 Report

Reports for operation of raw water intake should include the following:

6-2-1. Unusual condition in operation

Unusual condition, corrective action conducted and recovery time should be reported.

6-2-2. Monthly report

- Operation hours of each pump
- Recommendation on operation

6-2-3. Annual report

- Operation hours of each pump
- Recommendation on operation

Plant Name: ABBASA W.T.P.	Title of SOP: Raw water pumps	SOP TAG No. ABS-WTP02-OP
Kind of Doc. Trouble Shooting	Title of Document Trouble Shooting for the Pump	Document No. ABS-WTP02-OPTS-01

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PROBLEM	POSSIBLE CAUSE	RECOMMENDED REMEDY
No water delivered No flow No pressure	Delivery or suction valve closed	Open the closed valve
	The pump is not primed	Prime the pump
	Suction left is too high	Increase water level in suction sump
	Suction strainer is locked	Clean suction strainer
	Foot valve is partially closed	Clear the clog
	Air leak into suction line	Tight all flanges and packing
	Air buckets in suction line	Open air vent valves in suction pipe
	Leaks in the shaft seal	Replace the seal or tighten gland
	Air leak through stuffing box	Seal the stuffing box properly
	Impeller damaged	Replace the impeller
	Rotation direction is incorrect	Reverse the phases
Low flow and low pressure	Gasket for casing is leaking	Replace the gaskets
	Suction pressure close to vapor	Close partially the discharge valve
	Excessive amount of air in liquid	Open air vent to release air
	Wearing ring worn	Replace new wearing ring
	Foreign maters in the impeller	Open pump and clean impeller
	Foot valve is too small	Replace foot valve
	Parallel operation effect the pump	Check the system design
	Glands is too tight	Loosen the gland nuts
	Packing improperly installed	Replace the backing
	Shaft or shaft sleeve worm	Replace with new shaft and sleeves
	Shaft running off-center	Rectify the shaft centering
	Pump start and stop frequently	Adjust the system control
	Water seal pipe clogged	Clear water seal pipe

PROBLEM	POSSIBLE CAUSE	RECOMMENDED REMEDY
Short lifespan of shaft seal and packing	Gland is too tight	Loosen gland nuts
	Seal cage improperly located	Check the location and correct
	Dirt or grit in sealing liquid	Use clean water for sealing
	Cooling liquid is not provided	Repair or install cooling liquid pipe
	Clearance between casing and shat is too excessive	Open the pump and adjust the clearance to the designed value
	Lack of lubricants	Add more grease or oil
Short lifespan for bearing, noisy operation	Misalignment between motor and pump shafts	Adjust the alignment of motor and pump shafts
	Dirt getting into bearing	Check the bearing seal and correct
	Lack of lubrication	Add more grease or oil
	Bearing rusted	Clean and cover protect hosing
	Bearing worn out	Replace the bearing
	Foundation not rigid enough	Repair and tighten foundation bolts
	Excessive grease in bearing housing	Remove some of the grease from bearing hosing
	Shaft is bent	Replace the shaft with new one
	Rotor of pump or motor out of balance	Change the motor and pump shaft with the impeller and check balance
	Rotating parts are rubbing	Check and replace necessary parts
Pump trip Stopped by itself	Electrical overload settings are incorrect	Check and correct setting
	Bearing jammed	Change the bearing
	Impeller obstructed	Clear obstruction from the impeller

Plant Name: ABBASA W.T.P.	Title Raw Water Pump	SOP TAG No. ABS-WTP02-MT

Issued		Developed by		Signature	
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1. Introduction

Centrifugal pump consists of two (2) main components of pump and motor. Pump has two main components:

(1) Rotating component comprised of impeller, shaft and bearing
(2) Stationary component comprised of casing, casing cover, and bearing

Also pumps include some auxiliary components as shown below:

- Evacuation system
- Stuffing box cooling pipe
- Oiling/greasing pump bearings
- Seal water drains and vents

Auxiliary piping systems include tubing, piping and isolating valves (control valves, relief valves, temperature gauges and thermocouples).

Maintenance activity for the pump should be conducted to main components and auxiliary components.

2. Criteria for maintenance

It is represented in the pump maintenance activity in addition to the general cleanness, painting, confirm that internal parts work in proper condition and avoid the pump from not working so we can recover any simple phenomena like increase or decrease of cooling water, continuous lubrication, and inspecting pumps when much noise , rise in temperature or vibration occur.

3. Maintenance activity

Daily monitoring and check, and periodical inspection should be required to keep the pump in proper working. Maintenance activity shown herein means activity for the routine maintenance. Description regarding activity for the corrective maintenance is shown in trouble shooting. Maintenance activity consists of 4 kinds of working components as following;

(1) Monitoring and checking during working of facility
(2) Periodical inspection during working or after shut down
(3) Evaluate and analysis regarding result of monitoring and check, and inspection

(4) Recovery e.g., repairing, replace, supply or change of oil and so.

3-1. Monitoring and visual check

3-1-1. Pump

Period	Monitoring and Check Item
Daily	1. Visual check for leaks
	2, Adjustment of glands as required to maintain proper leakage
	3. Hand test of bearing housing for any sign of temperature rise
Every week	1. Visual check for leaks
	2. Adjustment of glands as required to maintain proper leakage
	3. Hand test of bearing housing for any sign of temperature rise
Every month	1. Check for lubrication
	2. Check of packing and the replacement when needed
	3. Check and re-grease of bearing
Every 6 months	1. Check for alignment of the pimp and motor
	2. Check of holding down bolts for tightness
Every year	1. Check of rotating element for wear
	2. Check of wearing clearance
	3. Vibration test

3-2. Periodical inspection during operation or after shutdown

This includes monitoring of flow rate, pressure head for pumps and current consumption to confirm pump operation efficiency. When pump has stopped, oil/grease of bearings have to be checked and excessive amount should be cleaned.

3-3. Evaluation and analysis on the results of monitoring, check, and inspection

Generally, we can recognize the efficiency of the pump or the corrective actions needed in case of not applying the flow rate or the pressure head or increase current consumption rater than the design rate for the pump from the results of monitoring.

3-4. Recovery by such as repair, replacement, supply or change of oil, etc

This means keep the pump in its original condition or the nearest to this condition. This condition will happen by rapid repair or replacing damage parts and avoid the pump from not working.

4. Report and record

4-1. Record

Record of operation of the facility should include the following:

- Result of monitoring and check (check list)
- Result of periodical inspection
- Record during working of facility
  - Indication of discharge pressure
  - Indication of current meter
  - Measurement of vibration by vibration meter
  - Measurement of noise by noise meter
  - Measurement of temperature of motor and bearing

4-2. Report

Reports should include the following:

4-2-1. Report for recommendation

(1) Rehabilitation
- Repair or replacement
- List of spare parts that should be stored in the plant

(2) Upgrading of facility or system
- Change of capacity, material, and other specifications
- Addition of facility
- Modification of facility or system
- Proposal of preventive maintenance activity to be needed

4-2-2. Report of maintenance activity

(1) Annual report
- Repair and replacement for each facility
- Trouble and accident
  - Result of corrective maintenance
  - List of consumed spare parts in a year

(2) Corrective action to prevent trouble or accident

Plant Name: ABBASA W.T.P.	Title: Receiving Well	SOP TAG No. ABS-WTP03-OP

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1. Description of the facility

1-1. Outline of facility

In ABBASA WTP, raw water from the raw water pump is fed into two distribution shafts through two raw water pipes. Alum and chlorine as coagulants are dosed into each raw water pipe. Chlorine is dosed prior to dosing of alum.

Raw water is distributed to three (3) sedimentation basins from 1st distribution shaft and to four (4) sedimentation basins from 2nd distribution shaft.

1-2. Function of the receiving well (called as "Distribution shaft")

Function of the distribution shaft is to receive raw water from the raw water pump and distribute the raw water evenly to sedimentation basins.

1-3. Impact of facility

Raw water quantity is one of essential data in the operation of water treatment plant. If the raw water quantity is distributed unevenly, load to coagulation and sedimentation basins will be different in each basin and water quality of effluent water from sedimentation basins will be different in each basin. Even distribution of raw water quantity should be conducted as much as possible.

1-4. Relation with other facilities

1-4-1. Raw water pump

Raw water is distributed to three (3) sedimentation basins from 1st distribution shaft and to four (4) sedimentation basins from 2nd distribution shaft. Hence, raw water quantity fed into the distribution shaft should be changed according to the total quantity of distribution. Three sevenths (3/7) of total raw water quantity should be fed into 1st distribution shaft and four sevenths (4/7) of total raw water quantity should be fed into 2nd distribution shaft.

Distribution of raw water quantity in the raw water pipes should be controlled by opening degree of the valve before flow meter and raw water quantity to the each distribution shaft will be confirmed by flow indicator.

1-4-2. Coagulation and sedimentation facilities

Even flow rate of raw water is required to proper treatment through coagulation and sedimentation according to the design criteria.

1-4-3. Alum and pre-chlorine dosing

Prior to flowing into distribution shaft of raw water, pre-chlorine and alum are dosed into the raw water pipe. Pre-chlorine will be dosed initially and alum dosing will be followed. Pre-chlorine oxidizes organics and other substances in the pipe and will decrease pH value of raw water slightly.

Contact time and well mixing of chlorine with raw water affects decrease of pH value. Proper coagulation by alum is performed within pH of 7.0-7.5. Generally, canal water shows high pH such as 7.6-8.0, pH decrease in raw water will lead to better coagulation.

2. The criteria for operation

Criteria for operation are not applied in this facility.

3. Operation under normal operation

Usually, raw water passes through distribution shaft and, inlet and outlet valves will be opened. Hence, only monitoring should be needed to confirm whether unusual condition exists or not. When sedimentation basin is cleaned, outlet valve for the sedimentation basin under cleaning should be closed.

When operation of the sedimentation basin is restarted, outlet valve should be opened gradually by confirming water quality in the sedimentation basin. The outlet valve can be opened after confirming that the water in the sedimentation basin has been stabilized.

4. Operation under the unusual condition

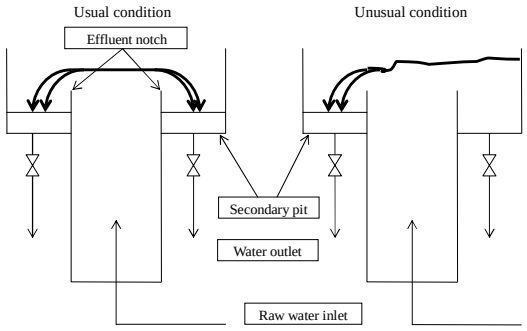
4-1. Typical unusual condition

Unusual condition of the distribution shaft will occur when the function become insufficient, that is, insufficient uniform distribution of raw water quantity happens. Insufficient uniform distribution of raw water quantity can be confirmed by observation of water level in the distribution shaft.

Water in the distribution shaft falls down though the notch to the attached secondary pit and the water level of the central area of the distribution shaft is normally not affected by the water level of this pit.

However, when the outlet valve is closed or opening of the valve is not sufficient, water level

of the secondary pit will arise and affect to the water level of the central area of the distribution shaft. In this condition, raw water will be distributed unevenly.



In case of the above condition, check opening degree of the outlet valve and open it as required.

4-2. Trouble shooting

Trouble shooting is referred to ABS-WTP03-OPTS-01.

5. Report and record

5-1. Record

Record for operation of the distribution shaft should include the following:
(1) Record of monitoring and visual check
(2) Record of flow rate of the raw water for each distribution shaft

5-2. Report

Report for operation of the distribution shaft should include the following:
(1) Annual report
- Report of raw water quantity
- Report of corrective action (if any)

(2) Recommendation
- Rehabilitation and upgrading
- Review of operation procedures
- Review of unified record sheet

Plant Name: ABBASA W.T.P.	Title: Receiving Well	SOP TAG No. ABS-WTP03-MT

Issued		Developed by		Signature	
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1. Introduction

Receiving well will be operated continuously and not able to stop usually. Inspection, cleaning and recovering work of the inside of the distribution shaft will be difficult in usual operation period. The above-mentioned works may be conducted in the scheme of the rehabilitation work.

However, maintenance for the external area of the distribution shaft such as piping and valves can be conducted in the routine works.

2. Criteria for maintenance

- Frequency of inspection: Every three (3) years or as required

3. Maintenance activity

Monitoring, check and inspection should be carried out to judge necessity of recovering activity such as adjustment, repairing or replacing. Unusual condition of the sludge drainage facility will be confirmed by monitoring the following:

- The water condition in the distribution shaft
  - Turbidity or color
  - Foreign substances
- External condition for distribution shaft

Maintenance activity consists of four (4) kinds of working as following:

(1) Monitoring and checking work during working
(2) Inspection
(3) Evaluate and analysis regarding result of inspection
(4) Recovery after the inspection

3-1. Monitoring and visual check

Monitoring and visual check should be carried out according to "O&M schedule" and uniformed check list, and it will be conducted with the monitoring activities for the sedimentation basin.

3-2 Inspection

Inspection should be carried out according to "O&M schedule" and uniformed check list and

it will be conducted with the inspection activities for the sedimentation basin. Causes of the troubles to be occurred in the distribution shaft shown below should be checked and solved:

- Uneven distribution
- Damage of the valve and piping
  - External condition
  - Internal condition
  - Sealing condition
- Unusual of water sealing around the pipe
- Leak around pipe and pipe connection part

3-3. Evaluate and analysis regarding inspection result

After inspection, following items should be evaluated:

- Necessity of recover such as repairing and replacing
- Necessity of adjustment such as opening of the valve
- Necessity of the cleaning

3-4. Recovery after the inspection

After the inspection, recovery action shown below should be conducted as required:

- Repainting
- Cleaning of inside of the drainage pipe
- The valve
  - Supplying the grease as needed
  - Change of part as needed
  - Replace the valve as needed or periodically
- Repairing of leak part around the drainage pipe
- Repairing of leak part of the pipe connection

4. Report and record

4-1. Record

Record for maintenance of the distribution shaft should include the following:

(1) Record of monitoring and visual check
(2) Record of inspection
(3) Record of recovery

4-2. Report

Report for maintenance of the distribution shaft should include the following:

(1) Recommendation
- Rehabilitation
- Review of maintenance activities

Plant Name: ABBASA W.T.P.	Title: Receiving Well	SOP TAG No. ABS-WTP03-QC

Issued		Developed by		Signature	
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1. Introduction

Water quality control for the distribution shaft should be conducted in the following manner:

- Monitoring and visual check
- Taking sample of water in the receiving well mixed with pre-chlorine
- Jar test of above water sample

The sampling tap is available for each raw water pipe located just before the each distribution shaft. A sample of the raw water mixed with pre-chlorine can be sampled from this tap.

2. Criteria for water quality control

(1) Frequency of taking of sample:
- Once a day or more
- According to the requirements from the Holding company

(2) Time of taking of sample: Around 9 a.m. in a morning
(3) Volume of sampling water: 10 litters or more
(4) Procedures for jar test:
- According to the standard operation procedures

(5) Items of water quality should be analyzed
- According to the requirements from the Holding Company

3. Water quality control under normal condition

The activity of the water quality control should require the following:

- Monitoring and visual check
- Water quality analysis and the laboratory test for the treatment
  - Sampling
  - Water quality analysis
- Determination of the dosing rate for the pre-chlorine
- Adjustment of the dosing rate for the pre-chlorine

3-1. Monitoring and visual check of process

Monitoring and visual check should be conducted according to the unified list for the monitoring and check. Unified list is provided in ABS-WTP03QC-CH01.

3-2. Water analysis and the laboratory test for the treatment

Water analysis and laboratory test should be conducted according to the standard operation procedures. The standard operation procedures can be referred the documents of procedures for water quality control.

3-3. Determination of the dosing rate for the pre-chlorine

The dosing rate of pre-chlorine should be determined by result of laboratory test of the break point. The dosing rate of pre-chlorine will be determined with some additional margin onto the break point value some additional margin depend on data which obtained from records of free residual chlorine in different process and what is target in network

3-4. Adjustment of dosing rate for pre-chlorination

Dosing rate of pre-chlorine should be adjusted by evaluation of free chlorine residual of the water in actual facility of the distribution shaft. Results of laboratory test will not always correspond with actual results. Many factors will be related to the operated results in the actual facility such as mixing condition, water temperature and pH of the raw water, and so.

4. Report and record

4-1. Record

Records for water quality control of the distribution shaft should include the following:

(1) Record of monitoring and visual check
(2) Record of water quality in the distribution shaft

4-2. Report

Reports for water quality control of the distribution shaft should include the following:

(1) Review of criteria
- Modifying
- Addition or delete

(2) Review of procedures for operation and control
- Modifying
- Addition or delete

(3) Recommendation
- Upgrading or rehabilitation of facility
- - Modification and arrangement
- - Repairing and replace
- - Additional of facility

(4) Annual report

Plant Name:	Title	SOP TAG No.
ABBASA W.T.P.	**Coagulation Facility**	**ABS-WTP04-OP**

1. Process Description

1-1. Function of coagulation processes in treatment process

Function of coagulation process is to make optimum condition aim for settling of particulate impurities in sedimentation basin.

1-2. Coagulation Process

Coagulation is the effect of chemicals added to the raw water reacting with the particulate impurities then pre-chlorine added to react with suspended materials then they negatively charged to attract positive ion from alum after dissolving it in water to form a flock.

A flock is the accumulation of the chemicals and the particulate matter to form small jelly-like particles which look like snowflakes in the water. As these pieces of flock clump together and combine with more particulate matter, they grow into larger and heavier flock which will settle out.

The coagulation process is a very complex chemical and physical reaction which depends on many factors of water quality, such as pH, turbidity, temperature, and hardness. It also depends on the chemicals and dosages of chemicals used for coagulation and physical treatment of water, such as rapid mixing, flocculation.

1-3. Impacts of process

Coagulation/sedimentation process is major process affect to treatment result in conventional filtration treatment plant. Coagulation process is completed by three (3) steps as follows:

1st step: Chemicals dosing step
Dosing of coagulant or other aid chemicals into raw water

2nd step: Flocks formation step
Rapid mixing of coagulant or other chemicals with raw water by flush mixer or stream

3rd step: Flocks growth step
Slow mixing by mechanical Flocculator or stream

Coagulation process will be successfully achieved by optimum results in all above-mentioned steps. Even if any one of the steps is not optimum, coagulation process will not be achieved properly.

1-4. Relation to other process

1-4-1. Preceding process

Intake and raw water distribution process

- Raw water quantity
  Number of raw water pump in operation, distributed water quantity
- Raw water quality
  Turbidity, pH, temperature, alkalinity, algae accounts, etc
- Water quality after dosing of pre-chlorine
  Residual chlorine, pH, alkalinity, etc

1-4-2. Following process: Sedimentation process

(1) Related factors
- Characteristics of flocks in outlet water from flocculation basin to sedimentation basin
  Weight, density
- Amount of settled sludge in sedimentation basin

(2) Factors to be affected
- Water quality of raw water
  Analysis conducted for raw water by achieving the jar test to determine proper alum dosage and the break point test to determine proper dosage for pre-chlorine. These analysis achieved in the laboratory by taking raw water samples then making the tests to determine proper dosage which realize best results to form flocks.
- Water quality after sedimentation
  - Turbidity
  - Residual chlorine concentration
  - pH
  - Alkalinity
  - Algae accounts
- Sludge drainage
  - Frequency of sludge drainage from sedimentation basin
  - Period of sludge drainage from sedimentation basin (every 2 hours)
  - Frequency of sludge drainage from sludge drainage basin
  - Period of sludge drainage in the period (3 to 5 minutes) or by calculating the clay content for raw water

2. Criteria for operation

Criteria are values to make a judgment to be maintain something or various your activities in proper. If criteria should not be prepared, you will not be able to judge something or various your activities in proper. We should know design criteria for operation and control of facilities.

Since, we show the design criteria for reference as following.

2-1. Design criteria

Design criteria use for initial design of facilities in water treatment plant to determine specifications such as capacity, ability, numbers and so. In other words, design criteria may mean limited ability of each facility.

- Rapid mixing
  - Rotation number per minutes of flush mixer
  - Detention time of raw water in mixing basin(from 60-180 sec)
  - Detention time of raw water in distribution shaft
- Slow mixing
  - Detention time of raw water in flocculation basin
  - Rotation number per minutes of flocculator
  - Working number of Flocculator in each flocculation basin
- Alum and pre-chlorine dosing
  - Detention time of raw water in raw water pipe after pre-chlorine dosing
  - Dosing range of pre-chlorine for pre-chlorinator
  - Dosing range of alum for alum dosing device
  - Concentration of alum solution for dosing

2-2. Operation criteria

Operation criteria should be used to judge a condition of the facility which is operating in proper or not. If operation criteria do not exist, we will not be able to judge operating condition of water treatment facility is proper or not. In other words, operation criteria may use as trigger to start of operation, control, repairing and so, activities for each facility.

- Rapid mixing
  - Judgment for necessity of continuous working
- Slow mixing
  - Judgment for rotation number per minutes of flocculator and collecting & thickening of flocks efficiency
  - Judgment for working number of flocculator
  - Working number of Flocculator in each flocculation basin
- Alum and chlorine facility
  - Refer to WTP11 and WTP12

3. Operation procedures under normal condition

3-1. Rapid mixing

Rapid mixing is the initial high speed agitation of the water to ensure a quick dispersion of the chemicals in processed water. This action causes the chemical to be distributed uniformly throughout the water. There is one mixing unit mounted over a smaller chamber having

proper detention time as range in 30sec to 60sec. It is desirable for the water to rapidly come into complete contact with chemicals so the chemical reactions begin; however, it is not desirable that any setting of chemicals or materials occur in this chamber.

Rapid mixer is electric driven motor having a long vertical shaft with propeller extending into the following though the chamber.

3-1-1. Start-up

(1) Pre-start check

Before operation, the following should be checked:

- Free shaft turning
- Check lubrication
- No unsafe conditions (e.g., exposed wires and so)
- MCB (circuit breaker) electrical power supply on

After determined pre-start check, push the Flocculator start button on switch board on site and check the rotation of the rapid mixer and its ability to mix water with chemicals.

3-1-2. Periodical check during working

Periodical check has to be achieved during the day to confirm continuous operation for the mixer, its operation condition and monitoring the temperature of the electric motor and no unusual noise or vibrations.

- Check items during working
- No sound during operation
  - No temperature rising of motor and drive unit
  - No leakage of oil or grease from parts of motor and speed reduction device
  - No loose or damage of shaft and paddle in mixing basin
  - No obstacles or foreign substances in mixing basin
- Monitoring rapid mixing condition
  - Mixing condition of alum with raw water in mixing basin by sampling
  - Mixing condition of chlorine with raw water by sampling

3-1-3. Control procedures

There are no items for mixer itself to be controlled, however, it should be required to judge mixer shall be operated or not, according to confirmation of flock formation in flocculation basin to distinguish the efficiency of the mixer.

Coagulation reactions are completed in very short moment especially under high water temperature in summer season. Since coagulation reaction may be proceed by mixing action by only water flow energy in upstream and/or downstream of mixer. In case of above, coagulation flocks will be broken by mixer or water flow energy in downstream of mixer and it is conceivable rapid mixing is harmful action for growth of flocks.

Generally, a relatively big amount of algae are contained in canal water in Egypt and these accounts will be increase in summer season (e.g., more than 15000 counts/ml in summer season). Coagulant flocks of algae origin are light and easily broken. Once flocks are torn apart, it is difficult to get them to reform to their optimum size and strength.

Details for control procedures refer to ABS-WTP4-QC SOPs for Water Quality Control.

3-2. Slow mixing

Slow mixing is next stage after rapid mixing of the water to ensure a gradual growth of the flocks in processed water. There are two or four mixing units mounted over a flocculation chamber having proper detention time as range in 20min to 30min each.

Although there are baffling slow mixers, the most common slow mixer is electric driven motor having a long vertical or horizontal shaft with paddles extending into the following though the chamber.

3-2-1. Start-up

(1) Pre-start check

Flocculator should be started approximately at the same time as the start-up of chemical dosing and rapid mixing. Prior to start-up, the drive unit should be visually checked.

- - Shaft turns freely
- - Check lubrication
- - Unsafe conditions (e.g., exposed wires and so on)
- - MCB (circuit breaker) electrical power supply

(2) Startup

After determined pre-start check, push the Flocculator start button on switch board on site and check the rotation of the slow mixer, its ability to mix water and forming heavy flocks.

3-2-2. Check items during working

- No sound of noise from motor or speed reduction device
- No temperature rising of motor and speed reduction device
- No leakage of oil or grease from parts of motor and speed reduction device
- No loose or damage of shaft and paddle
- No obstacles or foreign substances in mixing basin
- Formation of flocks in outlet water from flocculation basin
  (Visual check of configuration and density)

3-2-3. Control procedures of Flocculator

Control item of flocculator is checking that the flocculator operates all the time and monitoring the coagulation process to distinguish the efficiency of the mixer. There are many activities, tests, analysis and evaluations to control process as shown below:

- Result of water quality analysis of from this process
- Jar test results
- Analysis of current coagulation process condition
- Water quantity
- Pre-chlorine dosing rate and mixing, dispersion condition

Histories of revision

Rev.	Version	Revised Date	Description of revision
0	Original Version		

Plant Name: **ABBASA W.T.P.**	Title **Coagulation Facility**	SOP TAG No. **ABS-WTP04 -MT**

Issued	25/sept./07	Developed by		Signature	
Revised	01/oct./07	Approved by		Signature	

1. Criteria for maintenance activities

1-1. Criteria for frequency of preventive maintenance

Maintenance work should be conducted periodically as preventive maintenance. This is one of the criteria for preventive maintenance activity and these criteria are shown in Table-1.

Table -1 Category and Frequency for Maintenance Activity

Part name	Maintenance Work	Group	Frequency
1. Motor	Inspection	PM	Every 6 months
	Replace	CM	As required
2. Drive unit	Supply of lubricant	PM	Once a month
	Periodical overhaul	PM	Every 3 year
	Replace	CM	As required
3. Shaft, propeller	Inspection	PM	Once a year
	Polishing/painting	PM	Once a year
	Replace	CM	As required
4. Mixing basin	Cleaning inside	PM	Every 6 months
	Inspection inside	PM	Every 6 months
	Inspection pipe	PM	Every 6 months

PM: Preventive Maintenance activities
CM: Corrective Maintenance activities

2. Report and record

2-1. Record

Recording in the uniformed sheet should be required for all activities of O&M. Records should include working condition of facilities, maintenance results, troubles, causes and background of troubles, especially origin of causes, etc.

Items to be recorded should be as follows:

(1) Working condition of facility before and after maintenance
- Result of Monitoring and check
- Result of inspection

(2) Run time of facility in working
- Record of operation

(3) Information for maintenance activity
- Name of facility, parts in facility
- Items or kind of activity, e.g. repair, replace, adjustment, oil change etc,
- Picture of part before and after maintenance
- Others

(4) Unusual condition and recovery
- Description about unusual condition
- Damage part
- Date of occurring of unusual condition and completion of recovery
- Information for maintenance activity in the past
- Cause of unusual condition or trouble and damage
- Corrective action or preventive action

Maintenance history is technical record of a facility and we will be able to know characteristics, weak point and defect, age of used, etc.

Maintenance records are useful and they are important information to act the following matters:
- Realize and ensure a current condition
- Identify cause for unusual condition or damaged part
- Indicate procedures for recovery of unusual condition or damaged part
- Spare parts should be prepared in storing

Records should be utilized to prepare maintenance report such as annual report of O&M activity.

2-2. Report

Generally almost of technical records should be reported to staff in technical sections of WTP.

Any records are of no value unless they are utilized. Reports should be useful tool for next improvement activities by utilizing of records.

<Required Reports>
- Periodical maintenance report
- Corrective maintenance report
- Result of recovery of trouble or unusual condition

ABS-WTP04 O & M schedule	Revised version	Issued date	Page 1of 1

Plant Name: **ABBASA W.T.P**	Title: **Coagulation Facility**	SOP TAG No.: **ABS-WTP11**
Kind of document: **O & M Schedule**	Title of Document**:** **O & M Schedule for mixer and flocculator**	Document No. ABS-WTP04-MTOS-01

Issued	18/Sept./07	Developed by		Signature	
Revised		Approved by		Signature	

Operation and Maintenance Schedule

D: daily, W: weekly, M: monthly, 3M: every 3 month, 6M: every 6 month, Y: yearly, AN: as required

Name of Facility	Frequency						
	D	W	M	3 M	6 M	Y	AN.
1. Flush mixer							
1-1. Check sound of noise from motor or drive unit	○						
1-2. Check temperature rising of motor and drive unit	○						
1-3. Check no leakage of oil or grease	○						
1-4. Check no loose or damage of shaft and paddle	○						
1-5. Check no foreign substances in mixing basin	○						
1-6. Inspect corrosion, waste		○					
1-7. Inspection lubricant and supplying as needed			○				○
1-8. Cleaning and inspection of basin						○	
1-9. Repainting							○
2. Flocculator							
2-1. Check sound of noise from motor or drive unit	○						
2-2. Check temperature rising of motor and drive unit	○						
2-3. Check no leakage of oil or grease	○						
2-4. Check no loose or damage of shaft and paddle	○						
2-5. Check no foreign substances in mixing basin	○						
2-6. Inspect corrosion, waste		○					
2-7. Inspection lubricant and supplying as needed			○				○
2-8. Cleaning and inspection of basin						○	
2-9. Repainting							○

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- In summer season (May to October): 0.2 mg/L
- In winter season (November to April): 0.3 mg/L

(Note: Above values should be used for references.)

2. Water quality control items under normal condition

2-1. Monitoring of water condition in coagulation process

Water should be monitored in the following manner:

(1) Water in flocculation basin, about inlet and outlet
(2) Water in sedimentation basin, from upstream to downstream
(3) Scum in mixing basin, flocculation basin and sedimentation basin
(4) Foreign substances in mixing basin, flocculation basin and sedimentation basin

2-2. Coagulation condition check by sampled water after rapid mixing

(1) Laboratory test

3. Water quality control in unusual condition

(1) Unusual condition in coagulation process and activities for remedy
(2) Malfunctions of facilities and trouble shootings
(3) Trouble in the past, and cause and the sequence of events - for reference

4. Report and record

4-1. Records

Records should include the following:

- Daily visual check and monitoring results
- Jar test result
- Water analysis results

4-2. Reporting

Reports should include the following:

- Water analysis results and jar test results
- Result of happened unusual condition and process of recovery activities
- Periodical reports about water quality and water treatment condition
  - Monthly
  - Annually
  - Water analysis procedures
  - And so on

ABS-WTP04-QC	Revised version	Issued date	Page 1of 2

Plant Name: **ABBASA W.T.P.**	Title **Coagulation Facility**	SOP TAG No. **ABS-WTP04 –QC**

Issued		Developed by		Signature	
Revised		Approved by		Signature	

1. Criteria for water quality control

The water treatment process has to be effective starting from adding proper dosages proper coagulation ending by the disinfection according the water quality control criteria for each process.

Water treatment process consists of multi-number of processes and each process affects each other. The process condition in upstream affect processes in downstream. Since, we must set a treatment target value to be achieved in each process, and monitor and confirm the process condition comparing to the target usually and continuously.

1-1. Criteria for coagulation process

1-1-1. Water quality of clarified water

- Turbidity: not more than 2 NTU
- Free chlorine residual: not less than 0.5 mg/L

1-2. Criteria for coagulation facility

1-2-1. Rapid mixing

Judgment of working or not according to raw water quality unless it leads to break formed flocks, so that we have to check this condition in the laboratory according to the following changes in the raw water:

- Turbidity of raw water
- Algae accounts in raw water
- Temperature of raw water

1-2-2. Slow mixing

- Judgment of working number of flocculator in each flocculation basin
- 2 of 4 flocculators are working in usual
- Check that the turbidity in coagulation area more than that in the sedimentation area

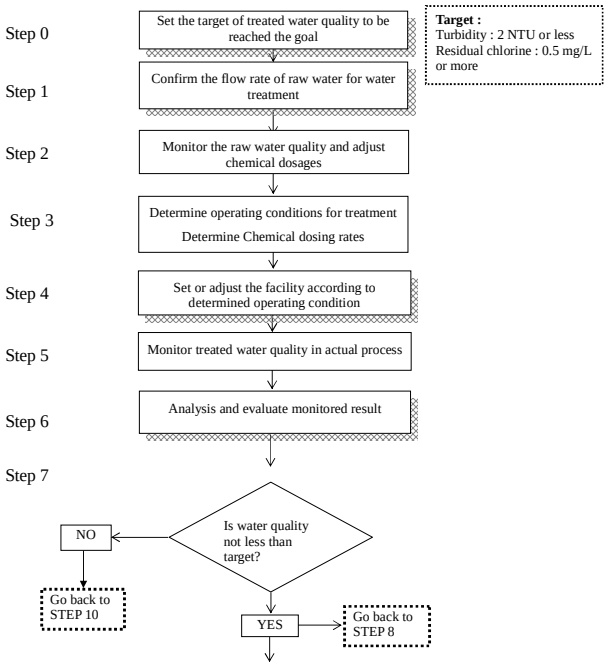
1-2-3. Alum and pre-chlorine dosing

- Alum dosing rate
  - Same as dosing rate of the best choice from result of jar test
- Pre-chlorine dosing rate
  - Same as dosing rate of the break point value

ABS-WTP04-QCFC	Revised version	Issued date	Page 1 of 2

Plant Name : **ABBASA W.T.P.**	Title **Coagulation Facility-Water Quality Control**	SOP Tag No. **ABS-WTP04 –QC**

Issued		Developed by		Signature	
Revised		Approved by		Signature	



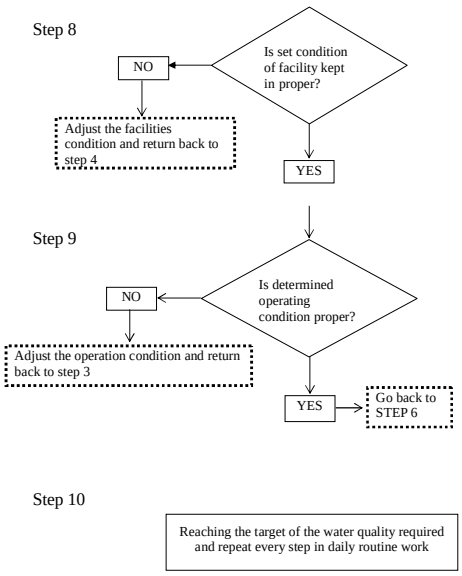


Figure-1 Required Steps for Water Quality Control for Coagulation facility

Plant Name: ABBASA W.T.P.	Title: Sedimentation Basin	SOP TAG No. ABS-WTP05 –OP

Issued	01/oct/07	Developed by		Signature	
Revised		Approved by		Signature	

1. Introduction

Condition of the water in a sedimentation basin and quality of effluent water from a sedimentation basin, should be checked and monitored. If quality is change to poor, check the operation condition of the process before sedimentation basin and modify the operation condition as needed.

Properness of coagulation process should be evaluated by quality of clarified water, density of precipitations inside the sedimentation basin, flow out of the flocks from the weirs of outlet water.

Water quality in the sedimentation basin should be checked to control the operation condition in the previous processes.

2. Features of process

2-1. Function of facility

Function of sedimentation basin is to settle and remove the flocks which produced by the coagulation and flocculation process.

2-2. Impacts of facility

(1) Result of coagulation process is indicated the water quality in a sedimentation basin.
(2) Change of water quality in a sedimentation basin will progress gradually and it will take approx. 2-3 days.

If control of coagulation process failed, operating condition of coagulation facilities will be changed. So, it will need 2 or 3 days to be evaluated the properness of control of coagulation process. Hence, it will need same days after changing of condition to make sure the result of change of operation condition.

- Detention time in sedimentation basin: Approx.2.5 hours
- Detention time in mixing basin and flocculation basin: Apprpx.0.5 hours
- Total detention time from start of coagulation to the end of sedimentation: Approx.3 hours

Though above mentions, changing place of water in a sedimentation basin will progress gradually. It will not be sufficient 3 hours and need more.

(3) High turbidities in the water leaving sedimentation are lead to poor performance of filtering.

2-3. Relations between other processes or other facility

(1) Water quality of clarified water affects to efficiency of filtering work.
Flocks, which should have been removed in the sedimentation basin, pass on to filters. This will result in reduced filter run times and poorer filtered water quality.
(2) The water treatment process is a chain of the several processes such as raw water intake and transferring, coagulation and flocculation, the sedimentation process.
(3) Water quality in sedimentation basin will be affected by operation condition of sludge drainage from the sedimentation basin. Insufficient of sludge drainage will cause of raise of flocks.
(4) Water quality in sedimentation basin will be affected by operation condition of sludge collector in the sedimentation basin. Insufficient of operation of sludge collector will cause of raise of flocks.

3. Criteria for operation

There is nothing to operate or control the sedimentation basin itself, but attached facilities such as sludge collector and sludge drainage facility. There are no criteria for operation or control of sedimentation basin.

Descriptions on water quality control refer to SOP of WTP05-QC, and sludge collector and sludge drainage facility refer to SOP of WTP06 and 07.

4. Operation under normal condition

4-1. Start-up and shut-down procedures

From previous process the water flows into sedimentation basin through openings around bottom in side of a flocculation basin. There are no valves and no gates.

4-1-1. Startup from a condition without water in sedimentation basin (e. g. Restart after cleaning of basin)

In early stage of water filling into sedimentation basin, condition of the water from a flocculation basin will be unstable by flow with shocks, turbulent flow or short circuit flow.

Hence, clarified effluent in early stage after restart should be drain out. During start up sequence, quality of clarified effluent should be monitored. Clarified effluent will be able to lead into filters by change the valves after clarified water be stable in well. Water quality should be confirmed refer to criteria. Until condition of clarified water will be stable in well, monitoring and check of water quality of effluent should be carried out periodically. It needs by intervals of approx. 30min – 60min in usual.

In this stage, flow rate of the water from the distribution tower should be reduced and after water condition will be stable, flow rate will be able to increase gradually.

Procedures for restart after cleaning of sedimentation basin are shown by steps of work in ABS-WTP05-OPFC-01.

4-1-2. Shutdown of operation of a sedimentation basin

Shutdown of sedimentation basin will be carried out in case of activity of periodical maintenance. Stop the water flow into the basin and drain out the water in the basin. If a basin will be shut down, distributed flow rate to the each basin should be increased under the condition in same total of flow rate of raw water.

Flow rate of raw water should be adjusted to suitable flow rate for numbers of sedimentation basin in work. If raw water flow rate will be changed, alum and chlorine dosing flow rate should be changed suitably.

4-2. Monitoring and visual check of facility

The jobs of monitoring and visual check should be daily routine work in O&M activity. Unusual condition or trouble should be picked up in early stage by these jobs. Damage by unusual condition or trouble will be minimized by early detection and rapid response of recovery.

These jobs should be carried out and ensured effectively, suitably by valuable check items, significant value will come out from these jobs. This list should be reviewed periodically for maximize of value of jobs and improvement of works.

5. Operation under unusual condition

5-1. Prospect troubles and trouble shootings

5-1-1. During in working

Condition of sedimentation basin will be affected by the operation of the facility in sedimentation basin, such as sludge collector or facility of sludge drainage. Water condition should be monitored and operation condition of the facility in above should be changed if necessary.

- Unusual condition of the water in sedimentation basin
  - Raising of flocks
  - Raising of sludge
  - Short circuit flow
  - Change of color of water
- Cause of unusual condition
  - Raising of flocks

- Insufficient of sludge drainage
- Operation of sludge collector cause of light flocks
- Improper velocity of inlet

◆ Raising of sludge
- Produced air by decomposition from precipitated sludge
- Structural defect of a basin (Matter of initial design)
- Increase of the inlet water flow rate
- The inlet opening becomes narrow because of the accumulating sludge

◆ Change of color of water
- Change to whitey
  - Insufficient of coagulation
  - Insufficient dosing flow rate of alum
  - Change of raw water quality
  - High pH or alkalinity of raw water
  - Other substance affects to harm coagulation reaction
- Change to green or blue
  - Too much dosing of alum

◆ Actions should be required to recover above as followings;
- Proper frequency of sludge drainage
- Proper time during sludge drainage
- Proper dosing rate of alum
- Control and confirm the raw water flow rate
- Proper monitoring and analysis of raw water quality

5-1-2. Restart after long term stopping

In case of stop for a long term, such as for 2 weeks or more, preparations before stop should be required to be possible the facility in a sedimentation basin to work normally when restart operation will be carried out.

Prospects of trouble by a long term stop are as following

(1) Sedimentation of sludge
◆ Prospect of condition
- Condensed and compressed of sludge on the bottom
- Condensed and compressed of sludge in the pipe

◆ Prospect of trouble of the facility
- Unable to operate the sludge collector by over load in starting
- Unable to drain out the sludge by clogging of drainage pipe

(2) Actions before stop should be required to prevent from above as followings;
◆ Operate a sludge collector more than 2 hours.
◆ Carry out sludge drainage during above.

(3) Cause of reducing of free chlorine residual in water of sedimentation basin
◆ Prospect of trouble of the process

- Insufficient of free chlorine residual in filtered water

(4) Actions before restart should be required to prevent from above as followings
◆ Monitor free chlorine residual in the effluent water
- Drain out the effluent water until free chlorine residual will become sufficient (Sufficient free chlorine residual: 0.5 mg/L or more).

5. Record and Report

5.1 Record

The record for sedimentation basin should be required to know operation condition and quality of clarified water. Quality of clarified water should be acceptable compare with criteria. Operation condition should be acceptable compare with design criteria. For reference, records from water quality control of sedimentation basin will be as follows:

◆ Result of monitoring and check
- Quality of clarified water
  - Turbidity
  - Free chlorine residual
  - Containing of aluminum
  - Color of the water in the basin
- Unusual condition
  - Excess of criteria of turbidity
  - Excess of criteria of free chlorine residual as high or low
  - Excess of criteria of containing of aluminum
  - Unusual color of the water in the basin
  - Arising of flocks in the basin

◆ Operation condition
- Flow rate into a sedimentation basin
- Quality of raw water
- Dosing rate and flow rate of alum and pre-chlorine
- Frequency of sludge drainage
- Operation condition of sludge collector
  - Time in work
  - Rink with sludge drainage or not

5-2. Report

Required reports for operation of sedimentation basin will be limited area and it will need to make a recommendation regarding to operation of sludge drainage and sludge collector. Report for operation of sedimentation basin will include the following:

(1) Recommendation for operation according to records of operation

(2) Report for corrective and preventive action
(3) Result of recovery of trouble or unusual condition
(4) Recommendations for improvement

Plant Name: **ABBASA W.T.P.**	Title **Sedimentation Basin**	SOP TAG No. **ABS-WTP05 -MT**

Issued		Developed by		Signature	
Revised		Approved by		Signature	

1. Criteria for maintenance

Main maintenance activity for sedimentation basin is to clean inside of the basin. This cleaning work is one of major events in WTP.

We can check and confirm the inside condition of the basin and submerged parts of facilities. We should check depth of precipitated sludge remaining in bottom of the basin.

(1) Frequency of cleaning and inspection of basin inside
◆ Cleaning work: Once 3-6 months
◆ Inspection and repairing: Once a year

Cleaning of effluent channel can be cleaned without drainage of water in a basin. So, it should be carried out higher frequency than cleaning of sedimentation basin as following;
◆ In winter season: Once a month
◆ In summer season: Once half month

(2) Judgment of effectiveness of sludge drainage and sludge collection
◆ By remaining sludge volume on bottom area in a sedimentation basin
◆ 3 steps of degree by external appearance: Big, medium, small

(3) Acceptable days during stop of sedimentation basin
◆ In winter season: 3 days
◆ In summer season: 2 days

2. Maintenance activity

2-1. Monitoring and visual check

Monitoring and visual check should be carried out according to “O&M schedule” and unified check list

2-2. Maintenance item

(1) External check of the basin
◆ Appearance of crack on a basin
◆ Leak of water from a basin
◆ Foreign substances such as wooden blocks, waste of vinyl materials and so.

(2) Cleaning of inside of the basin and effluent channel
◆ Flushing away remaining sludge by pressured water

- Brushing away to remove adherent algae on the wall

2-3. Procedures for maintenance activity

(1) Cleaning of a basin
- Make a plan and time schedule for cleaning
- Procedures for drainage of water in sedimentation basin
- Procedures for cleaning of a basin

(2) Cleaning of effluent channel

(3) Inspection procedure
Inspection check list of sedimentation basin should be required. Inspection check list should be provided on following items;
- Inspection of a basin
- Inspection of a sludge collector
- Inspection of a Flocculator
- Inspection of sludge drainage facility

3. Procedures under unusual condition after maintenance activities

3-1. Prospect troubles and trouble shootings

Unusual condition of facilities and actions of remedy is described in ABS-WTP05-QC.
- Not uniform flow from effluent notches
- A big amount of adhesion of algae on wall of a basin or effluent channel
  - Check free chlorine residual in clarified water
  - Review dosing rate of pre-chlorine and alum
  - Cleaning of effluent channel
- Leak of water from a basin
  - Repairing

4. Report and record

4-1. Records

Records for maintenance of sedimentation basin should include the following:
- Activity of cleaning
- Results of external check
- Result of internal check

4-2. Reports

Reports should be required for improvement of O&M activities. Reports should be improved are recommended as needed such as the following:

(1) Review of frequency of sludge drainage
(2) Review of operation methods of sludge collector
(3) Improvement of facility
(4) Upgrading or rehabilitation of facility
- Replacement of facility
- Repairing of facility

(5) Review of the criteria

Plant Name: **ABBASA W.T.P.**	Title **Sedimentation Basin**	SOP TAG No. **ABS-WTP05 –QC**

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1. Introduction

Condition of the water in a sedimentation basin and quality of effluent water from a sedimentation basin, should be checked and monitored. If quality is change to poor, check the operation condition of the process before sedimentation basin and modify the operation condition as needed.
Properness of coagulation process should be evaluated by quality of clarified water.

2. Criteria for water quality control

Criteria for clarified water quality control are as follows:
(1) Turbidity: Less than 2 NTU
(2) Residual chlorine: More than 0.5 mg/L
(3) Aluminum contains: Less than 0.15 mg/L
(4) Other items specified in Egyptian potable water standard should satisfy the specified value in the standard.

Bases of the criteria are as follows:
- High turbidity of a clarified water causes of the shortening of run time of a filter.
- Lower value of free chlorine residual causes of the growth of algae in a filter.
- Aluminum contained in clarified water should not be removed by the filtering.
- Almost of dissolved materials should not be removed by filtering.

3. Water quality control under normal condition

3-1. Water quality control for sedimentation basin

The water treatment process in a sedimentation basin is affected directly by the result of coagulation process.

In water treatment process on coagulation and sedimentation, water quality control should be performed mainly in coagulation process. Water quality control should not be ale to perform in sedimentation basin but to monitor the result of coagulation result. Various results of control in the previous processes are indicated in the quality of water from a sedimentation basin. These previous processes are included such as raw water flow rate, alum dosing rate and chlorination dosing rate, rapid mixing and slow mixing.

It is sure that fundamental function of removal of impurities in water is condensed in

coagulation and sedimentation process.

3-2. Impact of process and relation between other processes

3-2-1. Impacts of process

(1) Result of coagulation process is indicated the water quality in a sedimentation basin.
(2) High turbidities in the water leaving sedimentation are lead to poor performance of filtering.
(3) Change of water quality in a sedimentation basin will progress gradually and it will take approx. 2-3 days.

If control of coagulation process failed, operating condition of coagulation facilities will be changed. So, it will need 2 or 3 days to be evaluated the properness of control of coagulation process. Hence, it will need same days after changing of condition to make sure the result of change of operation condition.

- Detention time in sedimentation basin: Approx.2.5 hours
- Detention time in mixing basin and flocculation basin: Apprpx.0.5 hours
- Total detention time from start of coagulation to the end of sedimentation: Approx.3 hours

Though above mentions, changing place of water in a sedimentation basin will progress gradually. It will not be sufficient 3 hours and need more.

3-2-2. Relations between other processes or other facility

(1) Water quality of clarified water affects to efficiency of filtering work. Flocks, which should have been removed in the sedimentation basin, pass on to filters. This will result in reduced filter run times and poorer filtered water quality.

(2) The water treatment process is a chain of the several processes such as raw water intake and transferring, coagulation and flocculation, the sedimentation process.

(3) Water quality in sedimentation basin will be affected by operation condition of sludge drainage from the sedimentation basin. Insufficient of sludge drainage will cause of raise of flocks.

(4) Water quality in sedimentation basin will be affected by operation condition of sludge collector in the sedimentation basin. Insufficient of operation of sludge collector will cause of raise of flocks.

The step of water quality control for sedimentation basin is shown in ABS-WTP05-QCFC-02 as flow chart.

3-3. Start-up and shut-down procedures

During start up sequence, quality of clarified effluent should be monitored. Clarified

effluent will be able to lead into filters by change the valves after clarified water be stable in well. Water quality should be confirmed refer to criteria. Until condition of clarified water will be stable in well, monitoring and check of water quality of effluent should be carried out periodically. It needs by intervals of approx. 30min – 60min in usual.

From previous process the water flows into sedimentation basin through openings around bottom in side of a flocculation basin. There are no valves and no gates.

3-3-1. Start up from a condition without water in sedimentation basin (e. g. Restart after cleaning of basin)

In early stage of water filling into sedimentation basin, condition of the water from a flocculation basin will be unstable by flow with shocks, turbulent flow or short circuit flow. Hence, clarified effluent in early stage after restart should be drain out. In this stage, flow rate of the water from the distribution tower should be reduced and after water condition will be stable, flow rate will be able to increase gradually.

Procedures for restart after cleaning of sedimentation basin are shown by steps of work in ABS-WTP05-OPFC-01.

3-3-2. Shutdown of operation of a sedimentation basin

Shut down of sedimentation basin will be carried out in case of activity of periodical maintenance. Stop the water flow into the basin and drain out the water in the basin. If a basin will be shut down, distributed flow rate to the each basin should be increased under the condition in same total of flow rate of raw water.

Flow rate of raw water should be adjusted to suitable flow rate for numbers of sedimentation basin in work. If raw water flow rate will be changed, alum and chlorine dosing flow rate should be changed suitably.

3-4. Monitoring and visual check of process

The jobs of monitoring and visual check should be daily routine work in O&M activity. Unusual condition or trouble should be picked up in early stage by these jobs.

Monitoring and check list is provided in APPENDIX. This list should be reviewed periodically for maximize of value of jobs and improvement of works. Procedures for water analysis refer to documents in laboratory section.

4. Report and recording system

4-1. Records

Records should be kept under the following conditions:

(1) Operation condition

- Flow rate into a sedimentation basin
- Quality of raw water quality
- Dosing rate and flow rate of alum and pre-chlorine
- Frequency of sludge drainage
- Operation condition of sludge collector
  - Time in work
  - Rink with sludge drainage or not

(2) Unusual condition

- Excess of criteria of turbidity
- Excess of criteria of free chlorine residual as high or low
- Excess of criteria of containing of aluminum
- Unusual color of the water in the basin
- Arising of flocks in the basin

Records should require the following:

4-1-1. Results of water quality analysis

(1) Raw water

- Turbidity
- Break point and chlorine demands
- Other items as needed

(2) Clarified water

- Turbidity
- Free chlorine residual
- Containing of aluminum
- Color of the water in the basin

4-1-2. Raw water flow rate

- Total flow rate
- Flow rate into the No.1 distribution shaft
- Flow rate into the No.2 distribution shaft

4-1-3. Dosing rate of alum and pre-chorine

- Dosing rate of alum into the No.1 distribution shaft
- Dosing flow rate of alum into the No.1 distribution shaft
- Dosing rate of alum into the No.2 distribution shaft
- Dosing flow of rate of alum into the No.2 distribution shaft
- Dosing rate of chlorine into the No.1 distribution shaft
- Dosing flow rate of chlorine into the No.1 distribution shaft
- Dosing rate of chlorine into the No.2 distribution shaft
- Dosing flow rate of chlorine into the No.2 distribution shaft

4-1-4. Numbers of working of Flocculator

- Each sedimentation basin of new treatment line

4-2. Reports

Reports should be required for improvement of O&M and water quality control activities. Items should be improved are recommended as needed. Reports should include the following:

3-2-1. Analysis and evaluation regarding result of water quality analysis

3-2-2. Recommendation

- Review of water quality analysis works
- Review of O&M and water quality control works
- Review of the criteria
  - Modification of criteria
  - Additional criteria
  - Modification of utilize procedures of criteria
- Improvement of facility
- Upgrading or rehabilitation of facility

3-2-3. Materials for reports regarding general description

- Review of a plan for water quality control
- Review of O&M plan
- Review of training plan for O&M and water quality control works

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SOP Tag No. **ABS-WTP05 –QCFC01**	Title **Sedimentation Basin-Steps for restart of sedimentation basin**	Plant Name : **ABBASA W.T.P.**

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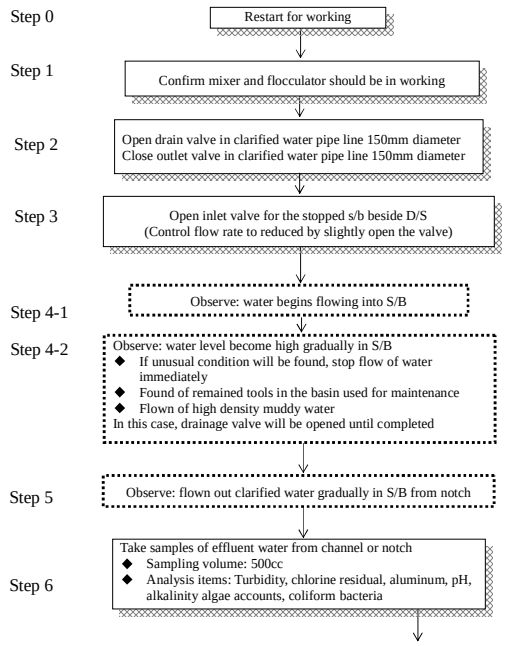

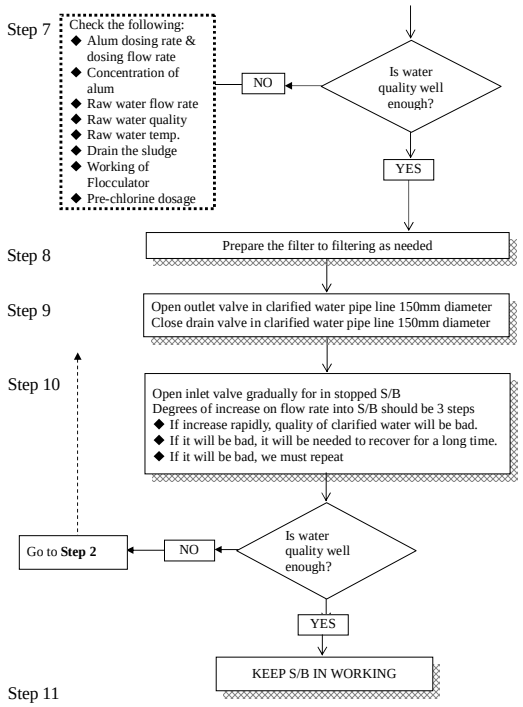

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Note:
D/S: Distribution Shaft
S/B: Sedimentation Basin

ABS-WTP05-QCFC02	Revised version	Issued date	Page 1 of 1

SOP Tag No. ABS-WTP05 –QCFC02	Title Sedimentation Basin-Water Quality Control	Plant Name : ABBASA W.T.P.

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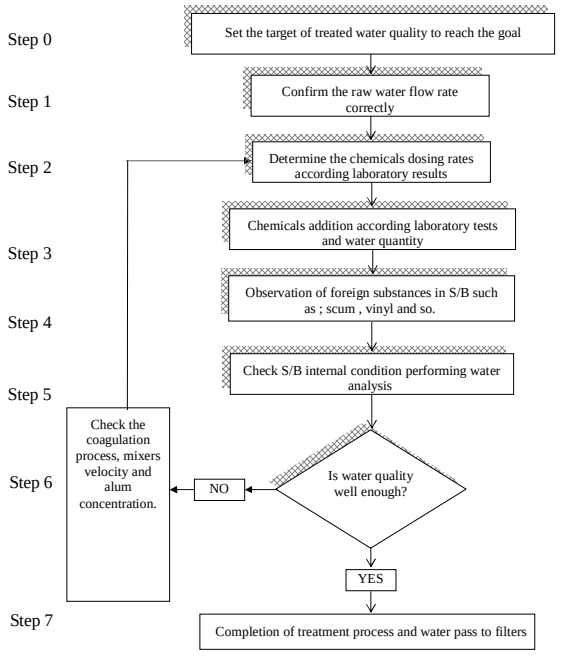

Plant Name: ABBASA W.T.P.	Title Sludge collector	SOP TAG No. ABS-WTP06-OP

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1. Description of facility

Sludge collector can be used to scrape the sludge on the bottom to the center part of the sedimentation basin. It consists of three (3) main parts and these are drive unit, scraper and moving bridge. The scraper is submerged under the water and moved with the moving bridge.

The drive unit is installed on the moving bridge and the scraper and the moving bridge is connected with steel arm. The settled sludge is scraped by scraper under the water with constant moving speed. The sludge collector will be operated continuously in a working period of the sedimentation basin.

Operation procedures of the sludge collector are very simple, that will be operation of ON/OFF switch on the switch board but operation to start must be conducted carefully. The outer end of the moving bridge of the sludge collector moves by a wheel on the inner edge of passageway of the sedimentation basin. If the moving bridge contacts with a person on the passageway, it will cause to sever damage of a human body. If the obstacles are there, it will be sever damage to the machine.

2. Impact of facility

The precipitated sludge is scraped by the sludge collector and gathered into the center gutter of the sedimentation basin and the gathered sludge is drained into the sludge drainage basin periodically. The sludge collector is essential auxiliary facility with the sedimentation basin same as the sludge drainage facility. It the sludge collector does not operate the sedimentation basin cannot be worked properly.

3. Relations with other facilities

3-1. Sedimentation basin

Operation of the sludge collector will be linked with operation of the sedimentation basin.

3-2. Sludge drainage

Operation of the sludge collector assists for working of the sludge drainage by gathering of the precipitated sludge to the center gutter.

4. Operation under normal condition

4-1. Start up and shut down

4-1-1. Pre-start check

(1) Check nobody is in a track of the bridge
- ◆ Nearby the passageway
- ◆ Nearby flocculator

(2) Check nothing obstacle is in a track of the bridge
- ◆ Nearby the passageway
- ◆ Nearby flocculator

(3) The sedimentation basin is working
(4) Electrical power supply is coming
(5) No damage of the machine and electrical wiring

4-1-2. Start up

After pre-start check completed the sludge collector can be operated by operation of a switch for ON/OFF on the switch board. If any unusual condition is found stop it immediately and cause of unusual condition should be investigated.

4-1-3. Shutdown

After stop working of the sedimentation basin the sludge collector should be kept working for 3 hours or more. Precipitation of the particles in the water of the sedimentation basin may need for 2 hours or more.

4-2. Monitoring and visual check

Monitoring should be required during operation to prevent from outbreak of serious situation by growth of slight trouble or unusual condition. Result of monitoring and check should be fed to the work for operation, maintenance or water quality control as feedback information.

Action of monitoring and check should be done securely in daily routine work. List of monitoring and check is provided in APPENDIX. Monitoring of the sludge collector will be mechanical part mainly.

5. Report and record

5-1. Record

Records for operation of the sludge collector should be required as following;

(1) Record of working time
(2) Record of trouble

5-2. Report

Reports for operation of the sludge collector during the day should include the following:

(1) Recommendation
- ◆ Upgrading or rehabilitation
- ◆ Recovery
- ◆ 3.Review of operation procedures

(2) Annual report
- ◆ Report of corrective action
- ◆ Report of preventive action

Plant Name: **ABBASA W.T.P.**	Title **Sludge collector**	SOP TAG No. **ABS-WTP06-MT**

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1. Introduction

Sludge collector usually consists of two (2) components, one submerged under the water and the other exposed in the air. Maintenance of the part in the air will be conducted under routine maintenance (oil leakage from drive unit). Maintenance of the part in the water will be conducted along with activities of cleaning of the sedimentation basin.

Maintenance for the part in the water will be difficult in routine work and chance of cleaning of the basin will not be conducted frequently. Frequency of maintenance chance for the part in the water will be once in 3 month or less. Hence, plan and schedule of maintenance activities for the part in the water should be prepared sufficiently.

2. Criteria for maintenance

(1) Frequency of inspection for the routine maintenance
(2) Frequency of inspection for the periodical maintenance
(3) Frequency of supplying of grease
(4) Frequency of overhaul of drive unit

3. Maintenance activity

Daily monitoring and check, and periodical inspection should be required to keep the machine in proper working. Maintenance activity shown herein means activity for the routine maintenance.

Maintenance activity consists of four (4) types of work components as follows:
(1) Monitoring and checking
(2) .Periodical inspection
(3) Evaluate and analysis regarding result of monitoring and check, and inspection
(4) Recovery e.g., repairing, replace, supply or change of oil and so.

3-1. Monitoring and visual check

Monitoring and visual check should be conducted for the part in the air such as the drive unit and moving bridge.

(1) External damage, vibration, temperature and unusual sound of the machine
(2) Overheating, leakage of oil or grease, unusual sound of drive unit

(3) Smooth moving of the machine
(4) Clearance between collector blade and bottom of basin
(5) Looseness of tightened parts
(4) Electrical current

3-2. Periodical inspection

Periodical inspection should be conducted for the part in the air such as the drive unit moving bridge and for the part in the water such as the scraper and the arm.

(1) Looseness, corrosion, wear, damage, condition of welding part, detached painting
(2) Leakage of oil or grease, quantity of oil or grease

3-3. Evaluation and analysis after monitoring and check, and inspection

Evaluation and analysis should be conducted under the thinking of prospect trouble and the risk, and a cost for maintenance activity.

3-4. Recovery

Activity of the recovery will be many kinds of work and part.
- ◆ Replace
- ◆ Repainting
- ◆ Adjustment and tightening
- ◆ Repairing
- ◆ Cleaning
- ◆ Change or supplying of oil or grease
- ◆ Overhaul of the drive unit

After inspection, evaluation and analysis optimum activity for recovery should be conducted. This activity should be conducted under the thinking of prospect trouble and the risk, and a cost for maintenance activity.

4. Report and record

4-1. Records

Records for maintenance of the sludge collector should include the following:
(1) Record of monitoring and visual check
(2) Record of inspection
(3) Record of recovery

4-2. Reports

Reports for maintenance of the sludge collector should include the following:

(1) Recommendation
- ◆ Recovery and rehabilitation
- ◆ Review of operation procedures
- ◆ Review of maintenance procedures
- ◆ Review of the criteria

(2) Annual report
- ◆ Report of corrective action
- ◆ Report of preventive action
- ◆ Report of the cost for activity of maintenance

Plant Name: ABBASA W.T.P.	Title: Sludge Drainage	SOP TAG No. ABS-WTP07-OP

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1. Introduction

Sludge drainage facility is included and attached in the sedimentation process. Sludge in the sedimentation basin should be removed periodically and according to the proper frequency. It cannot be confirmed by visually that condition of the precipitation of the sludge in the sedimentation basin.

Improper frequency of sludge drainage should cause to a poor water quality in the sedimentation basin as it leads to rapid chlorine consumption and also cause clogging in pipes and so sludge is precipitated on the bottom of the sedimentation basin. It is possible to determine the sludge quantity by calculating the contained clay and detention time inside the basin.

And according to this, the decision of the frequency of sludge drainage and time of remaining the valves opened is proper.

2. Description of facility

2-1. Function

Function of the sludge drainage facility is to drain out the precipitated sludge from the sedimentation basin into the sludge basin.

2-2. Impact

Improper frequency of sludge drainage should cause to a poor water quality in the sedimentation basin and cause of increase of frequency of cleaning basin. And therefore the basin will be out of service for short period.

2-3. Relation between other facilities

2-3-1. Sedimentation basin

Sludge drainage facility will be recognized as a essential part of the sedimentation basin.

2-3-2. Sludge collector

Sludge precipitated on the bottom of the sedimentation basin is collected into the center gutter in the basin by sludge collector. Operation of sludge drainage will linked with operation of sludge collector. However, usually sludge collector will be operated continuously.

2-3-3. Sludge drainage basin

Sludge transfer from sedimentation basin and back washing water through sludge drainage network to sludge drainage basin. After receiving, a sludge water will be drain out to the canal by the drainage pump according to the water level of the sludge drainage basin.

Sludge drainage from the sedimentation basin should be conducted one by one about 6 sedimentation basins. Sludge drainage cannot be conducted at the same time with filter backwashing.

3. Criteria

3-1. Frequency of drainage

- ◆ In case of low or medium turbidity: At least once a day
- ◆ In case of high turbidity as more than 30 NTU: Twice a day or more

3-2. Time in operation of drainage

Operating time for drainage shall be 15 min or more. Monitoring should be needed for drained sludge at the sludge drainage basin.

4. Operation under normal condition

4-1. Startup and shutdown procedures

4-1-1. Pre-start check

The sedimentation basin operated should be selected.

(1) The water level in the sludge drainage basin
Water level should be sufficient for sludge drainage.
(2) Filter backwashing is not in progress
(3) The water level in the clear water reservoir is sufficient

4-1-2. Start and stop

(0) Supply the water into the ejector for vacuum arise
(For old plant line only)
(1) Operate the bridge in the sludge collector facility a complete cycle
(2) Open the valve for the sludge drainage
(3) Wait approx.15 min in drain out
Confirm the drained sludge by visually of by sampling
(4) Continue the drainage if necessary
(5) Close the valve for the sludge drainage
(6) Stop the supplying of the water into the ejector for vacuum arise
(For old plant line only)

(7) Check no leakage of the water at the end of pipe of the sludge drainage

4-2. Monitoring and visual check during operation

It should be conducted each sludge drainage by prepared check list. If unusual condition will be found, corrective action should be conducted immediately.

4-3. Operation for control

The only way to control the operation is visual check and monitoring of the drained water either for quantity or turbidity.

5. Operation under unusual condition

5-1. Prospect troubles and trouble shooting

(1) Clogging in the drainage pipe
(2) Sludge is not drained but only water is coming out
(3) Many flocks is arising in the sedimentation basin

Trouble shooting is shown as ABS-WTP07-OPTS-01.

6. Reports and records

6-1. Records

Records for operation of the sludge drainage should include the following:

(1) Time in operation of each drainage
(2) Operation condition
- ◆ Drained sludge quality and quantity

(3) Water level in the sludge drainage basin
(4) Unusual condition of the sludge drainage

6-2. Reports

Reports for operation of raw water intake should include the following:

(1) Unusual condition in working
(2) Monthly report
- ◆ Time in operation of each sludge drainage
- ◆ Recommendation on operation

(3) Annual report
- ◆ Time in operation of each pump
- ◆ Recommendation on operation

Plant Name: ABBASA W.T.P.	Title: Sludge Drainage	SOP TAG No. ABS-WTP07-MT

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1. Introduction

Maintenance for the sludge drainage facility will be conduced with a cleaning work of the sedimentation basin mainly. However the precipitated sludge should be drained out from the sedimentation basin through the drainage pipe, once in a while the remaining sludge on the bottom or the center gutter of the sedimentation basin will be observed.

Activity for maintenance of the sludge drainage facility will be to keep the work of sludge drainage sufficient and smooth. Clogging of the drainage pipe will be connected to a stop working of the sedimentation basin and if main drainage pipe will be clogged all of the sedimentation basins will be stopped.

2. Criteria for maintenance

- Frequency of the pipe flushing of the drainage pipe: Once a year

3. Maintenance activity

Monitoring, check and inspection should be carried out to judge necessity of recovering activity such as adjustment, repairing or replacing. Unusual condition of the sludge drainage facility will be confirmed by the monitoring results of the following:

(1) Water condition under treatment in the sedimentation basin
- Turbidity
- Condition of flocks in the water

(2) Condition of the drained sludge
- Quantity
- Quality

Maintenance activity consists of four (4) kinds of works as follows:
- Monitoring and checking work during working
- Inspection
- Evaluate and analysis regarding result of inspection
- Recovery after the inspection

3-1. Monitoring and visual check

Monitoring and visual check should be carried out according to "O&M schedule" and unified

check list, and it will be conducted with the monitoring activities for the sedimentation basin.

3-2. Inspection

Inspection should be carried out according to "O&M schedule" and unified check list and it will be conducted with the inspection activities for the sedimentation basin. Causes of the trouble in operation for the sludge drainage should be removed in such manners as follows:

- Depth of the remaining sludge on the bottom and the center gutter
- Foreign substances such as wooden block or vinyl
  - On the scraper of the sludge collector
  - On the bottom
  - In the center gutter
- The drainage valve
  - External condition
  - Sealing condition
- Leak or clogging around pipe

3-3. Evaluate and analysis regarding inspection result

After inspection, following items should be evaluated.
- Operation pattern of the sludge collector
  - Frequency and time in operation of the sludge drainage
- Monitoring items of the sedimentation basin
- Operation condition of the drainage valve

3-4. Recovery after the inspection

After the inspection, recovery action should be conducted as follows when needed:
- Repainting
- Cleaning of inside of the drainage pipe
- The drainage valve
  - Supplying the grease as needed
  - Change of part as needed
  - Replace the valve incase of repeating or difficulty of repairing

4. Reports and records

4-1. Records

Records for maintenance of the sludge drainage should include the following:

(1) Record of monitoring and visual check
(2) Record of inspection
(3) Record of recovery

4-2. Reports

Reports for maintenance of the sludge drainage should include the following:

4-2-1. Recommendation

(1) Modifying of operation of the sludge drainage
- Frequency
- Time in operation of the sludge drainage

(2) Frequency of cleaning of the sedimentation basin

(3) Activity of recovery and rehabilitation
- Drainage valve
  - A part of the valve
  - Valve itself
- Drainage piping
  - Pipes
  - Gasket
  - Bolt and nut
- Repairing
- Repainting

(4) Upgrading and improvement
- Modifying of the system
  - Addition or delete of facility
  - Change of a shape or a structure
  - Change of a type or diameter

(5) Review
- Criteria
- Operation procedure
- Maintenance procedure

4-2-2. Annual report

(1) Analysis report for trouble and recovery
(2) Waste water quantity by sludge drainage

Plant Name: ABBASA W.T.P.	Title: Rapid Sand Filter	SOP TAG No. ABS-WTP08 –OP

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1. Features of process

1-1. Function of the filtration in the treatment processes

The function of the filtration process in the treatment processes is the complete removal of flocks and suspended materials from the water resulted after sedimentation basin by restrain these materials in the sand layer and getting the required quality of water according the International and Egyptian Standard for potable water.

1-2. Description of process

Filtration is the removal of flock and solid suspended from the water after it has passed thorough the sedimentation basin.

The filtration process is more complex than to described as a straining but the light flock carried on the filter media from sedimentation basin adheres to the grain of the filter media and this coating penetrates into the filter bed. This coating on the filter media attracts the suspended particulate matter which enhances the filtered water quality. This coating continues to build on the filter media and attracts more of the flock and suspended particulate matter. Then the water passes through the deep filter layer then to the ground reservoir.

When this layer reaches the density that avoids the water passages then we need to start back-washing to start forming a new coat layer which increase the efficiency of filtration.

1-3. Impacts of process

Filtration is the final process for treatment processes, removing impurities and suspended materials to reach the required degree of transparency to get safe potable water. Then the last stage is to inject the post chlorine in the ground reservoir to disinfect water and make an amount of residual chlorine exist inside distribution system.

1-4. Relation between other processes

(1) Previous process (sedimentation process)
- Removing algae and suspended materials
- Existence of residual chlorine to disinfect filter sand
- Quantities of water transferring to filters

(2) Subsequence process (disinfect by post-chlorine)
- Relation factor

- Characteristics of the water outlet water from sedimentation basin
- Quantity and volume of flocks escaping from this water

◆ Affecting factor
- Quality of water after sedimentation
  - Turbidity
  - Volume and quantity of flocks
  - Concentration of residual chlorine

◆ Back-washing for filters
- Runtime for filter
- Efficiency of back-washing
- Adjusting water level over filter media
- Compensate the flown out sand from filter media resulting after repeating back-washing

2. Characteristics of operation activity

Characteristics of the operation activities are the indicators concerns the operator knowledge extent of correct operation rules and in case of not existing of these characteristics, we can not judge the efficiency of operation and therefore no corrective actions can be achieved to oblige the operator following these characteristics and reaching best operation.

We have to know the design criteria and characteristics to determine the operation criteria. We use characteristics of design at the beginning of design stage and during the construction of the water treatment facilities and from these characteristics flow rate, number of proper units, operation limit and so on.

These facilities include:

(1) Filter
- ◆ Filter dimensions (length-width-depth)
- ◆ Filter bed (Filter under drain-nozzle-H-block etc.)
- ◆ Filter surface load (flow rate/surface area)

(2) Filter media
- ◆ Filter sand (depth-grading-effective size)
- ◆ Gravel (depth-grading-effective size)

(3) Operation, monitoring, and control device for a filter
- ◆ Head loss meter
- ◆ Control device for filtering rate
- ◆ Gradual start mechanism

(4) Filtering backwashing equipment
- ◆ Blowers
- ◆ Backwashing pumps
- ◆ Flow meters

(5) Auxiliary equipment

- ◆ Compressor for hydraulic actuation of the valves
- ◆ Piping and valves
- ◆ Filtered water basin

3. Criteria for operation

We use operation criteria to judge the operation efficiency and to obligate the operators to operate the facility with proper operating parameters for the water treatment facilities and processes witch include;

- ◆ Filtration rate: 120 - 150 (m3/m2/d)
- ◆ Head loss should be wash: 2 (m) or less
- ◆ Operation target of filter washing frequency: 24 hours at least
- ◆ Treatment target of filtered water quality:
  - Turbidity: 0.5 NTU or less
  - Free chlorine residual: 0.5 mg/l or more and 1.5 mg/l or less
  - Dissolved Aluminum: 0.15 mg/l or less
- ◆ Replacing frequency of filter media: Once 10 years or less
- ◆ Scoping frequency of filter media: Once 6 months or less
- ◆ Filter washing water:
  - Air scouring flow rate: 0.8 – 1.5 (m3/m2/min)
  - Backwashing flow rate: 0.6 - 0.8 (m3/m2/min)
  - Air scouring operating time: 5 min
  - Combined wash operating time: 6 min
  - Backwashing operating: 5 min

  The above operating time should be checked periodically for check procedures refer to SOP of filter refreshment
- ◆ Reference criteria

  Following criterion is for coagulation and sedimentation process, but this criterion has tight relation with efficiency of filtering process. Treatment target of clarified water quality
  - Turbidity 2.0 NTU or less
  - Free chlorine residual: 1.5 mg/L or less
  - Dissolved Aluminum: 0.15 mg/L or less

4. Operation under normal condition

4-1. Operation for a filter

Following operations should be required for a filter;

(1) Startup for filtering

Common procedures

1. Open inlet valve of filter.

2. Open outlet valve of filter and control filtering rate by regulating valve.

(2) Shutdown for filtering

1. Close outlet valve of filter.
2. Close inlet valve of filter.

(3) Startup for washing of a filter
- ◆ Air scouring
- ◆ Combined washing of air scouring with backwashing
- ◆ Backwashing

(4) Shut down for washing of filter
- ◆ Stop back-washing
- ◆ Clarified water inlet and continuous closing outlet valves
- ◆ Gradual opening for out let valves after formation of surface coating

(5) Control the filtering rate

After washing of filter filtering rate will be increase, hence filtering rate shall be controlled by regulating valve. Filtering rate shall be less than 120 m/d.

5. Reports and records

5-1. Records

Records for operation of filter should include the following:

(1) Operating condition
- ◆ Flow rate
  - Raw water
  - Clarified water
  - Filtered water

(2) Data of background on operation
- ◆ Filtering rate in each line of old and new
- ◆ Dosing rate and flow rate of alum and pre-chlorine
- ◆ Specifications of back wash and air scouring
- ◆ Frequency of filter washing
- ◆ Head loss at starting of filter washing
- ◆ Disinfection data in the past
  - Name of applied disinfectant such as bleach and sodium hypo-chloride
  - Date of recent implementation
  - Method and procedures for disinfection

5-2. Report

Reports for water quality control of filter should include the following:

4-2-1. Recommendation as needed

(1) Maintenance of filter layer
- ◆ Change of filter media

- ◆ Supplying of filter sand
- ◆ Scooping of surface of filter sand
- ◆ Disinfection of filter layer
- ◆ Cleaning of inside of filter basin

(2) Change of dosing rate and flow rate of alum and pre-chlorine

(3) Change of frequency of filter washing

(4) Change of head loss at starting of filter washing

(5) Change of specifications of back wash and air scouring
- ◆ Time of air scouring, backwashing and combined washing
- ◆ Flow rate of air for air scouring
- ◆ Flow rate of air for backwashing

(6) Change of specification of disinfection of filter layer
- ◆ Frequency
- ◆ Methods and procedures

(7) Change of target of filtered water quality

(8) Change of target of clarified water quality

4-2-2. Result of recovery of trouble or unusual condition

(1) Description of unusual or trouble condition

(2) Sequence event leads to unusual or trouble condition

(3) Damage of influence
- ◆ - A damage of human body
- ◆ - A damage of facility
- ◆ - A damage of water quality
- ◆ - A damage of environment
- ◆ - The amount of damage
- ◆ - The influence area of damage
- ◆ - Others

(4) Activity for recovery
- ◆ Procedures according to steps of activity
- ◆ Parts or facility for recovery
- ◆ Days to solve the trouble

(5) Description of similar case in the past

4-2-3. Corrective and preventive action for water quality control

- ◆ Unusual condition happened in ABBASA WTP
- ◆ Essential cause and background
- ◆ Steps to prevent from a similar event lead to unusual condition

Plant Name: ABBASA W.T.P.	Title: Rapid Sand Filter	SOP TAG No. ABS-WTP08 –MT

Issued		Developed by		Signature	
Revised		Approved by		Signature	

1. Introduction

Relationship between operation and maintenance, and the water quality control is tightly each other especially in filtering process. Activity and result of the operation and maintenance affects to effectiveness of facility and quality of water, especially in filtering, O&M activity.

2. Criteria for maintenance

Criteria for maintenance of rapid sand filter are shown below:

2-1. Criteria of frequency for maintenance

(1) Inspection of sand layer
(2) Replacing of sand layer
(3) Inspection of under drain
(4) Disinfection of filter media
(5) Inspection of control device of filtration rate

2-2. Criteria for judgment

(1) Improper of filter sand
(2) Improper of filter basin
(3) Improper of filtration rate
(4) Improper of filter washing

3. Maintenance activity

Monitoring, check and inspection should be carried out to judge necessity of recovering activity such as adjustment, repair or replacement. Maintenance activity consists of four (4) kinds of works as follows:
(1) Monitoring and checking during the maintenance work
(2) Inspection
(3) Evaluation and analysis regarding the result of inspection
(4) Repair or replacement including check after the work

3-1. Maintenance of filter layer

Improper condition of filter layer may make filtered water quality worse and connect to acceleration of waste in filter layer further more. As a result, we will have to replace whole of filter sand in a short period. To avoid above, conduct periodical monitoring and check about filter layer should be required periodically.

When unusual condition is found about filter layer, prompt corrective action should be carried out such as improvement of filter washing formation or supply of filter sand. Investigation of filter layer should be included as following;

- Distribution of degree of sand grain
- Waste degree of filter layer
- Existing of mud ball
- Existing of algae
- Existing of other waste such as adhesion substances
- Irregularity of filter layer
- Existing of crack or crater
- Existing of clearance beside of wall

A plan for maintenance of filter layer should be issued and maintenance activities for filter layer should be carried out according to this plan.

3-2. Monitoring and check

3-2-1. Usual monitoring and check

Description of inspection	Interval
(1) Check of water level in filter basin	Daily
(2) Check of filtered water quantity, filtration rate, head loss of filter layer, filter run time	Daily
(3) Check of filtered water quality (turbidity, free chlorine residual, pH, alkalinity, etc.	Daily

3-2-2. Periodical inspection

Description of inspection	Interval
(1) Check waste adhesion on inside wall, drain trough in filter basin	Every 2-6 months
(2) Check water leak, cracks, damage of filter basin inside	Every 2-3 years
(3) Check of filter layer quality (waste, mud ball, effective diameter and, uniformity, depth of filter sand layer)	Every 1-3 years
(4) Check of moving of the gravel layer	Every 1-3 years
(5) Check working condition of flow rate controller	Once a year
(6) Check working condition of head loss meter	Once a year
(7) Check of condition of under drain	Every 10-15 year

(8) Check of flow rate and time formation for filter washing	Every 2-6 months
(9) Monitoring of filter washing (e.g. flow out of filter media, malfunction of filter washing facility, improper condition of filter layer after washing such as crater, and so)	Every 3-4 days
(10) Check turbidity of water of filter washing waste	As required

3-2-3. Detail inspection and check (rehabilitation)

Description of inspection or rehabilitation	Interval
(1) Additional supply of filter sand	As required

3-3. Evaluate and analysis of result after inspection

Description of inspection	Criteria
(1) Check of water level in filter basin from sand surface	1.0 m or more
(2) Check of clarified water quantity	According flow rate
◆ Turbidity	5 NTU of less
◆ Residual chlorine	1.5 mg/L or more
◆ Aluminum content	0.15 mg/L or less
(3) Check of filtration rate	120 m^3/m^2/day or less
(4) Check of head loss of filter layer	2 m or less
(5) Check of filter run time	24 hours or more
(6) Check of filtered water quality (turbidity, residual chlorine, pH, alkalinity, etc.)	
◆ Turbidity	0.5 NTU of less
◆ Residual chlorine	0.5 mg/L or more
◆ Aluminum content	0.15 mg/L or less
◆ pH, alkalinity, etc.	Not more than Egyptian standard for potable water quality
(7) Monitoring of filter washing (e.g. flow out of filter media, malfunction of filter washing facility, improper condition of filter layer after washing such as crater, and so)	According to the situation
(8) Check of flow rate for filter washing	Turbidity of washed drain: 10 NTU or less
(9) Check of time formation for filter washing	Turbidity of washed drain: 10NTU or less
(10) Check turbidity of water of filter washing waste	Turbidity of washed drain:10 NTU or less
(11) Volume of sand layer	Decrease of 10% or less of initial volume

4. Reports and records

4-1. Records

Records for maintenance of rapid sand filter should include the following:
(1) Monitoring and visual check
- ◆ Check list for monitoring

(2) Inspection
- ◆ Check list for inspection

4-2. Reports

Reports for maintenance of rapid sand filter should include the following:
(1) Periodical maintenance report
(2) Corrective maintenance report
(3) Result of recovery of trouble or unusual condition
(4) Recommendation to O&M and improvement of facility

Plant Name: **ABBASA W.T.P.**	Title **Rapid Sand Filter**	SOP TAG No. **ABS-WTP08-QC**

Issued	18/sept./07	Developed by		Signature	
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1. Criteria for water quality control

1-1. Filtered water quality

Filtered water quality should satisfy the following criteria:

- Turbidity: 0.5 NTU or less
- Free chlorine residual: 0.5 mg/L or more and 1.5 mg/L or less
- Containing of aluminum: 0.15 mg/L or less

1-2. Turbidity of drained water by backwashing

Filter washing drainage water quality should satisfy the following:

- Turbidity: 5 NTU or less

2. Procedures for water quality control under normal condition

2-1. Monitoring and check

Monitoring and checking are conducted to confirm change of water quality and change of operating condition in the process. The process can not be controlled without monitoring and criteria to judge something in proper.

Filtration process is the final stage to remove turbidity in the process water. Hence, we must deliver the filtered water with same or higher quality than the Egyptian standard for potable water quality. After filtration post-chlorine should be dosed into the water to adjust final free chlorine residual in water of transmission and customer's tap. Monitoring steps are shown by flow chart in ABS-WTP08-QCFC-01

3. Procedures for water quality control under unusual condition

3-1. Prospect troubles and trouble shootings

Refer to WTP08-QCTS-01 "Trouble Shooting for Filter".

Trouble shootings consist of four (4) categories as follows:

(1) Unusual water quality and actions of remedy
(2) Unusual water quantity and actions of remedy
(3) Unusual filter layer and actions of remedy

(4) Other unusual and actions of remedy

4. Reports and records

4-1. Record

Records for water quality control of filtering process should include the following:

(1) Water quality of raw water
(2) Water quality of clarified water
(3) Water quality of filtered water
(4) Water quality of drain water after filter washing
(5) Data for background of water quality
    - Filtering rate and flow rate of raw water in each line of old and new
    - Dosing rate and flow rate of alum and pre-chlorine
    - Specifications of back wash and air scouring
    - Frequency of filter washing
    - Head loss at starting of filter washing

4-2. Report

Reports for water quality control of filtering process should include the following:

(1) Periodical report for water quality control
    - Trend of change of raw water quality
    - Change according to weather such as seasonal change
    - Change according to water level of canal
    - Change of source basically
    - Trend of change of filtered water quality
    - Change according to clarified water
    - Change according to filtration rate
    - Change according to loss head
    - Change according to other condition
(2) Result of recovery of trouble or unusual condition
    - Description of unusual or trouble condition
    - The Sequence event leads to unusual or trouble condition
        - Damage of facility
        - Damage of water quality
        - Damage of environment
        - Amount of damage
        - Influenced area of damage
    - Activity for recovery
        - Procedures according to steps of activity
        - Parts or facility for recovery
        - Days to solve the trouble

        - Description of similar case in the past
(3) Corrective and preventive action for water quality control
    - Unusual condition happened in ABBASA WTP
    - Essential cause and background
    - Steps to prevent from a similar event lead to unusual condition
(4) Recommendation
    - Modification or arrangement of O&M activity
    - Recovery and rehabilitation of facility such as repair and replacing.
    - Improvement of facility such as upgrading or modification.
    - Modification for activity of water quality control
    - Review of SOP document

Title **Rapid Sand Filter**	SOP No: WTP08-QC
Document Name **Trouble Shooting**	Document No. WTP08-QCTS01

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1. Unusual water quality

Unusual condition	Reason	Remedy
1.In working of filter		
1-1.Unusual of clarified water		
1-1-1. Becoming clouded	Failure of coagulation	Control coagulation process
1-2.unusual of filtered water		
1-2-1.leak of turbidity More than 0.5 NTU	Shortage of coagulant	Increase alum dosing rate
	Insufficient filter washing	Change washing formation
	Negative pressure filtration	Shortening of wash interval
	Abnormal of filter layer, under drain	Inspection and repair
1-2-2.Leak of aluminum More than 0.15 mg/l	Insufficient filter washing	Change washing formation
	Negative pressure filtration	Shortening wash interval
	Excess of alum dosing	Adjust to proper
	Shortage of alum dosing	Adjust to proper
2.After replace of sand		
2-1.Insufficient free chlorine residual Less than 0.5 mg/l	Insufficient free chlorine residual of clarified water	Adjust pre-chlorine dosing rate
	Insufficient of disinfection of filter layer	Disinfect more Continue filter and drain
2-2.Insufficient turbidity More than 0.5 NTU	Insufficient washing of sand	Wash more
	Excess of filtration rate	Control to proper

2. Unusual water quantity

Unusual condition	Reason	Remedy
1.High head loss	Insufficient washing of sand	Wash more
		Change washing formation
	Insufficient scooping of fine sand in sand surface	Scoop more
	Over fine of sand grain	Observe in working
		Replace of sand
	Breeding of plankton in filter	Shortening of wash interval
		Cleaning of sedimentation
		Increase of pre-chlorine
	Negative pressure filtration	
2.High initial head loss	Insufficient scooping of fine sand in sand surface	Scoop more
	Insufficient washing of sand	Wash more
	Foreign matter in filter layer	Remove foreign matter at sedimentation basin and filter basin
3.Abnormal of filtering flow rate	Malfunction of device for control flow rate	Inspection of device for control flow rate
4.Appearance of bubble from the water in a filter	Negative head loss	Avoid negative head loss
		Do not rapid change of filtering rate

3. Unusual filter layer

Unusual condition	Reason	Remedy
1.Flown out of sand	Excess of washing rate	Refer to attached paper
	Getting mix of air in wash water	Adjust of grand packing of washing pump Check of pipe line
	Excess of air scouring rate	Check opening of control valve for air scouring
2.Happening of crater on sand layer	Flown out of sand cause of under drain damage	Check under drain and repair as needed
3.Mud ball or crack in sand layer Gap between wall and sand layer	Insufficient of filter washing Confirm turbidity of washed drain: 5 NTU or less	Change washing formation Maintenance of sand layer

4. Other unusual condition

Unusual condition	Reason	Remedy
1.Power failure	----------	Act according to plan
2.Not uniform flow into drain trough	Not uniform level of drain trough	Adjust to uniform
3.Water leak from filter basin	Damage of structure	Investigate structure Take out and inspect sand
4.Waste of wall or drain trough	Adhesion of organics without free chlorine residual	Cleaning and check free chlorine residual in clarified water

Histories of revision

Rev.	Version	Revised Date	Description of revision
0	Original Version	23/sept/2007	Draft version

Plant Name: **ABBASA W.T.P.**	Title **Filter Wash Facility**	SOP TAG No. **ABS-WTP09 –OP**

Issued	02/Oct/07	Developed by		Signature	
Revised		Approved by		Signature	

1. Introduction

Filtration is the last treatment stage that can physically remove contaminants before disinfection. The effectiveness of this stage is therefore very important on water quality control, because particles in the water hinder germs being killed by the disinfectant, and because the large germs that cannot be killed by chlorine have to be physically removed.

Filter backwashing affects to filtering efficiency. Since this facility is important same as filtering facility we must check, maintain, and monitor and control the water quality usually.

2. Features of process

2-1. Function of facility

Function of filter washing facility is to cleanse the filter media of flock and particulate matter. Filtration coating builds and penetrates into the filter bed, and the head loss across the filter becomes greater until the flow rate is greatly reduced and at the time the head loss reach the allowable maximum limit or the minimum filtration flow rate, the filter must be backwashed to clean the media and renewing the filtration effect.

2-2. Impacts of facility

Filer washing must be carried out periodically to keep the function of filtration in proper. Therefore, filter backwash facility should be united with rapid sand filter. Filter washing facility is indispensable one for filtering process.

2-3. Relations between other processes

2-3-1. Water for backwashing

Water for backwashing is used filtered water in filtered water basin in new plant line. In old plant line backwash water is supplied to head tank through branched pipe from network pipe line.

2-3-2. Backwashing drainage from filter

Drainage from the filter in old plant line flows into old drainage basin. Drainage from the filter in new plant line flows into new drainage basin.

3. Criteria for operation

Control of filtering process should require the following;

(1) Water quality
- ◆ Monitoring of clarified water
- ◆ Monitoring of filtered water

(2) Flow rate of the water
- ◆ Control of flow rate of filtered water
- ◆ Control of flow rate of clarified water

(3) Loss head of filter layer
- ◆ Monitoring of loss head
- ◆ Upper limit of loss head for running of a filter

(4) Filter washing
- ◆ Control of frequency of filter washing
- ◆ Procedure for filter washing cycle

(5) Turbidity of drain water after filter washing
- ◆ Monitoring of turbidity

Only three (3) items can be controlled in operation of filter as follows:
- ◆ Flow rate of filtered water
- ◆ Frequency of filter washing
- ◆ Procedure and specification for filter washing

The capability required to activity of filter washing is following;
- ◆ Suitable quantity for backwashing water
- ◆ Suitable time in operation for filter washing
- ◆ Flown out of filter sand does not appear

3-1. Filter backwashing criteria

(1) Air flow rate for air scouring: 0.8-1.5 8m^3/m^2/min)
(2) Water flow rate for backwashing: 0.6-0.8 (m^3/m^2/min)
(3) Run time for air scouring: 7 (min)
(4) Run time for combined washing: 3 (min)
(5) Run time for backwashing: 10 (min)

3-2. Upper limit of loss head for running of a filter: 2 (m) or less

3-3. Water level in starting of air scouring: 15-20 cm as depth from sand surface

3-4. Reference criteria

(1) Turbidity of drain water after filter washing: 5 NTU or less
(2) Properness of filter washing should be evaluated by turbidity of drain water after filter

washing. And also it should be evaluated the flown out of filter sand does not appear.

(3) Filter sand should be checked periodically to confirm properness of filter washing.

(4) Procedure and specification for filter washing cycle should be modified by result of above to be effective and suitable furthermore.

4. Operation under normal condition

4-1. Startup and shutdown procedures for filter washing

Startup and shutdown procedures for filter washing are referred to ABS-WTP09-OPFC01.

Common procedures

1. Confirm water level in sludge drainage basin and check water level is low enough to receive filter washing drainage water.
2. Close inlet valve for filter and keep open outlet valve of filter.
3. Confirm water level in filter and close outlet valve when water level reached to approx.15 cm from filter sand surface.
4. Open drainage valve of filter.
5. Open scouring air inlet valve of filter and operate switch of blower panel to start.
6. Keep running blower for 7minutes.
7. After passed for 7 minutes of scouring starting, operate switch of backwashing panel to start and open inlet valve for backwashing water.
8. Keep running blower and backwashing pump for 3minutes.
9. After passed for 3 minutes of scouring and backwashing, stop blower and close scouring air inlet valve of filter.
10. Keep running backwashing pump for 10minutes.
11. After passed for 10 minutes of backwashing, close inlet valve for backwashing water and stop backwash pump.
12. After backwash drainage water is flown out from filter basin, close drainage valve of filter.
13. Confirm water level in sludge drainage basin and check water level is low enough to receive filter washing drainage water for next filter washing.
    If water level is not low enough, sludge drainage water in sludge drainage basin shall be drained out to outside of the plant by operation of sludge drainage pump.

4-2. Monitoring and visual check of facility

Steps and monitoring and visual check are shown in ABS-WTP09-OPFC-01.

4-3. Control of filter washing

Controllable operation should be the following:

(1) Frequency of filter washing

(2) Procedure and specification for filter washing

4-3-1. Frequency of filter washing

Frequency of filter washing should affect to efficiency of operation in water treatment plant such as volume of waste water and electrical power consumption. And it will affect to chemical and chlorine consumption indirectly.

Frequency of filter washing should be reduced as possible as we can. However, too long of run time of filter will cause of waste of sand layer up to deep zone or break through of particle to the filtered water. In the filter of single filter media type, filter run time will be less than approx. 72 hours. Suitable run time as target goal of improvement of performance will be 48 hours.

4-3-2. Procedure and specification for filter washing

Following works are required for achievement of above targets:

(1) Severe control of water quality of clarified water by severe control of coagulation and sedimentation process

(2) Severe control of filtration rate

(3) Optimization of filter washing operation

5. Operation under unusual condition

Trouble shooting is shown in ABS-WT08-QCT5.

6. Reports and records

6-1. Records

Records for filter washing facility should include the following:

6-1-1. Records of filter washing

- Filter washing procedure
- Time and flow rate of air scouring
- Time and flow rate of backwashing
- Time and flow rate of combined washing
- Head loss at starting of filter washing
- Result of Monitoring and check
- Turbidity of drain water after backwashing

6-1-2. Record of blower for air scouring

- Time of start and stop
- Number in operation
- Electrical current during operation

- Result of monitoring and check

6-1-3. Record of pump for backwashing

- Time of start and stop
- Number in operation
- Flow rate of backwashing
- Electrical current during operation
- Result of monitoring and check

6-2. Reports

Reports should include the following:

6-2-1. Recommendation

- Filter washing procedure and specification
- Replace or supplying of sand
- Inspection of under drain
- Maintenance of facility such as blower or pump and so.
- Cleaning of filter basin

6-2-2. Operation report

- Consumption of water volume use for backwashing
- Free residual chlorine in backwash water
- Turbidity of backwashing

Plant name	Title:	SOP No.
ABBAS W.T.P.	**Filter Washing Facility**	**ABS-WTP09-OP**
Document Name	Document Title	Document No.
Flow Chart	**Steps for Filter washing in new plant line**	**ABS-WTP09-OPFC-01**

Issued		Developed by		Signature	
Revised		Approved by		Signature	

1. Facility for filter washing

Facilities for filter washing are as follows:

- Air scouring: By roots blower
- Backwashing: By backwash pump
- Valve: Pneumatic valve

2. Steps for the filter washing

2-1. Trigger of filter washing

Filter washing will start by which backwash pump is driven.

(1) Filter washing by fixed time in a day

In this mode of filter washing, the filter wash will be started by trigger of fixed time in a day. Filter running time will be fixed as 24 hours and it is preferable not to be done at the peak hourly demand.

(2) Filter washing by head loss

In this mode of filter washing, the filter wash will be started by trigger of indication of specified head loss of filter sand. Filter run time will be not fixed.

2-2. Steps for filter washing in new plant line

STEP 0: Check water level in sludge drainage basin

STEP 1: Close the pneumatic valve for inlet of clarified water to a filter.
Keep opened the valve of outlet of filtered water.
Wait until water level will decrease to approx.15cm depth from sand surface.

STEP 2: Check the water level in filtered water basin of 1st extension.

STEP 3: Select the pump and blower to be operated and turn the change over switch to the selected side on the switch board.

STEP 4: Confirm the manual operated valve should be opened or closed.

STEP 5: Open the pneumatic valve for backwashing drainage and start the blower.

STEP 6: Confirm the condition of air bubbling by watching the surface water in a filter, and

it should be sufficient of air discharge volume and uniformly bubbling.

STEP 7: Start backwashing pump to be operated and open the pneumatic valve for backwashing. Start of combined washing and keep above 3 min.

STEP 8: Close the pneumatic valve for inlet of air scouring valve for a filter.
After closed the valve, blower should be stopped immediately.
Keep above 10 min. Start of backwashing.

STEP 9: Close the pneumatic valve for backwashing.
After closed the valve, back washing pump should be stopped immediately.

STEP10: After flown out the backwashing drainage from drain gutter in a filter basin, close the pneumatic valve for backwashing drainage.

STEP11 Open the pneumatic valve for inlet of clarified water to a filter.

STEP12 Open the pneumatic valve of outlet of filtered water.
Control the control valve for flow rate of filtered water.

STEP13 Check water level in sludge drainage basin.

Plant Name: **ABBASA W.T.P.**	Title **Filter Washing Facility**	SOP TAG No. **ABS-WTP09 –MT**

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1. Introduction

Filter backwashing facility consists of the following:

- Old plant line: Head tank for backwash
- New plant line: Backwash pump
- Blower for air scouring
- Trough for backwashed water
- Under drain facility (common facility with filtering facility)
- Filter layer (common facility with filtering facility)
- Pipes and valves

2. Criteria for maintenance

Criteria for maintenance are as follows:

(1) Inspection interval and inspected facility or part of facility
(2) Acceptable limit value for using
(Time in working, pipe thickness, etc)
(3) Interval for periodical entire replacement of facility or part of facility

Criteria for maintenance of facility should be referred to manufacturer's instruction manuals.

3. Maintenance activity

Maintenance activity shown herein means activity for the routine maintenance. Description regarding activity for the corrective maintenance is shown in trouble shooting. Maintenance activity consists of four (4) kinds of working components as follows:

(1) Monitoring and checking during working of facility
(2) Periodical inspection during working or after shut down
(3) Evaluate and analysis regarding result of monitoring and check, and inspection
(4) Recovery e.g., repairing, replace, supply or change of oil and so.

3-1. Monitoring and visual check

3-1-1. For backwash pump

Every week	1. Visually check for leaks
	2. Check for lubrication
	3. Adjust glands as necessary to maintain proper leakage
	4. Hand test bearing housing for any sign of temperature rise
Every month	1. Check bearing temperature with a thermometer
Every 6 months	1. Check the packing and replace if necessary
	2. Check alignment of the pimp and motor
	3. Check holding down bolts for tightness
	4. Check coupling for wear
Every year	1. Check rotating element for wear
	2 Check wear ring clearance
	3. Check and re-grease bearings
	4. Vibration testing

3-1-2. Blower

Every week	1.Check for lubrication
	2.Hand test bearing housing for any sign of temperature rise
Every month	1.Check bearing temperature with a thermometer
Every 6 months	1.Check alignment of the belt/coupling
	2.Check holding down bolts for tightness
	3.Check coupling for wear
	4.Check belt tension condition
Every year	1.Check rotating element for wear
	2.Check and re-grease bearings
	3.Clean air filter and replace if necessary
	4.Vibration testing

3-2. Periodical inspection

3-3. Recovery

4. Reports and records

4-1. Records

Records should be as follows;

(1) Record of filter washing

- Sequence of filter washing procedures
- Specification of filter washing
- Time at the start and the end of filter washing
- Turbidity of drain water after backwashing
- Head loss during work of a filter

(2) Record of working of the facility (Pumps, Air blowers etc.)

- Result of monitoring and check (check list)
- Result of periodical inspection
- Record during working of facility
- Flow rate of backwash water
- Indication of discharge pressure
- Indication of current meter
- Measurement of vibration by vibration meter
- Measurement of noise by noise meter
- Measurement of temperature of motor and bearing

3-2. Report

Report should include the following:

(1) Report for recommendation

- Rehabilitation
  - Repairing or replace
  - List of spare parts that should be required to stock in the plant
  - For proposal of newly additional parts
- Upgrading of facility or system
  - Change of capacity, material, and other specifications
  - Addition of facility
  - Modification of facility or system
  - Proposal of preventive maintenance activity to be needed

(2) Report of maintenance activity

- Annual report
  - Repairing and replace for each facility
  - Trouble and accident
  - Result of corrective maintenance
  - List of consumed spare parts in a year
- Corrective action to prevent the trouble or accident

Plant Name: ABBASA W.T.P.	Title: Clear water Reservoir	SOP TAG No. ABS-WTP10-OP

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1. Introduction

Clear water reservoir (ground reservoir) is the basin to store the treated clear water and to keep it clean. Filtered water is led into the clear water reservoir through the filtered water basin and filtered water pipe after post-chlorine dose.

Dosed post-chlorine is mixed and contact with filtered water through the baffling water way in the reservoir. Contact time of chlorine with the water should be needed sufficiently. The water in the reservoir is final treated water in the plant. Hence, the water in the clear water reservoir must be kept it clean.

Activity of water quality control is the most important event in operation of the clear water reservoir, especially monitoring of free chlorine residual must be conducted by suitable frequency.

Operation about the clear water reservoir will be valve operation and monitoring check. However, valve operation will need only maintenance of inside of the reservoir such as cleaning. Main activity of operation for the reservoir will be monitoring and visual check.

2. Features of process

2-1. Function of process

Functions of the process are as follows:

- To store the purified clear water
- To contact post-chlorine with filtered water
- To keep the purified clear water clean and safety
- To achieve balance between production and consumption during peak hours and least demand

2-2. Impacts of process

In the clear water reservoir, the water should be finished for purification process to the potable water after dosing of post-chlorination and, mixing and contacting of post-chorine with filtered water.

The water in the clear water reservoir is real potable water. Hence, the water must be cleaned and safety condition. Any contamination is never accepted.

2-3. Relations between other processes

(1) Chlorination process

Post-chlorine is dosed into the filtered water in previous step of the clear water reservoir and free chlorine residual is adjusted to the target of free chlorine residual of transmission water, and that is final control of free chlorine residual.

(2) Filtration

Filtration is the last stages that can physically remove contaminants before disinfection. The effectiveness of this stage is therefore very important, because particles in the water hinder germ being killed by the disinfectant, and because the large germs that cannot be killed by chlorine have to be physically removed.

3. Criteria for operation

(1) Frequency of water analysis for turbidity, free chlorine residual and pH
- Frequency: Every 2 hours in a day or more

(2) Frequency of monitoring and visual check
- To prevent from contamination: Twice a day or more

(3) Water level
- To keep the water level to make the pumps operate safely at minimum level and ensure that no water loss will happen from the overflow pipe at the highest level Alarm should be operated in both cases.

(4) Frequency of cleaning inside of the reservoir
- Frequency: Once a year or as required

4. Operation under normal condition

4-1. Startup and shutdown procedures

Operations regarding clear water reservoir will be as follows:

(1) Operation of inlet and outlet valves for clear water reservoir
(2) Draining out of the water in clear water reservoir
(3) Cleaning of the inside of clear water reservoir
(4) Draining out of the water after cleaning
(5) Leading of purified water into clear water reservoir
(6) Disinfection of the inside of clear water reservoir

Procedures for the above are shown in flow chart of ABS-WTP10-OPFC-01.

4-2. Monitoring and visual check

Monitoring and visual check of clear water reservoir should be conducted in the following manner:

(1) Routine monitoring and check
(2) Monitoring and check in the operation

Standard form for monitoring and check list is provided in ABS-WTP10-OPSC-01.

4-3. Operation for control

Equipment for control of the clear water reservoir is nothing in the facility of the clear water reservoir facility such as quality, quantity or water level. The water quality and water level of the clear water reservoir should be controlled by the operation of other facilities in the previous processes such as chlorination, filtration, coagulation, and raw water pump and transmission pump facility. Water quality control is described in ABS-WTP10-QC.

Water level in the clear water reservoir will be changed by consumption in the network and inside of the plant, and quantity of treated water. Main consumption in the plant is the supplied water for backwashing of the filter.

The consumption tendency of the clear water should be grasped to control the water level in the clear water reservoir. This tendency is essential information and it should be utilized for the operation plan of almost facility in the water treatment plant.

For example, in a period of high consumption, filter backwashing will not be able to carry out and quantity of treated water will be increased. And in a period of low consumption, filter backwashing will be able to carry out and quantity of treated water will be decreased and the number of working of transmission pump will be deduced.

Control like above is carried out as total quantity control and the water level in the clear water reservoir is base and essential information for this control. Total quantity control for treated water is described in ABS-WTP10-OPFC-02.

5. Operation under unusual condition

5-1. Prospect troubles and trouble shootings

Trouble shooting for the clear water reservoir is provided in ABS-WTP10-QCTS-01.

6. Reports and records

6-1. Records

Records for operation of clear water reservoir should include the following:

(1) Record of monitoring and visual check
(2) Record of water level in the clear water reservoir

6-2. Reports

Reports for operation of clear water reservoir should include the following recommendation:

- Upgrading or rehabilitation of facility
- Modification and arrangement
- Repairing and replace
- Additional of facility
- Review of criteria
- Review of procedures for operation and control

Plant Name: ABBASA W.T.P.	Title: Clear Water Reservoir	SOP TAG No. ABS-WTP10-MT

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1. Introduction

The clear water reservoir is important facilities to keep the water quality. Hence facilities must be maintained by periodical inspection. It will be found to need for recovery such as water leak or crack of basin, rapid action for recovery should be needed.

It had better that the activity of the inspection and cleaning of the clear water reservoir will be carried out in a season of small amount consumption in the network such as a winter season. In the activity of inspection and cleaning, the capacity for the clear water for storage should be reduced. Therefore, the activity should be conducted in a short period as possible according to the planed procedures.

The attached valves with the clear water reservoir will be not necessary to operate usually. Under this situation if these valves will not be operated for a long period, these valves will be damaged by corrosion of metal part. Hence periodical operation and supplying of grease should be needed for the valve.

2. Criteria for maintenance

(1) Frequency of monitoring and visual check
- ◆ Frequency for preventing from contamination: Twice a day or more

(2) Periodical operation of the valve: Once a month

(3) Frequency of cleaning and inspection inside of reservoir: Once a years or as required

3. Maintenance activity

Maintenance activity consists of four (4) kinds of activities as follows:
(1) Monitoring and checking work during working
(2) Inspection
(3) Evaluate and analysis regarding result of inspection
(4) Recovery after the inspection

3-1. Monitoring and visual check

Monitoring and visual check should be carried out according to "O&M schedule" and unified check list

3-2. Inspection

Inspection should be carried out according to "O&M schedule" and unified check list.

3-3. Evaluate and analysis regarding inspection result

After inspection, following items should be evaluated:
- ◆ Waste of the inside
- ◆ Operation of the valve
- ◆ Crack of the basin
- ◆ Leak of the water from outside

3-4. Recovery after the inspection

After the inspection recovery action should be conducted as follows;
(1) Waste of the inside
- ◆ Cleaning of inside of the basin
- ◆ Disinfection inside after cleaning

(2) Operation of the valve
- ◆ Supplying the grease as needed
- ◆ Change of part as needed
- ◆ Replace the valve as needed or periodically

(3) Crack of the basin
- ◆ Repairing

(4) Leak of the water from outside
- ◆ Repairing

4. Reports and records

4-1. Records

Records for maintenance of clear water reservoir should include the following:
(1) Record of monitoring and check
(2) Record of inspection
(3) Record of recovery
(4) Record of disinfection

4-2. Report

Reports for maintenance of clear water reservoir should include the following:
(1) Recommendation
- ◆ Review of the criteria
- ◆ Review of procedures
- ◆ Replacement and rehabilitation

(2) Annual report

Plant Name: ABBASA W.T.P.	Title: Clear Water Reservoir	SOP TAG No. ABS-WTP10-QC

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1. Criteria for water quality control

1-1. Frequency of water analysis

Frequency of water analysis should be based on Egyptian potable water standards and the prepared methods from HCWW and it includes;
- ◆ Turbidity, residual chlorine and pH: Frequency of each 2 hours in a day or more
- ◆ Other water quality items: Once a day

1-2. Frequency of monitoring and visual check

- ◆ Conditions that should prevent contamination: Twice a day or more

1-3. Water quality of the water in clear water reservoir

In order to keep the water quality of the water in clear water reservoir good enough compared with the Egyptian potable water standard, especially following water quality should be satisfied with the SHAPWASCO's own standard.
- ◆ Residual chlorine of water at the inlet and the outlet of clear water reservoir
  - ➢ Inlet: 2.5 mg/L or more and less than 3.0 mg/L
  - ➢ Outlet: 1.5 mg/L or more and less than 2.5 mg/L
- ◆ Turbidity of inlet water of the clear water reservoir
  - ➢ Inlet and outlet: 0.2 mg/l or less
- ◆ Aluminum contain of inlet water of the clear water reservoir
  - ➢ Inlet and outlet: 0.15 mg/l or less

1-4. Frequency of cleaning inside of the reservoir

Frequency: Once a year or as required

2. Operation under normal condition

2-1. Start-up and shut-down procedures

Water quality control regarding clear water reservoir will be as follows:
(1) The water quality analysis of turbidity, chlorine residual, pH
(2) Disinfection inside of the clear water reservoir

2-2. Monitoring and visual check

Monitoring and visual check of clear water reservoir should be conducted in the following manner:
(1) Routine monitoring and check
(2) Monitoring and check in the operation

2-3. Operation for water quality control

The water quality and water level of the clear water reservoir should be controlled by the operation of other facilities in the previous processes such as chlorination, filtration, coagulation, and raw water pump and transmission pump facility.

2-3-1. Control of turbidity, pH, aluminum contain

Control of turbidity pH, aluminum contain should be conducted in the process of filtration.

2-3-2. Control of free chlorine residual

Control of free chlorine residual should be conducted by control of post-chlorination. Control of post-chlorination is based on measurement result of free chlorine residual at inlet and outlet point of the clear water reservoir.

Consumption of free chlorine residual will be small amount that in the water through the pipe from filtered water basin to the clear water reservoir, and in the clear water reservoir. Hence, almost of dosed post-chlorine will be added as free chlorine residual.

And difference of free chlorine residual at inlet and outlet in the clear water reservoir, that is full covered basin, will be small amount. If big difference of free chlorine residual from inlet and outlet such as reduction of 0.3-0.5mg/L will be appeared it should be result of unusual condition in the clear water reservoir. Situation like above will be out of control. Investigation should be needed and cause of reducing of free chlorine residual must be removed.

3. Reports and records

3-1. Records

Records for operation of clear water reservoir should include the following:
(1) Record of monitoring and visual check
(2) Record of water quality in the clear water reservoir

3-2. Reports

Reports for operation of clear water reservoir should include the following:

(1) Recommendation
- ◆ Upgrading or rehabilitation of facility
  - ➢ Modification and arrangement
  - ➢ Repairing and replace
  - ➢ Additional of facility
- ◆ Review of criteria
- ◆ Review of procedures for operation and control

(2) Annual report

Plant Name: ABBASA W.T.P.	Title: Alum Dosing Facility	SOP TAG No. ABS-WTP11-OP

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1. Features of process

1-1. Function of process and facility

Aluminum sulfate (abbreviate as Alum) dosing facility is one of important element facility in coagulation process. Function of alum dosing action is to make a flock by neutralizing of negative charges on dispersed non-settling solids such as clay and organic substances. Once the charge is neutralized, the small suspended particles are capable of sticking together.

Function of alum dosing facility consists of three (3) woks as follows:
(1) Store of alum as solid or solution
(2) Measuring and control of flow rate of alum dose
(3) Transferring and dosing of alum into dosing point

1-2. Impacts of process

Coagulation process is affected by effectiveness of the alum dosing. The whole of water treatment process is affected by effectiveness of coagulation process. Failure of coagulation process is never recovered by any other functions of facilities or processes for particles removal.

1-3. Relations between other processes

Alum dosing facility has tight relation to coagulation process. Generally alum is dosed into location of just before rapid mixing. After adding of alum into the process water coagulation reaction will start immediately. Coagulation reaction will be affected mainly by the following:
- ◆ Characteristics of raw water
  - ➢ Turbidity
  - ➢ pH
  - ➢ Alkalinity
  - ➢ Contained algae
  - ➢ Water temperature
- ◆ Effectiveness of mixing
  - ➢ Detention time in mixing basin
  - ➢ Dosing point of alum

In above factors, water temperature of raw water and efficiency of mixing should be affect

strongly as physical condition. And coagulation process is based on following condition of operation and control;
- ◆ Proper water quality analysis, test, monitoring and control
  - ➢ Grasp of raw water characteristics by examination such as water analysis
  - ➢ Determination of required alum dosing rate by examination such as jar test
- ◆ Proper rapid mixing and detention time
  - ➢ Effective mixing and dispersion of alum with the raw water
  - ➢ Detention time of raw water
- ◆ Proper operation, monitoring and control of alum dosing facility
  - ➢ Adjustment and keeping to required alum dosing rate
  - ➢ Monitoring and keeping of dosed alum quality

2. Criteria for operation

2-1. Receiving volume of Liquid Aluminum Sulfate (LAS)

Receiving volume of LAS is as follows:
Vr = (L)

2-2. Transfer volume at a time

Transfer volume at a time is as follows:
Vt = (L)
Solution level in a dosing tank = (m)

2-3. Specific gravity of alum (LAS and diluted solution in the dosing tank)

- ◆ LAS: DL = 1.315 (kg/L)
- ◆ Diluted solution in the dosing tank: D_d =1.05 (kg/L)

2-4. Calculation formula for dosing flow rate

Calculation formula for dosing flow rate is as follows:
Dosing flow rate (m^3/h)
= Raw water flow rate (m^3/h) x Dosing rate (mg/L) x 1/D_d (kg/L) x 1/1000000

2-5. Response time to adjust dosing flow rate when raw water flow rate is changed

Alum dosing flow rate should be changed simultaneously with change of raw water flow rate. And time of delay to be changed will be acceptable as following;
- ◆ In case of increase the dosing flow rate: Within 3 min
- ◆ In case of decrease the dosing flow rate: Within 5 min

3. Operation under normal condition

3-1. Startup and shutdown procedures

(1) Receiving of liquid alum
Refer to Flow Chart - No.WTP11-OPF01
(2) Transfer of liquid alum
Refer to Flow Chart - No.WTP11-OPF02
(3) Dilution of alum solution
Refer to Flow Chart - No.WTP11-OPF03
(4) Dosing and adjustment of alum solution
Refer to Flow Chart - No.WTP11-OPF04

3-2. Monitoring and visual check

Monitoring and visual check should be conducted to confirm the proper dosing of alum. Check list should be required to ensure the confirmation. Details and frequency for monitoring and check should be referred to ABS-WTP11-OPIP-01.

(1) Alum storage tank
- ◆ Solution level indication of each tank
- ◆ Condition of covering of tank top
- ◆ Condition of leak from tank, valve and connection part
- ◆ External damage and corrosion
- ◆ Indicate condition of tank as “in working” or “stand-by”

(2) Liquid alum transfer pump
- ◆ Leak from pump, valve and connection part
- ◆ External damage and corrosion

(3) Alum solution dosing tank
- ◆ Level of solution in the tank
- ◆ Leak from the tank, valve and connection part
- ◆ External damage and corrosion

(4) Alum dosing device
- ◆ Dosing flow rate
- ◆ Dosing without overflow
- ◆ Level in the attached tank
- ◆ Waste in the attached tank
- ◆ Leak of alum and water from connection part
- ◆ External damage and corrosion

(5) Pipe and valve
- ◆ Leak from valve and connection part
- ◆ External damage and corrosion

3-3. Operation procedures for control of facility

Controlled item is dosing flow rate of alum. Dosing flow rate of alum is controlled by manually adjusted valve. The control is conducted in separately for dosing point of each distribution shaft.

Controlled alum flow rate is monitored by flow meter installed in dosing device in separately for dosing point of each distribution shaft. Type of flow meter is variable area type.

4. Operation under unusual condition

Prospected troubles and trouble shootings are as follows:

(1) Trouble in the common activity
- ◆ Observation of leakage
- ◆ Observation of external damage or corrosion

(2) Trouble in the activity of storage
- ◆ Waste of LAS
- ◆ Unusual reducing of storage volume

(3) Trouble in the activity of transfer
- ◆ Impossible to transfer
- ◆ Too much time for transferring
- ◆ Solid substance is included in transferred solution
- ◆ Insufficient of concentration in transferred solution

(4) Trouble in the activity of adjusting of dosing
- ◆ Clogging of inside of pipe or valve
- ◆ Clogging of flow meter
- ◆ Insufficient of dosing
- ◆ Overflow from upper tank or dosing tray of dosing device
- ◆ Waste of dosing tank or upper tank of dosing device
- ◆ Damage of the control valve
- ◆ Leak of alum

5. Reports and records

5-1. Records

Records should include the following:

(1) Daily record
- ◆ Dosing rate and flow rate of alum
- ◆ Raw water flow rate into the each distribution shaft
- ◆ Solution level

- ➢ Alum storage tanks
- ➢ Alum dosing tanks
- ➢ Concentration of alum

(2) Other record
- ◆ Concentration of LAS
- ◆ Check list for daily monitoring and check

5-2. Reports

Reports should include the following:

(1) Consumption data of alum
- ◆ Weight of alum used each 24-hour period during a month
- ◆ Total weight of alum used for a month
- ◆ Average weight of alum dosed during a 24-hour period for a month
- ◆ Maximum weight of alum used during any 24-hour period during a month
- ◆ Minimum weight of alum used during any 24-hour period during a month

(2) Recommendation on facility
- ◆ Rehabilitation and upgrading
  - ➢ Repairing
  - ➢ Replacement
  - ➢ Additional facility
- ◆ Spare parts should be stored

(3) Recommendation on modification of the criteria
(4) Recommendation on training for persons
(5) Recommendation on review of O&M plan
(6) Supplying of materials for review of water quality control plan

ABS-WTP11 O & M schedule	Revised version	Issued date	Page 1of 1

Plant Name: **ABBASA W.T.P.**	Title of SOP: **Alum Dosing Facility**	SOP TAG No. **ABS-WTP11-OP**
Kind of Doc. **O & M Schedule**	Title of Document **O & M Schedule**	Document No. **ABS-WTP11-OPSC-01**

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Operation and Maintenance Schedule

D: Daily, W: weekly, M: Monthly, 3M: Each 3 month, 6M: Each 6 month, Y: Yearly, AN: As needed

Name of Facility	Frequency						
	D	W	M	3 M	6 M	Y	AN.
1.Liquid Alum Storage Tank							
1-1.Check liquid level in duty and in standby	○						
1-2.Check covering over the tanks	○						
1-3.Check tank and valves for leaks	○						
1-4.Check waste in the tanks						○	
1-5.Inspect tank inside for corrosion, waste						○	
1-6.Inspect tank outside for corrosion						○	
1-7.Inspect specifications of liquid alum							○
2.Liquid Alum Transfer Pump							
2-1.Check tank and valves for leaks	○						
2-2. Inspect pump inside for corrosion, waste						○	
2-3. Inspect pump outside for corrosion		○					
3. Alum Solution Dosing Tank							
3-1.Check liquid level in duty and in standby	○						
3-2.Check tank and valves for leaks	○						
3-3.Check waste in the tanks			○				
3-4.Check close and stop of water supply valve	○						

ABS-WTP11-OPFC-01	Revised version	Issued date	Page 1of 1

Plant Name: **ABBASA W.T.P.**	Title **Alum Dosing Facility – Steps for LAS Receiving**	SOP TAG No. **ABS-WTP11-OP**

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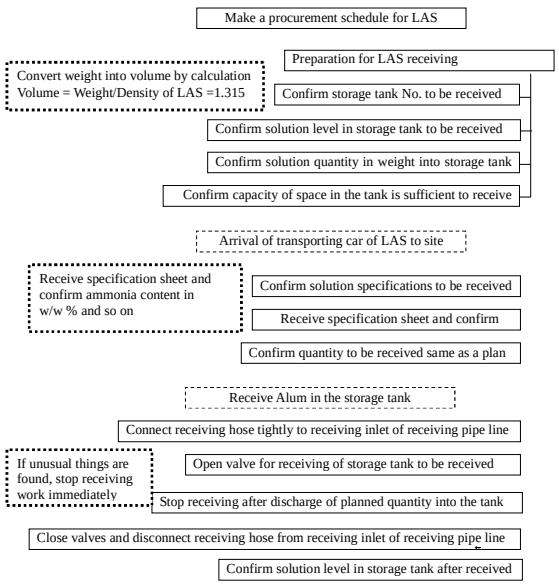
Steps for LAS Receiving



ABS-WTP11-OPFC-02	Revised version	Issued date	Page 1of 2

Plant Name: **ABBASA W.T.P.**	Title **Alum Dosing Facility – Alum Dosing Control**	SOP TAG No. **ABS-WTP11-OP**

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1. Purpose

This flow chart provides to know procedures on alum dosing control.

2. Application

Required Steps for Control of Alum Dosing Quantity

3. Preparation

STEP 0

Confirm raw water flow rate in L/sec and m^3/day	No.1 D/S No.2 D/S
	Raw water pump numbers in working Old P/S New P/S

STEP 1-1

Confirm level of solution of dosing tank in cm Confirm density of solution in dosing tank in kd/cm^3	No,1 tank No.2 tank

STEP 1-2

Check condition of valves attached to dosing tank, in opened or closed	
	No.1 tank No.2 tank

STEP 1-3

Check the level and condition of solution in head tank	Level regulator in head tank should be stooped.
	No.1 tank No.2 tank

STEP 1-4

Check condition of valves around distribution shaft, in opened or closed	
	No,1 tank No.2 tank

STEP 2. Start the Dosing

Open the valves in dosing device

Set the Control Target: Alum flow rate in m^3/h	Measure the flow rate: Read flow meter in m^3/h
Order the flow rate change	Adjust flow rate to the control target Change opening of outlet valve
Type of Alum dosing facility is manually controlled and gravity flow type.	

STEP 3. Control the Dosing

Calculate alum dosing flow rate in m^3/h for target flow rate of alum 1. Raw water flow rate QT: Total flow rate (m^3/day)or (L/s) Q1: Flow rate to No.1 D/S (m^3/day) Q2: Flow rate to No.2 D/S (m^3/day) 2. Alum dosing flow rate VT: Total flow rate (m^3/h) V1: Flow rate into No.1 D/S (m^3/h) V2: Flow rate into No.2 D/S (m^3/h)	Followings need to calculate • Raw water flow rate, dosing rate • Density and concentration of alum solution will be dosed • Flow rate to No.1 D/S: 3 distributions • Flow rate to No.2 D/S: 4 distributions

Open outlet valve and dosing valves in alum dosing pipe line	Line to No.1 D/S Line to No.2 D/S
Open outlet valve and dosing valves in alum dosing device	Line to No.1 D/S Line to No.2 D/S
Confirm and read flow meter in alum dosing device	Line To No.1 D/S Line To No.2 D/S
Adjust outlet valve and dosing valves in alum dosing device	Line To No.1 D/S Line To No.2 D/S

ABS-WTP-11-MT	Revised version	Issued date	Page 1of 5

Plant Name: **ABBASA W.T.P.**	Title **Alum Dosing Facility**	SOP TAG No. **ABS-WTP11-MT**

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1. Introduction

Chemical of alum solution is high corrosive acid liquid. This is key point for maintenance activities of alum dosing facility. We should avoid leak of alum and if it leaks it is necessary to act early detection and rapid response of repairing. And after repairing, clean up around leaked area by water and clean away moisture to keep drying by cloth.

Character of alum solution as cloggy solution, is another key for maintenance. Alum solution will be clogged inside of pipe by using for long time. We should clean away and remove it periodically. We also must clean and remove the precipitations on the bottom of tanks such as storage tank or dosing tank.

2. Criteria for maintenance

Criteria for maintenance are shown as follows:

(1) Inspection interval for facility or parts should be inspected
(2) Acceptable limit value for using (e.g. run time in working)
(3) Interval for replace of facility or parts

3. Maintenance activity

3-1. Facilities for maintenance

(1) Alum storage tank
(2) Alum transfer pump
(3) Alum dosing tank
(4) Alum dosing device
(5) Compressor for mixing of alum solution in alum dosing tank
(6) Pipes and valves

3-2. Maintenance activity

Maintenance activity consists of four (4) kinds of works as follows:

(1) Monitoring and check during working
(2) Inspection
(3) Evaluate and analysis regarding result of inspection

(4) Repair or replacement including check after the work

Monitoring, check and inspection should be carried out to judge necessity of recovering activity such as adjustment, repairing or replacing.

3-2-1. Monitoring and visual check

Monitoring and check should be conducted to keep the facility in satisfactory condition during working. Satisfactory condition in the alum dosing facility is required following conditions;

- Alum dosing flow rate is kept in required amount and correct.
- Alum dosing flow rate should be able to change in required variable range.
- The alum solution is fed into two dosing points separately.
- A foreign substance does not exist in the solution
- External damage does not observe on the facility.
- Unusual over flow does not happen.
- Concentration of solution is kept in required condition.
- Solution level in a tank is kept in satisfactory condition.
- Time of transfer of solution does not exceed the time in usual condition.
- Leak of alum does not exist.

3-2-2. Inspection

Inspection should be conducted to ensure that facility should go on with satisfactory working. Inspection should be required not only by external check but internal check of the facility. In inspection the facility should be looked closely at parts especially to check that everything is satisfactory.

Inspection should be conducted periodically and frequency of inspection will be different from characteristics of facility or parts by importance, load in working, and possibility of occurring of trouble, and so.

3-2-3. Evaluation and analysis regarding result of inspection

Evaluation should be conducted by suitable point of view such as cost performance and risk assessment and time in working. Hence, preparation of the spare part should be needed before maintenance activity. Time of replacing of the part should be recognized by the record of maintenance. Early detection of unusual condition and rapid recovery may lead to the elongation of the facility life.

3-2-4. Recovery after inspection

Alum dosing facility cannot stop anytime in working of water treatment. When recovery action will be needed after inspection, preparation for recovery without stop of alum dosing should be planned such as temporary piping. Prospect recovery action will be following;

- Change or cleaning of valve or strainer
- Change or cleaning of pipe

- Cleaning in the tank including of removal of precipitations on the bottom.
- Repairing of leaked part or damaged part
- Cleaning of the flow meter
- Repainting to prevention of corrosion
- Replacing of equipment

4. Recovery from unusual condition after maintenance activities

4-1. Expected troubles and trouble shootings

4-1-1. Unusual condition of facilities and actions for remedy of process control

Expected unusual conditions are shown below:

- Leak of alum
- Dosing flow rate is unable to control
- Flow rate of alum solution does not increase to required flow rate
- Flow rate of alum solution does not decrease to required flow rate
- Alum does not be dosed
- Alum solution does not supply into alum dosing device from dosing tank
- Alum solution does not transfer into dosing tank from storage tank
- Unusual time during transfer of alum solution
- Unusual over flow from tanks such as storage tank, dosing tank and attached dosing device.

5. Reports and records

5-1. Records

5-1-1. Records for maintenance

Records for maintenance of alum dosing facility should include the following:

- Alum storage tank
- Alum transfer pump
- Alum dosing tank
- Alum dosing device
- Pipes and valves
- Alum storage tank
  - External condition
  - Corrosion, leak and so on
  - Other items
- Alum transfer pump
  - External condition
  - Corrosion, leak and so on
  - Other items
- Alum dosing tank

  - External condition
  - Corrosion, leak and so on
  - Other items
- Alum dosing device
  - External condition
  - Corrosion, leak and so on
  - Sealing of inlet valve with ball tap for attached tank
  - Other items
- Pipes and valves
  - Leak of alum solution
  - Looseness of connection part in piping
  - Other items

5-1-2. Records of recovery

Records of recovery work after monitoring and check should include the following:

- Results of recovery work of adjustment, repairing and replacement
  - Stop position of inlet valve with ball tap for attached tank
- Results of recovery work of repairing
  - Name of facility and name of part including a No. of facility
  - Indication of location of part in facility by drawing or sketch
  - Reason of repairing
  - Date of repairing
  - Name of person in charge of repairing work

Contents of records are the same as those of repair work, but the word of “repair” should be changed to “replacement”.

5-1-3. Results of inspection

Records of inspection should be required as the records of monitoring and check.

5-2. Reports

Reports should include as follows:

5-2-1. Report for recommendation

(1) Rehabilitation
- Repairing or replace
- List of spare parts that should be required to stock in the plant
  - For supplementation
  - For proposal of newly additional parts

(2) Upgrading of facility or system
- Change of capacity, material, and other specifications
- Addition of facility
- Modification of facility or system

- Proposal of preventive maintenance activity to be needed

4-2-2. Report of maintenance activity

(1) Annual report
- Repairing and replace for each facility
- Trouble and accident
- Result of corrective maintenance
- List of consumed spare parts in a year

(2) Corrective action to prevent the trouble or accident

Plant Name: **ABBASA W.T.P.**	Title **Alum Dosing Facility**	SOP TAG No. **ABS-WTP11-QC**

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1. Introduction

In ABBSA WTP, alum solution is used as coagulant. Alum is received as liquid alum solution (LAS) into storage tank with 50% as solid alum concentration. Stored alum will be transfer into alum dosing tank. Transferred alum is diluted so the concentration will be 10% which is equivalent to 1-6% concentration Al_2O_3 (effective element). This job is carried out as water quality control by a chemist.

2 Criteria for water quality control

Water quality control in alum dosing facility is to check and monitor alum specifications especially concentration of contained Al_2O_3.

Criteria of alum dosing facility are the following;

(1) Concentration of received liquid alum: More than 8 (w/w %) as Al_2O_3
(2) Concentration of dosed alum solution: Not less than 1.6 (w/w %) as Al2O3

3. Water quality control under normal condition

3-1. Monitoring and check

Concentration of alum solution should be monitored as following:

- Monitor received LAS in the storage tank after receiving.
- Monitor diluted alum solution in the dosing tank after dilution of LAS.

4. Water quality control under unusual condition

4-1. Prospect troubles and trouble shootings

(1) Unusual condition of process and actions of remedy for process control

Unusual condition of concentration of alum will be following;

- Concentration of storage alum will be lower than specified concentration
- Concentration of diluted alum will be lower than specified concentration
- Concentration of diluted alum will be higher than specified concentration

5. Reports and records

5-1. Records

Records should include the following:

- Concentration of alum solution in storage tank after receiving
- Periodical check
- Concentration of alum solution in dosing tank after dilution
- Periodical check

5-2. Reports

Data of concentration of alum solution will be used for calculation of consumption amount. Hence, following report should be required about diluted solution:

- Average concentration of alum solution during a 24-hour period for a month
- Maximum concentration of alum solution used during a month
- Minimum concentration of alum concentration used during a month

Plant Name: ABBASA W.T.P.	Title: Chlorination Facility	SOP TAG No. ABS-WTP12-OP

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1. Features of process

1-1. Function of process

Two kinds of functions are provided to chlorination facility, one of them is pre-chlorination and another is post-chlorination.

Function of pre-chlorination is to oxidize metal and organic matter and so contained in raw water.

Function of post-chlorination is to destroy disease causing organics, also called pathogenic organics contained in clear water and to make the watr continuously disinfected in the network until reaching the customer.

1-2. Impacts of process

Pre-chlorine is dosed into raw water prior to dosing of alum. Pre-chlorine aid the coagulation and sedimentation process by oxidation of metal or organics in raw water.

Post-chlorination performs disinfection of clear water and the free chlorine will continue to react with the impurities in the water, such as organic materials and organisms, until all the impurities and organisms are destroyed and there is an excess of free chlorine.

It is important to recognize that the combination of sufficient free chlorine residual and adequate contact time are essential for effective killing of the pathogenic organisms.

1-3. Relations between other processes

Pre-chlorine dosing rate is varied by raw water quality especially organic matter and ammonia contained quantity in raw water. Pre-chlorination affects to coagulation process. Post-chlorination dosing rate is varied by filtered water quality. Pre-chlorination affects to final quality of produced potable water contained free residual chlorine concentration.

2. Criteria for operation

(1) Treatment target of residual chlorine for water in the transmission line
1.5 mg/L or more and less than 2.0 mg/L
(2) Target of residual chlorine for water at the tap of distribution network

0.5 mg/L or more and less than 1.5 mg/L
(3) Treatment target of free chlorine residual for clarified water
0.5 mg/L or more and less than 1.0 mg/L
(4) Treatment target of residual chlorine for filtered water
0.2 mg/L or more and less than 0.5 mg/L
(5) Treatment target of free chlorine residual for water in ground reservoir
1.5 mg/L or more and less than 2.5 mg/L
(6) Response time of change of the dosing flow rate for chlorination after change of raw water flow rate

Chlorine dosing flow rate should be changed simultaneously with change of raw water flow rate. And delay of change for response will be acceptable as following;

- Pre-chlorine
  - In case of increase: Within 5 min
  - In case of decrease: Within 5 min
- Post-chlorine
  - In case of increase: Within 5 min
  - In case of decrease: Within 5 min

3. Procedures for operation under normal condition

Basically, operation procedures for facility such as chlorinator should be kept strictly according to manufacturers recommendations in instruction manuals.

3-1. Operation of chlorination facility

Operate chlorine facility by persons with certificate of working knowledge and skills on handling of chlorine and chlorination facility must be required for persons to handle chlorination facility. Persons to operate chlorination facility must be trained on chlorine , chlorination facility and handling skills on them.

Common procedures for chlorination facilities
Handling of chlorine container

1. Receiving of container

1-1.Check
1) No leakage of chlorine from container such as outlet valve and fuse metal part and so.
Leakage check of chlorine gas should be carried out used by ammonia solution.
2) No deterioration or damage of thread part of outlet valve of container
3) No deterioration or damage of container outside

1-2.After check

1) When check results are good enough, container can be received in the container room.
2) When check results are not good container should not be received.
Not good container should be changed by supplier.

1-3.Arrangement of containers in the container room
1) It should be distinguished by indication stickers that filled containers and empty containers are recognized easily.
2) Container arrangement area should be separated for filled containers and empty containers.

1-4. Store of container
1) Put up a Keep Out sign beside container room and chlorinator room.
2) Keep room temperature less than 30 ℃

1-5. Change the container should be worked
1) 2 chlorine gas feed pipes are available for consumption in container room.
One of them is worked for consumption and another line is for stand by.
Stand by line for chlorine consumption should be prepared for use
2) When pressure in chlorine gas feed pipe will be fell down less than alarm point of pressure gauge, alarm will be set off.
3) When alarm is confirmed, keep working until pressure gauge reading fall down to zero.
4) When pressure in chlorine gas feed pipe will be fell down to zero, close outlet valve of containers.
Keep consume the chlorine gas in above condition for approx.5 minutes.
5) After keeping in zero pressure indication for 5 minutes, loose a bag nut slightly and check leakage from copper lead tube.
When chlorine gas leak from copper lead tube, connect it again and keep consume for several minutes and check again same as above.
6) If no leakage chlorine is confirmed, open slightly outlet valve of stand by containers and check no leakage around connection part of copper lead tube.
After check of above, open fully outlet valve of container and check no leakage again.
7) After check of no leakage, open slightly inlet valve of manifold, and check no leakage around connection parts of manifold.
8) After above, open fully inlet valve of manifold, and check no leakage again.
9) Empty containers should be transferred to empty container area in the container room

Start up of chlorinator

1. Preparation and check
1-1. All valves of chlorinator should be closed.
1-2. Water supply to pressure booster pump is prepared and inlet valve and discharge valve for booster pump are open fully.
1-3. Power supply for pressure booster pump is prepared.

1-4. Valves in dosing pipes are open fully including dosing point and changeover valves for dosing point are open properly.
1-5. Confirm outlet valve of chlorine gas manifold is closed.
1-6. Chlorine gas inlet valve of injector is opened.

2. Start up chlorine dosing
2-1. Operate switch of booster pump to start.
2-2. Check discharge pressure gauge of booster pump is in proper range.
2-3. Check no unusual of booster pump such as water leakage, abnormal noise and so.
2-4. Confirm occurring noise from injector.
2-5. Select chlorinator and open slightly inlet valve in selected chlorinator.
2-6. Open outlet valve of chlorine gas manifold slightly and check no leakage of chlorine from connection part of chlorine manifold. After check no leakage, open fully outlet valve of manifold.
2-7. Confirm chlorine gas is fed to inside of flow meter glass of chlorinator.
If chlorine gas is fed to Inside of flow meter glass, inside of flow mater change color to yellow colored gas of chlorine.
2-8. Adjust chlorine flow rate to required rate by inlet valve of chlorinator and confirm steady moving of float inside of flow meter.

Shut down of chlorinator

1. In case of short term stopping
1-1. Close inlet valve in selected chlorinator and keep for several minutes in this condition.
1-2. Confirm chlorine gas in flow meter glass of chlorinator is sucked into injector.
If chlorine gas in chlorinator is sucked into injector completely to, inside of flow mater change color to no colored gas from yellow color of chlorine gas and indication of flow meter will indicate zero.
1-3. Keep above condition in short term stopping.

2. In case of long term stopping
2-1. Close outlet valve of chlorine gas manifold completely.
2-2. Confirm chlorine gas in flow meter glass of chlorinator is sucked into injector.
If chlorine gas in chlorinator is sucked into injector completely to, inside of flow mater change color to no colored gas from yellow color of chlorine gas and indication of flow meter will indicate zero.
2-3. Close chlorine gas inlet valve of injector
2-4. Close outlet valve and inlet valve of injector.
2-5 Close discharge valve of booster pump and operate switch of booster pump to stop

3-2. Early detection and rapid response to chlorine leak accidents

Basically, early detection and rapid response as corrective action of chlorine leak is very important action for operation of chlorination facility.

3.3. Close all doors in chlorination house when chlorine leakage accidents occur

We must operate chlorine facility with the greatest care to prevent from happening of chlorine leak. But in case of happening of chlorine leaked, we must try to avoid diffusing leaked chlorine to outside of chlorination house. Therefore, all doors must be closed usually in chlorination house.

3.4. Periodical practice on activity in emergency situation

Emergency case means situation of accident with severe chlorine leak. Under emergency situation, we must act immediately according to prepared action plan and program. Safety devices and tools must be provided and maintained and kept in proper condition to use any time. And they should be stored in the room without chorine such as chlorine neutralization room.

3.5. No smoking in the room of chlorination house

No need to explain.

4. Report and record

4-1. Records

Records for operation condition should include the following:
(1) Chlorine gas feed
- Pressure gauge indication of chlorine gas feed before pressure reducing valve
  - Line-1, Line-2
- Pressure gauge indication of chlorine gas feed after pressure reducing valve
  - Line-1, Line-2
- Weight indication of the chlorine container
  - Set -1, Set-2
- Water temperature in the evaporator
- Water flow meter indication

(2) Records for Chlorinator
- Pre-chlorine dosing flow rate
- Post-chlorinator dosing flow rate
- Water supply pressure fed to the chlorinator

(3) Indication of chlorine gas leak detector
- For container room

- For chlorinator room

4-2. Report

Reports should include the following:
(1) Consumption tendency of the chlorine
- Weight of chlorine used each 24-hour period during a month
- Total weight of chlorine used for a month
- Average weight of chlorine dosed during a 24-hour period for a month
- Maximum weight of chlorine used during any 24-hour period during a month
- Minimum weight of chlorine used during any 24-hour period during a month

(2) Recommendation on facility
- Rehabilitation and upgrading
- Repairing
- Replacement
- Additional facility
- Spare parts should be stored
- Recommendation on modification of the criteria
- Recommendation on training for persons
- Recommendation on review of O&M plan

Plant name **ABBAS W.T.P.**	Title: **Chlorine Gas Properties**	SOP No. WTP12-OP TI-01

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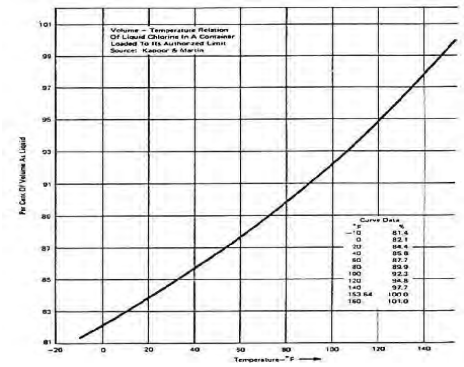
1. Chlorine Gas Properties

Elemental chlorine is a greenish-yellow gas about 2.5 times heavier than air. Therefore, it will sink to the floor if released from its container. It is sold to the water supplies as a compressed liquid. If liquid chlorine is unconfined, it rapidly vaporizes to gas (one volume of liquid chlorine equals about 450 volumes of gas) so the maximum allowable limit for the chlorine gas to be withdrawn from the cylinder not exceeding 9kg/hr to avoid the temperature decreasing and forming ice which may clog the pipe.



Volume-Temperature Relation of Liquid Chlorine in a Container Loaded to Its Authorized Limit

Chlorine is only slightly soluble in water; its maximum solubility is approximately one percent at 49° C. When the water supply to a gas chlorinator is below normal room temperature, it may cool the chlorine gas to the point at which chlorine ice is formed and accumulates on the needle valve and gas outlet tube, resulting in erratic feed results.

Chlorine reacts with many compounds. Because of its great affinity for hydrogen, it removes hydrogen from some compounds, such as hydrogen sulfide. It also reacts with ammonia or other nitrogen-containing compounds to form various mixtures of chloramines. It reacts with organic materials.

Although it is neither explosive nor flammable by itself, chlorine is capable of supporting the combustion of certain substances. It should be handled and stored away from compressed gases, such as ammonia and other flammable materials.

Most common metals are not affected at normal temperatures by dry chlorine, either gas or liquid. Chlorine is, however, reactive with aluminum and ignites carbon steel at temperatures above 450° F. Moist chlorine is corrosive to all common metals with the exception of gold, silver, platinum, titanium, and certain specialized alloys.

2. Physical Effects of Exposure to Chlorine Gas

Chlorine gas is primarily a respiratory irritant and concentrations in air above one ppm can usually be detected by most persons. Chlorine causes varying degrees of irritation of the skin, mucus membranes, and the respiratory system, depending on the concentration and the duration of exposure. Severe exposure can cause death, but the severe irritating effect makes it unlikely that anyone would remain in the chlorine-containing atmosphere unless trapped or unconscious.

Liquid chlorine may cause skin and eye burns upon contact with these tissues. Chlorine produces no known cumulative or chronic effect, and complete recovery usually can be expected to occur shortly following mild, short term exposure.

3. Use of Combined Residual Chlorination

Combined residual chlorination involves the addition of chlorine to water to produce, with natural ammonia present or with ammonia added, a combined available chlorine residual. Combined available chlorine forms have lower oxidation potentials than free available chlorine forms and are less effective as oxidants. They are also less effective as disinfectants. In fact, 25 times more combined available residual chlorine must be obtained to meet the same disinfectant level as a free available residual. The contact time has to be up to 100 times greater to obtain the ame level of bacterial kill at the same pH and temperature conditions.

When combined available residual chlorine is desired, the character of the water determines

how it can be accomplished. These conditions may have to be considered:

- If the water contains sufficient ammonia to produce the desired level of combined residual.
- 2. If the water contains too little or no ammonia, then addition of both chlorine and ammonia is required.
- 3. If the water has a free available chlorine, all that is required is the addition of ammonia alone.

4. Use of Free Residual Chlorination

The free residual chlorine is the residual amount of chlorine after oxidization with all impurities, chloroamines formation and exceeding the break point.-a free available chlorine residual and to maintain the water disinfected while passing through the pipes, tanks and distribution system.

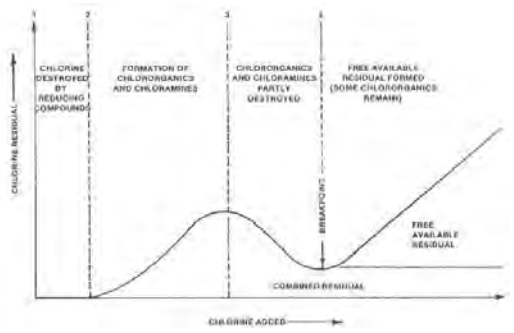
Free available residual forms have higher oxidation potentials than combined available chlorine forms and are more effective as disinfectants.

5. Breakpoint Chlorination

Breakpoint chlorination is the point which the residual chlorine starts to appear and at this point the chlorine finished all its reactions. The existence of this residual chlorine to assure that all reactions have been achieved and also a sufficient amount exist to continue disinfecting water until reaching the customer taps.

Breakpoint chlorination is the name of the process of adding chlorine to water until the chlorine demand has been satisfied. Chlorine demand equals the amount of chlorine used up before free available residual chlorine is produced.

Further additions of chlorine will result in the residual chlorine that is directly proportional to the amount of chlorine added beyond the breakpoint. Public water supplies normally chlorinate past the breakpoint.



Breakpoint Chlorination

When chlorine is initially added to water, the following may happen:

(1) If the water contains some iron, manganese, organic matter, and ammonia, the chlorine reacts with these materials and no residual is formed, meaning that no disinfection has taken place.

(2) If additional chlorine is added at this point, it will react with the organics and ammonia to form chloramines. The chloramines produce a combined chlorine residual. As the chlorine is combined with other substances, it loses some of the disinfection strength. Combined residuals have poor disinfection power and may be the cause of taste and odor problems.

(3) With a little more chlorine added, the chloramines and some of the chlororganics are destroyed.

(4) With still more chlorine added, a free residual chlorine is formed.

Free available chlorine is the best residual for disinfection. It disinfects faster and without odor. The common practice today is to go just beyond the breakpoint to a residual of about .2 to .5 ppm.

A variety of reactions take place during chlorination. When chlorine is added to a water containing ammonia (NH3), the ammonia reacts with hypochlorous acid (HOCL) to form monochloramine, dichloramine, and trichloramine.

The formation of these chloramines depends on the pH of the water and the initial chlorine-ammonia ratio.

Ammonia + Hypochlorous acid ----> Chloramine + Water

NH_3 + HOC1----------> $NH_2C1 + H_20$ Monochloramine

NH_2C1 + HOC1---------- > $NHC1_2 + H_20$ Dichloramine

$NHC1_2$+ HOC1---------- > $NC1_3 + H_20$ Trichloramine

At pH of most natural water (pH 6.5 to 7.5*)*, monochloramine and dichloramine exist together. At pH levels below 5.5, dichloramine exists by itself. Below pH 4.0, trichloramine is the only compound found. The monochloramine and dichloramine forms have a definite disinfection power. Dichloramine is a more effective disinfecting agent than monochloramine.

However, dichloramine is not recommended as a disinfectant due to the possibility of the formation of taste and odor compounds. Chlorine reacts with phenol and salicylic acid to form

6. Injection Points

The points of application of chlorine must be selected carefully, considering the different reactions that may occur at different points of the water treatment process. The common application points are:

6.1. PRE-CHLORINATION

Pre-chlorination is the application of chlorine ahead of any other treatment process. It provides the following benefits:

- Control of algae and slime growths.
- Control of mud ball formation in the filters.
- Improved coagulation.
- Reduction of tastes and odors.
- Increased safety factor in disinfection of heavily contaminated waters.

6.2. POST-CHLORINATION

Post-chlorination is the application of chlorine after treatment and before it enters the distribution system. The purpose is to disinfect water and saving it until reaching customers taps.

6.3. TANKS AND RESERVOIRS

Usually tanks and reservoirs are not chlorinated continuously, but they must be disinfected after any maintenance has been done on the inside of the tank.

Plant Name:	Title	SOP TAG No.
ABBASA W.T.P.	**Chlorination Facility**	**ABS-WTP12-MT**

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1. Introduction

Chlorine has the potential to cause serious injury, even death in the worst case. Concentration of 1000 ppm, or one percent by volume will lead to a fatal accident for a very short time. Since the odor of gas chlorine is noticeable in very small amount, it is generally easy to avoid the heavy concentrations that will cause injury. Detail on chlorine gas properties are shown in technical information sheets of WTP12-MTTI01.

Chlorine gas shall not be leaked by sufficient maintenance and careful handling and operation. All the persons should be well trained in the use of self-contained breathing equipment, the methods of detecting leaks, and emergency procedures.

2. Criteria for maintenance

Criteria for maintenance are listed as follows:

2-1. Inspection interval and inspected facility or part of facility

Refer to "Inspection List for maintenance" ABS-WTP12-HTIP-01.

2-2. Acceptable limit value for using

(For example, accumulating time in working, dimension of pipe thickness, and so)

2-3. Frequency of periodical replace of facility or part of facility

Refer to "Inspection List for maintenance" ABS-WTP12-HTIP-01.

3. Maintenance activity

Maintenance activity consists of four (4) kinds of work components as follows:

3-1. Monitoring and check during working of facility as routine work

- Frequency of monitoring and check, such as after each working, daily, weekly.

3-2. Inspection

- Inspection works should require the following jobs and these jobs are shown in the

inspection list of ABS-WTP12-MTIP01.

- Objects of inspection, such as parts and facility
- Inspection method
- Frequency of inspection

Records of inspection results are required.

3-3. Evaluate and analysis regarding inspection results

Results of inspection should be applied to recovery jobs such as repairing, adjustment, or replacing of parts or facilities. There are some criteria that we cannot provide numerical values such as degree of corrosion.

3-4. Recovery by repairing or replacing work including checking after the work

Recovery action itself will be not difficult but we should judge not only technical performance but cost performance. Under this situation, we should introduce thinking way of risk. Risk is indicated by multiplied result that chance of happening by scale of damage if it will be happened. High risk items should be recovered by evaluated priority.

3. Reports and records

3-1. Records

Records for maintenance of the chlorination should include the following:

(1) Records of inspection

(2) Records of recovery
- Replace of the parts or facility
- Repairing of the parts or facility
- Adjustment of the parts or facility
- Tightening or fixing of the connection parts or fixing parts
- Repainting
- Supplying or change of the grease or oil

3-2. Reports

Reports on maintenance of the chlorination should include the following:

(1) Recommendation
- Rehabilitation as the preventive action
  - Replace
  - Repair
  - Repainting
- Review of the SOPs
  - Procedures

  - The criteria
  - Record and report
- Training for the operator
  - Check and handling skill as routine operation
  - The manuals for the O&M activity
- Review of procedures under the emergency situation

(2) Annual report
- Reports of the trouble or unusual situation
- Reports of recovered parts or facility and the cost for recovery
- Plan for the maintenance activity

Plant Name:	Title of SOP:	SOP TAG No.
ABBASA W.T.P.	**Inspection List for Maintenance For Chlorination Facility**	**ABS-WTP12-MTIP-01**

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Inspection List for Chlorination Facility

D: Daily, W: Weekly, M: Monthly, 3M: Each 3 month, 6M: Each 6 month, Y: Yearly, AN: As needed

Name of Facility & inspection item	Frequency					
	D	W	M	3M	6M	Y
1.Stand frame for chlorine container						
1-1.External corrosion		○				
1-2.Tightenig of bolts & nuts		○				
1-3.Smooth rotation of rotor		○				
1-4.Stopper of rotor				○		
1-5.Condition of foundation						○
2.Evaporator	----	----	----	----	----	----
2-1.Leak of water			○			
2-2.External corrosion of heater					○	
2-3.Damage of lead cable					○	
2-4.Insulation resistance of cable					○	
2-5.External corrosion of thermometer					○	
2-6.Smooth moving of needle of thermometer					○	
2-7.External corrosion of pressure gauge					○	
2-8.Waste of inside part of pressure gauge					○	
2-9.Sealing of connection part			○			
2-10. Smooth moving of needle of pressure gauge				○		
2-11.Working of thermostat				○		
2-12.Damage of cable and cable connection part				○		
2-13.Rooseness of cable at terminal part				○		
3.Chlorinator						
3-1.Pressure gauge						
3-1-1.External corrosion			○			
3-1-2.Waste of inside part			○			
3-1-3.Sealing of connection part			○			
3-1-4. Smooth moving of needle			○			
3-2.Pressure reducing valve						
3-2-1.External corrosion				○		
3-2-2.Waste of inside part				○		

Name of Facility & inspection item	Frequency					
	D	W	M	3M	6M	Y
3-2-3.Sealing of connection part			○			
3-2-4.Pressure reducing value (bar)		○				
3-3.Control valve for chlorine flow rate						
3-3-1.External corrosion				○		
3-3-2.Clean of needle and seat inside the valve				○		
3-3-3.Waste of inside part				○		
3-3-4. Sealing of connection part			○			
3-4.Flow meter for chlorine gas						
3-4-1.Cleaning inside				○		
3-4-2. Sealing of connection part				○		
3-5.Ejector						
3-5-1.Extenal damage and corrosion				○		
3-5-2.Sealing of connection part			○			
3-5-3.Proper working				○		
4.Piping						
4-1.Chlorine gas line of steel pipe						
4-1-1.Extenal damage and corrosion				○		
4-1-2.Crack, deformation, and wear				○		
4-1-3.Tightenig of bolts & nuts				○		
4-1-4. Sealing of connection part			○			
4-2. Chlorine gas line of copper tube						
4-2-1.Bending, cut area reducing by irregularity			○			
4-2-2.External corrosion				○		
4-2-3.Waste of inside part				○		
4-2-4. Sealing of connection part			○			
4-2-5.pressure reducing valve		○				
4-2-6. Cleaning of contact face of connection				○		
4-3.Ordinary line						
4-3-1.Extenal damage and corrosion			○			
4-3-2.Crack, deformation, and wear						○
4-3-3.Tightenig of bolts & nuts						○
4-3-4. Sealing of connection part			○			
4-4.Supprt for pipe						
4-4-1.Extenal damage and corrosion						○
4-4-2.Check terminal pipes safety						○
4-4-3. Crack, deformation, and wear						○
5.Container lifting beam						
5-1.Extenal damage and corrosion			○			
5-2.Crack and wear			○			

Name of Facility & inspection item	Frequency					
	D	W	M	3M	6M	Y
5-3.Deformation of hook			○			
5-4.Tighten of bolts for hook			○			
6.Crane						
6-1.Push button swich						
6-1-1.Damage of terminal contact			○			
6-1-2.Tighten of screws at terminal			○			
6-1-3.Smooth actions of push buttons, correct moving			○			
6-2.Cable						
6-2-1.External damage			○			
6-2-2.Twisting and bending			○			
6-2-3.Damage of cable end finishing			○			
6-3.Limit switch (L/S) for over winding prevention						
6-3-1.Condition of contact			○			
6-3-2.Fixing condition			○			
6-3-3.working of arm lever			○			
6-3-4.Confirm lifting margin after operation of L/S			○			
6-4.Wire rope						
6-4-1.Damage			○			
6-4-2.Wear			○			
6-4-3.Twisting and bending			○			
6-4-4.External corrosion			○			
6-4-5.Confirm finishing end of wire			○			
6-4-6.Application of oil for wire			○			
6-5.Hook						
6-5-1.Crack and wear			○			
6-5-2.Deformation of opening of hook			○			
6-5-3.supplying oil in bearing part			○			
6-5-4.Normal rotation			○			
6-6.Cabtire cable						
6-6-1.Looseness of wiring connection at terminal			○			
6-6-2.External damage			○			
6-6-3.Twisting and bending			○			
6-6-4.Confirm finishing end of wire			○			
6-7.Trolley and drive unit						
6-7-1.Wear of guide roller			○			
6-7-2.Oil supplying into gear box for lifting			○			
6-7-3.Oil supplying into gear box for traveling			○			
6-7-4.External corrosion		○				

Plant Name: **ABBASA W.T.P.**	Title **Transmission Pump**	SOP TAG No. **ABS-WTP13-OP**

Issued		Developed by		Signature	
Revised		Approved by		Signature	

1. Features of process

1-1. Function of process

The function of the transmission pump is to feed the potable water to the network with adequate quantity, adequate pressure and reliable quality.

1-2. Impacts of process

The transmission pump process is the final stage in the water treatment process. The transmission pump facility must be working for 24 hours in a day and 365 days in a year.

Quantity and pressure of the distribution water should be controlled in this process. Insufficient control of quantity of the distribution water will be cause of the suspension of water supply or wasteful operation of the water treatment plant such as unnecessary consumption of chemicals and electrical power.

Insufficient control of pressure in the pipe of the network will be cause of the water leakage or increasing of leak quantity from the network pipe, or contamination from outside of the network pipe.

1-3. Relations between other processes

(1) The clear water reservoir

The clear water to distribute for the network is fed into the clear water basin from the clear water reservoir, and this is the suction tank for the transmission pump. The water in the clear water reservoir and the clear water basin must be kept clean and safety. These basin or reservoir must be covered to isolate from the air outside to avoid contamination by dust or sprayed agricultural chemical.

(2) Network

The operation of the transmission pump relates to the function of the network. Hence, condition of the network such as pressure of pipe inside should be monitored usually in the operation of the transmission pump.

From ABBASA WTP, the clear water is distributed to following six (6) networks:

<From old pump station>

- Zagazig booster pump station

- Bilbeis booster pump station
- City of Zagazig, Bilbeis, Abu Kabier, Abu Hammad
- Unserved village: from old pump station

<From new pump station>

- City of Faqus
- City of Abu Hammad

(3) The booster pump station

By this communication, information on feed quantity and reduced degree of free chlorine residual will be obtained and information will be utilized to control of the transmission pump and chlorination in WTP or the maintenance of network. Communication with water treatment plant and booster pump stations, Zagazig BPS and Bilbeis BPS should be needed to control the quantity of water transmitted for the boosters to get safe booster s operation.

2. Criteria for operation

2-1. Acceptable pressure inside of the network

The pressure in the main pipe: 5 Bar or less

2-2. Schedule for working of pump

The transmission pump should be operated according to operation schedule. Usually a pump will be operated for 24 hours and after that changed to stand by pump.

2-3. Indication of vacuum meter be possible for starting of pump

Prior to start a pump air in the casing of a pump should be sucked out by the vacuum pump. After pump casing will be in condition of filled water, a pump is possible to start. Vacuum indicator should be required -0.5 lb/in2 or more to start a pump.

2-4. Controlled range of required water pressure in the network

Discharge pipe from transmission pump in WTP and well pumps in well stations are connected to the network piping.

Working number of the transmission pump or well pumps in the well stations should be controlled in a proper range based on required water pressure in the network.

3. Operation under normal condition

3-1. Startup and shutdown procedures

3-1-1. Pre-start check

The pump will be operated should be selected.

(1) The water level in the clear water basin
Water level should be sufficient for working of pump.
(2) Valves in suction line should be opened fully while valves in discharge line should be closed in the beginning of the operation.
(3) Valve for air sucking by the vacuum pump
Valve for air sucking by the vacuum pump should be opened fully.
(4) Electrical switch board
Power should be supplied. Starting regulator should be in starting position.

3-1-2. Start

(1) Operate vacuum pump to start
Wait approx.15 min in working of the vacuum pump. Confirm vacuum indicator -0.5 lb/in^2.
(2) Close valve for air sucking and stop the vacuum pump
(3) Operate the start switch on switch board to start the pump
(4) Open the discharge valve gradually
(5) Confirm the pressure gauge of discharge line.
Indication of pressure gauge of discharge should be 5 bar or less.
(6) Check indicator of current meter on switch board
(7) Check unusual noise, vibration, temperature arise and leak of water
(8) Check dripping condition of water from part of grand packing in stuffing box
Adjust tightening of grand packing as needed (10-15 points per minute).

3-1-2. Shutdown

(1) Close the pump discharge line
(2) Operate the stop switch on switch board to stop the pump

3-2. Monitoring and visual check during operation

It should be conducted more than twice every day by prepared check list. If unusual condition will be found, corrective action should be conducted immediately.

3-3. Operation for control

The control of the transmission pump should be conducted mainly by change of working number of the pumps and quantity and pressure in the network should be controlled. The water level in the clear water basin and the clear water reservoir should be monitored periodically.

4. Operation under unusual condition

4-1. Expected troubles and trouble shootings

(1) Clogging in the suction pipe or the discharge pipe
(2) Discharge pressure is not enough
(3) Discharge quantity is not enough
(4) The water level in the raw water basin is not enough
(5) Mechanical or physical trouble of the pump
(6) Unusual pressure in the network
(7) Elecrical power failure

Trouble shootings are shown in ABS-WTP13-OPTS-01.

4-2. Trouble in the past and cause, background and events for recovery

- Trouble history -

5. Report and record

5-1. Record

Records for operation of the transmission pump should include the following:

5-1-1. Record of working of the pump

(1) Time in operation of each pump
(2) Operation condition
- ◆ Discharge pressure, quantity, electrical current, and so
- ◆ Water pressure in the network
- ◆ Transmission water quantity

(3) Water level in the clear water reservoir
(4) Unusual condition of the pump and water pressure in the network

5-1-2. Record of working of the vacuum pump

(1) Time in operation of each pump
(2) Operation condition
- ◆ Vacuum pressure, electrical current, and so on.

5-2. Report

Reports for operation of the transmission pump should include the following:

5-2-1. Unusual condition in the maintenance work

5-2-2. Monthly report

(1) Time in operation of each pump
(2) Total quantity of transmission water
(3) Recommendation on operation

5-2-3. Annual report

(1) Time in operation of each pump
(2) Recommendation on operation

Plant Name: **ABBASA W.T.P.**	Title of SOP: **Transmission water pumps**	SOP TAG No. **ABS-WTP13-OP**
Kind of Doc. **Trouble Shooting**	Title of Document **Trouble Shooting for the Pump**	Document No. **ABS-WTP13-OPTS-01**

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PROBLEM	POSSIBLE CAUSE	RECOMMENDED REMEDY
No water delivered No flow No pressure	Delivery or suction valve closed	Open the closed valve
	The pump is not primed	Prime the pump
	Suction left is too high	Increase water level in suction sump
	Suction strainer is locked	Clean suction strainer
	Foot valve is partially closed	Clear the clog
	Air leak into suction line	Tight all flanges and packing
	Air buckets in suction line	Open air vent valves in suction pipe
	Leaks in the shaft seal	Replace the seal or tighten gland
	Air leak through stuffing box	Seal the stuffing box properly
	Impeller damaged	Replace the impeller
	Rotation direction is incorrect	Reverse the phases
Low flow and low pressure	Gasket for casing is leaking	Replace the gaskets
	Suction pressure close to vapor	Close partially the discharge valve
	Excessive amount of air in liquid	Open air vent to release air
	Wearing ring worn	Replace new wearing ring
	Foreign maters in the impeller	Open pump and clean impeller
	Foot valve is too small	Replace foot valve
	Parallel operation effect the pump	Check the system design
	Glands is too tight	Loosen the gland nuts
	Packing improperly installed	Replace the backing
	Shaft or shaft sleeve worm	Replace with new shaft and sleeves
	Shaft running off-center	Rectify the shaft centering
	Pump start and stop frequently	Adjust the system control
	Water seal pipe clogged	Clear water seal pipe

PROBLEM	POSSIBLE CAUSE	RECOMMENDED REMEDY
Short lifespan of shaft seal and packing	Gland is too tight	Loosen gland nuts
	Seal cage improperly located	Check the location and correct
	Dirt or grit in sealing liquid	Use clean water for sealing
	Cooling liquid is not provided	Repair or install cooling liquid pipe
	Clearance between casing and shat is too excessive	Open the pump and adjust the clearance to the designed value
	Lack of lubricants	Add more grease or oil
Short lifespan for bearing, noisy operation	Misalignment between motor and pump shafts	Adjust the alignment of motor and pump shafts
	Dirt getting into bearing	Check the bearing seal and correct
	Lack of lubrication	Add more grease or oil
	Bearing rusted	Clean and cover protect hosing
	Bearing worn out	Replace the bearing
	Foundation not rigid enough	Repair and tighten foundation bolts
	Excessive grease in bearing housing	Remove some of the grease from bearing hosing
	Shaft is bent	Replace the shaft with new one
	Rotor of pump or motor out of balance	Change the motor and pump shaft with the impeller and check balance
	Rotating parts are rubbing	Check and replace necessary parts
Pump trip Stopped by itself	Electrical overload settings are incorrect	Check and correct setting
	Bearing jammed	Change the bearing
	Impeller obstructed	Clear obstruction from the impeller

Plant Name: **ABBASA W.T.P.**	Title **Transmission Pump**	SOP TAG No. **ABS-WTP13-MT**

Issued		Developed by		Signature	
Revised		Approved by		Signature	

1. Introduction

A centrifugal pump consists of two (2) main components as a pump and a motor. The pump has two main components as follows:

(1) A rotating component comprised of impeller and shaft
(2) A stationary component comprised of a casing, casing cover, and bearing

Auxiliary components generally include the following systems for the following services:

- (Seal flushing, cooling, quenching system)
- Seal drains and vents
- Bearing lubrication, cooling system
- (Seal chamber) or stuffing box cooling, heating system

Auxiliary piping systems include tubing, piping, isolating valves, (control valves, relief valves, temperature gauges and thermocouples), pressure gauge, (sight flow indicator, orifices, seal flush coolers, dual seal barrier/buffer fluid reservoirs), and all related vents and drain.

Maintenance activity for the pump should be conducted to main components and auxiliary components.

2. Criteria for maintenance

It is represented in the pump maintenance activity in addition to the general cleanness, painting, confirm that internal parts work in proper condition and avoid the pump from not working so we can recover any simple phenomena like increase or decrease of cooling water, continuous lubrication, and inspecting pumps when much noise , rise in temperature or vibration occur.

3. Maintenance activity

Daily monitoring and check, and periodical inspection should be required to keep the pump in proper working. Maintenance activity shown herein means activity for the routine maintenance. Description regarding activity for the corrective maintenance is shown in trouble shooting.

Maintenance activity consists of four (4) kinds of working components as follows:

(1) Monitoring and checking during working of facility

(2) Periodical inspection during working or after shut down
(3) Evaluate and analysis regarding result of monitoring and check, and inspection
(4) Recovery e.g., repairing, replace, supply or change of oil and so.

3-1. Monitoring and visual check

3-1-1. Pump

Daily	1. Visually check for leaks
	2, Adjust glands as necessary to maintain proper leakage
	3. Hand test bearing housing for any sign of temp. rise
Every week	1. Visually check for leaks
	2. Adjust glands as necessary to maintain proper leakage
	3. Hand test bearing housing for any sign of temperature rise
Every month	1. Check for lubrication
	2. Check the packing and replace it if necessary
	3. Check and re-grease the bearing
Every 6 months	1. Check alignment of the pimp and motor
	2. Check holding down bolts for tightness
Every year	1. Check rotating element for wear
	2. Check wear ring clearance
	3. Vibration testing

3-2. Periodical inspection during working or after shut down

It includes monitoring of flow rate, pressure head for pumps and current consumption to recognize the pump operation efficiency. When the pump stopped, oiling/greasing of bearings have to be checked and cleaning the excesses.

3-3. Evaluate and analysis regarding result of monitoring and check, and inspection

Generally, we can recognize the efficiency of the pump or the corrective actions needed in case of not applying the flow rate or the pressure head or increase current consumption rater than the design rate for the pump from the results of monitoring.

3-4. Recovery e.g., repairing, replace, supply or change of oil, etc

This means keep the pump in its original condition or the nearest to this condition. This condition will happen by rapid repair or replacing damage parts and avoid the pump from not working.

4. Reports and records

4-1. Records

Records should include the following:

4-1-1. Records of the maintenance work for the facility

- Result of monitoring and check (check list)
- Result of periodical inspection
- Record during the maintenance work of facility
  - Indication of discharge pressure
  - Indication of current meter
  - Measurement of vibration by vibration meter
  - Measurement of noise by noise meter
  - Measurement of temperature of motor and bearing

4-2. Reports

Reports should include the following:

4-2-1. Report for recommendation

(1) Rehabilitation
- Repairing or replace
- List of spare parts that should be required to stock in the plant

(2) Upgrading of facility or system
- Change of capacity, material, and other specifications
- Addition of facility
- Modification of facility or system
- Proposal of preventive maintenance activity to be needed

4-2-2. Report of maintenance activity

(1) Annual report
- Repairing and replace for each facility
- Trouble and accident
  - Result of corrective maintenance
  - List of consumed spare parts in a year

(2) Corrective action to prevent the trouble or accident

SOP for Zagazig WTP

Plant Name: ZAGAZIG W.T.P.	Title: Overview for ZAGAZIG Water Treatment Plant	SOP TAG No. ZAG-WTP00-OV

Issued		Developed by		Signature	
Revised		Approved by		Signature	

1. General information of the plant

1-1. General information

(1) Location
(2) Construction Phases
(3) Source of raw water
(4) Type treatment process
(5) Nominal and current treatment capacities
(6) General layout
(7) General flow diagram
(8) Service areas and connections to the distribution network
(9) Organization and staff formation

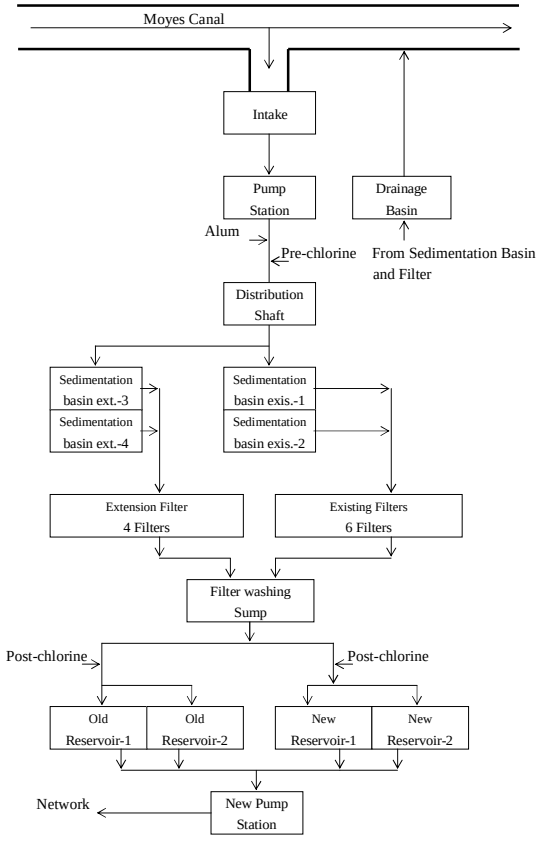
1-2. Components of process and facility in water treatment plant

- There are relations and connections between each process in the overall water treatment process and facilities in each process.
- Water treatment plant works properly by using functions of water treatment process.
- Water treatment process consists of plural processes.
- Water treatment process works by using functions of each process.
- Each process consists of many facilities.
- Each process works by using functions of many facilities.
- Water treatment process works reciprocally with each process.
- Each process works reciprocally by using functions of many facilities.

1-2-1. Components of unit process

There are seven (7) unit processes in ABBASA water treatment plant as follows:
(1) Raw water intake, transfer and distribution process
(2) Coagulation process
(3) Sedimentation process
(4) Filtering process
(5) Disinfection process
(6) Clear water storage and distribution process
(7) Sludge drainage process

1-2-2. General flow diagram



1-2-3. Components of facility in each process

Components of facility in unit process are the following:

(1) Raw water intake, transfer and distribution process
This process includes the following:
- Raw water intake area and canal
- Raw water intake gate, channel and screen
- Raw water basin facility
- Raw water pump facility
- Raw water receiving well (or distribution shaft) facility
- Water sampling facility

(2) Coagulation and sedimentation process
This process includes the following:
- Mixing basin
  - Rapid mixing facility (Flush mixer)
  - Flocculation basin
  - Slow mixing facilities (Flocculator)
- Aluminum sulfate dosing facility
  - Aluminum sulfate solution storage tank
  - Aluminum sulfate dosing pump

(3) Sedimentation process
This process includes the following;
- Sedimentation basin with effluent trough
- Sludge collector
- Sludge drainage facilities
- Water sampling facility

(4) Filtering process
This process includes the following;
- Filter basin with filter media and under train facility
- Filter control facility with compressor facility
- Filter monitoring facility
- Filter washing facility
- Water sampling facility

(5) Disinfection and chlorination process
This process includes pre-chlorine and post-chlorine facility as follows;
- Chlorine storage facility
- Chlorine gas evaporator
- Chlorine gas piping and valve
- Pre-chlorinator and post-chlorinator
- Chlorine neutralization facility with chlorine leakage detector

(6) Clear water storage and distribution process
- Underground reservoir
- Clear water basin
- Transmission pump facility
- Water sampling facility

(7) Sludge drainage process
- Sludge drainage basin
- Sludge drainage pump facility

1-2-4. Specifications of machines and devices in each facility

Refer to attached facility list in APPENDIX.

1-3. Basic system on facility operating and process control

1-3-1. Basic system on unit process control

(1) Water treatment plant type
- Conventional filtration treatment plant
- Coagulation/ordinal sedimentation/rapid sand filter type

(2) Process control
All unit processes are controlled manually by chemists

(3) Water quality control
Water quality analyses are carried out periodically in the plant laboratory by chemists. There are no water quality items monitored continuously by monitoring instrument.

1-3-2. System description

(1) Basic system
- Operation of facility: Manual operation for all the facilities
- Control of process: Manual control for all the process
- Monitoring of water quality: Not continuous monitoring

(2) System of each process
- Raw water transfer
  Individual pump stations are available for old and new plant. Raw water is drawn into raw water basin by gravity from canal
- Distribution of raw water
  - Raw water is transferred to two raw water pipes and flown into two distribution shafts.
  - The raw water is distributed to mixing, flocculation and sedimentation basin by distribution shafts. Raw water line distributes the raw water to two (2) existing sedimentation basins lines and two (2) extension plant lines

- Control of raw water quantity
  Total flow rate of raw water of WTP is controlled manually by working numbers of raw water pumps in old and new pump stations.
- Operation of facility: Manual operation for all facilities basically
- Aluminum dosing facility: Common use for both of existing and extension plant
- Aluminum sulfate dosing method: By metering pump
- Aluminum sulfate dosing control: By manual control
- Aluminum sulfate specifications for operation
  - Receiving and storage: Solid aluminum sulfate
  - Solid alum for receiving and storage: 16 (w/w%) as Al_2O_3 contained
  - Solution concentration of aluminum sulfate dosing: 10 (W/V%) solution concentration
  - Aluminum sulfate dosing point: At raw water pipes before distribution shafts
- Rapid mixing
  - Mechanical mixing by flush mixer for each sedimentation basin
- Slow mixing
  - Mixed by mechanical Flocculator and rotation number is valuable
  - Sedimentation basin
  - Circular shaped and up-stream flow type for old and new plant
- Sludge collector
  - Mechanical sludge collector type for old and new plant
- Sludge drainage from sedimentation basin
  - Operation: Manual operation
  - Gravity flow assisted by telescopic valves
- Filtration
  - Type of filter: Rapid sand filter by gravity
  - Control of filtering: Constant flow rate filtration
  - Filter media: Single media filtration
  - Filter washing method: Air washing and backwashing
  - Supply for backwashing water
    - Supplied from back wash pump
  - Filtered water basin (Backwash sump)
    - Available
  - Chlorination
    - Store of chlorine: 1 ton container
    - Chlorine taken out from container: Gas chlorine only
    - Chlorinator: Pre-chlorinators and post-chlorinators are available at both old and new plant. Pre-chlorine is dosed into raw water pipe by pre-chlorinator Post-chlorine is dosed into filtered water individually by old and new chlorinator.
      - Type of chlorinator: Injector vacuum type
      - Type of operation: Manual operation

  - Type of dosing flow rate control: Manual control
- Drainage facility: Type of operation for drainage pump: Manual operation
  Drainage basin receives drained sludge from sedimentation basin and waste water from filters. Drainage sludge and waste water are mixed in drainage basin and all of mixed waste drainage water is drained out to canal by drainage pumps.

2. Overview of the SOPs of the Plant

2-1. Purpose of SOPs

Purpose of SOPs is to provide assistance to the water supplier in the operation & maintenance (O&M) and water quality control (WQC) procedures for each facility or process in water treatment plant.

2-2. Application of SOPs

SOPs should be applied surely to actual O&M and WQC. However, SOPs are not necessarily constant and subject to change. SOPs should not only be kept as documents but also be utilized as tools for O&M and WQC activities. Since SOPs must be utilized in actual activities, they should be reviewed and revised so that they can be suitable and useful anytime in any situation for water supplier according to evaluation of utilized results. We should find improved results of O&M and WQC activities whenever we review and revise SOPs.

2-3. Component of SOPs

SOPs for WTP consist of twenty-one (21) SOPs component units and these components are shown in "SOPs Headline". Each SOP consists of three (3) SOPs packages as follows:
- SOPs for operation
- SOPs for maintenance
- SOPs for water quality control

2-3-1. SOPs for Operation

Documents which require criteria and procedures for operation and control activities of facility are provided in this SOPs and include the following:
- Explanation of process and relation between other process
- Criteria for operation activity and design
- Operation and control procedures for facility in normal condition and unusual condition
- Monitoring and visual check items for facility
- Reporting and recording system

2-3-2. SOPs for Maintenance

Documents which require criteria and procedures for maintenance activities of facility are provided in this SOPs and include the following:
- Criteria for maintenance activity
- Maintenance procedures for facility in normal condition and unusual condition
- Monitoring and visual check items for facility
- Reporting and record system

2-3-3. SOPs for Water Quality Control

Documents which require criteria and procedures for water quality control and process control are provided in this SOPs and include the following:
- Criteria for water quality control activity
- Water quality control and process control procedures in normal condition and unusual condition
- Monitoring and visual check items for water quality and process
- Reporting and record system

2-4. Review of SOPs and O&M plan

SOPs is one of tools to perform optimum O&M and WQC activities and results and as the result to improve management of water treatment plant operation. We can realize and find in our O&M activities should be modified or arranged for improvement such as more simple, effective or suitable method, by utilizing of SOPs. When we find part to be modified or arranged for improvement in SOPs, we should approach to review SOPs to be proper according to prepared procedures, as soon as possible if necessary.

2-4-1. Review of O&M and WQC activities

Review of SOPs should be carried out periodically not less than once a year and properly if necessary. After review of SOPs, SOPs should be updated to revised version. Records of SOPs review and histories of review must be required to issue and keep them. Records of view should include the following:
- Activities before review and after review and reviewed reasons
- Signatures of approved persons, date of review
- Results of review
- Marking of reviewed part and description of reviewed histories in revised SOPs documents

2-5. Preparation for making of O&M plan

O&M plan is developed to provide a material that can be easily referred to for guidance in

operating a water system. The O&M plan will also provide ready reference for following;

- All equipment data which is necessary for performing normal maintenance
- Ordering replacement parts and supplies
- Organized system for keeping records of O&M of the system
- Water sampling, analysis and testing which required for compliance with regulations
- Monitoring of the treatment process for compliance with accepted waterworks procedures.
- Information regarding start-up and normal operating procedures and emergency operating procedures

O&M plan will become a training manual to provide personnel which handy source reference while they learn to operate the facilities. The experienced operator will usually refer to the O&M plan for confirmation of normal operation and maintenance procedures and as a reference guide for unusual operating conditions. The entry level operator should frequently refer to the O&M plan for guidance and instruction.

Plant Name: ZAGAZIG W.T.P.	Title: Raw Water Intake	SOP TAG No. ZAG-WTP01-OP

Issued	09/oct/07	Developed by		Signature	
Revised		Approved by		Signature	

1. Introduction

In general, water sources for water treatment plant consist of surface water, groundwater or bulk water purchased from another water supply utilities. Surface water source will be from rivers, streams, lakes, or impoundments and groundwater will be from wells or springs.

For ZAGAZIG water treatment plant (WTP), the water source is surface water from the Moyes canal.

Water quality of raw water must be acceptable as a safe drinking water when treated, and the quantity must be constantly sufficient for the water demand of the target areas to be supplied by the plant. In many cases, after raw water has been contaminated, it is a better solution to protect the quality of the raw water than to treat it.

There are some possibilities that water from the contaminated water sources contains chemical, microbiological or radiological substances which may be harmful for human health.

Intake facility has a function of withdrawing water from canal or river and conveying it to water treatment plant. The ideal intake facility will be capable of taking raw water from various distances and screening it to prevent algae scum, trash, logs, or fish from entering the plant.

2. Features of process

2-1. Function of process

(1) Taking water from the canal and conveying it to water treatment plant
(2) Prevention of algae scum, trash, logs, or fish from entering the plant
(3) Prevention of harmful substances such as oil from entering the treatment process of the plant

2-2 Impacts of process

(1) The first stage of water treatment plant
(2) Initial cleaning by removing trashes, logs, or suspended materials
(3) Critical situation in water treatment plant should be avoided by shutdown of water intake.

2-3. Relations between other processes

Raw water quality may be affected by this process, so that it will influence on many other supply elements, especially treatment processes.

3. Criteria for operation

3-1. Frequency of monitoring and visual check

Monitoring and visual check should be conducted by routine work twice a day or more. And information of the canal condition in upstream should be collected when the Ministry of Irrigation will disinfect the canal and monitoring any emergency change.

3-2. Frequency of cleaning of screen in the intake channel

Cleaning of the screen in the intake channel will be conducted as a routine work twice or three times a day.

4. Operation under normal condition

4-1. Start-up and shutdown procedures

4-1-1. Start-up

The canal water should be withdrawn from intake and led into the raw water basin through two lines of the raw water pipe by the gravity. Main gate is installed at the inlet of intake channel and the raw water valve is installed at the end of the intake channel. The intake channel of the raw water is installed 2 sets individually. The raw water from the canal should be able to lead into the raw water basin by the following steps:

1st: Intake channel No.1, No.2, No.3 or all should be chosen.
2nd: Main gate will be opened for the chosen intake channel according to the required amount of water for treatment.
3rd: Raw water pipe No.1, No.2 or No.3 or all should be chosen.
4th: Raw water valve in the chosen raw water pipe should be opened.

Activities around the raw water basin

5th: The raw water valve in the raw water basin should be opened.
The raw water will be flown into the raw water basin.

Start-up precautions

1) Main gates should be opened but not fully. Substances on the water surface should be prevented from entering into the raw water channel.
2) Raw water valves in the channels should be opened fully. When they are opened not fully, mud or algae in the raw water will be precipitated in the raw water pipes.

4-1-2. Shutdown

There are two (2) kinds of activities for shutdown. The first one is the planned shutdown and the other is the emergency shutdown.

(1) Planned shutdown
For periodical cleaning or inspection of the raw water channel, shutdown of the intake will be planned. In this shutdown, the main gate and the raw water valve will be closed. And the raw water in the raw water channel will be drained out as needed.

(2) Emergency shutdown
In this case, situation is critical. Therefore, the raw water must be avoided to enter into the water treatment plant. Shutdown of the intake means shutdown of water treatment plant.

Hence, this decision must be done by the person-in-charge at the water treatment plant.

1st: The raw water pump must be stopped.
2nd: The raw water valve in the raw water channels and the raw water basin must be closed. Simultaneously, the main gate for the raw water channel must be closed.

Note
1) Person-in-charge should be appointed beforehand who can make a decision for shutdown of the intake under the emergency situation.
2) Plan of activity in emergency case should be prepared.
   - Communication action
   - Organization of the team for aid
   - Steps of the activity to avoid expansion of damage
   - Steps of the activity for recovery

4-2. Monitoring and visual check of facility

Monitoring and visual check of the intake area is very important activity. It should be conducted more than twice every day by prepared check list ZAG-WTP01-OPSC. If unusual condition will be found, corrective action should be conducted immediately. Especially accidents related to water source contamination must be listed beforehand to avoid.

4-3. Operation procedures for control of facility

Quantity of raw water from the intake will be controlled to avoid precipitation of muddy substances in the raw water. This will be conducted by fully opening of the raw water valve.

5. Operation under unusual condition

5-1. Expected troubles and trouble shootings

Refer to trouble shooting sheets for common use.

5-2. Troubles in the past, causes, backgrounds and events for recovery

Trouble history

Examples of troubles in the past will be useful for solution of the troubles to be happened. Trouble history, the data of troubles in the past, should be applied to the following jobs:

- Recognition of weak point of facility
- Recognition of weak point of facility
- Recognition of weak point of activity of operation and maintenance
- Recognition of wear of facility or part of facility
- Reference for approaching ways and procedures to the trouble
- Reference for “Need to know” to approach the trouble
- Reference for “Prohibit to do” to approach the trouble

Information for trouble history should be recorded and filled in form sheet. Trouble history shall be referred to ABS-WTP01-OPTS-01.

6. Report and record

In order to perform a reasonable activity in O&M of WTP, it should be carried out based upon not only our experiences and instincts but also utilization of statistical and mathematical approaches by prediction, analysis and trial action aiming at optimum results.

Hence, the record or report is one of essential and fundamental documents in O & M of WTP. Reporting is the activity of preparing documents and making communication with staff inside and outside of WTP by utilization of records, reports, data and other facts. Reports include periodical reports such as monthly report or annual report and report on recovery activities against troubles or unusual conditions.

6-1. Record

Record for operation of raw water intake facilities should require as follows:

6-1-1. Record of monitoring and visual check

Monitoring and visual check list should be required. When unusual conditions are found, they should be corrected, and noted in check list sheet. Monitoring and check items are the following:

- Gate and lifting device
- Raw water channel

- Screen
- Raw water valve
- Condition of the canal in the upper stream
- Condition of the canal around inlet of the intake
- Environment around the intake channel

Activity of monitoring and visual check should be recorded according to O&M schedule, ZAG-WTP01-OPSC-01.

6-2. Report

Reports for operation of raw water intake should include as follows:

- Recommendation
- Review of O&M plan
- Review of contents for monitoring and visual check
  - Frequency
  - Check item

Plant Name:	Title of SOP:	SOP TAG No.
ZAGAZIG W.T.P.	**Raw Water Intake - O&M Schedule**	**ZAG-WTP01-OPSC**

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O&M Schedule for Raw Water Intake

D: Daily, W: weekly, M: Monthly, 3M: Each 3 month, 6M: Each 6 month, Y: Yearly, AN: As needed

Name of Facility	Frequency						
	D	W	M	3M	6M	Y	AN
1. Intake gate							
1-1. Condition of opening	○						
1-2. Suspended substances around the gate	○						
1-2. Damage and corrosion					○		
1-3. Water seal						○	
1-4. Damage of frame						○	
1-5. Condition of lifting hook			○				
2. Lifting device of gate							
2-1. Condition of lifting chain	○						
2-2. Condition of operation			○				
2-3. Lubrication			○				
2-4. Condition of lifting hook			○				
2-5. Damage and corrosion			○				
3. Intake channel							
3-1. Condition of waste such as mud or algae growth	○						
3-2. Suspended substances in the channel	○						
3-3. Precipitation in the channel		○					
4. The raw water valve							
4-1. Condition of opening	○						
4-2. Damage and corrosion							○
4-3. Water seal					○		
4-4. Clogging	○						
5. Screen							
5-1. Clogging	○						
5-2. Damage and corrosion			○				
6. The canal around inlet of the intake							
6-1. Waste	○						
6-2. Foreign substances such as body of animals	○						
6-3. Growth of mud, algae or water plant	○						

Name of Facility	Frequency						
	D	W	M	3M	6M	Y	AN
6-4. Color and odor of water	○						
6-5. Water level of canal	○						
6-6. Speed of the stream	○						
7. Environment around the intake channel							
7-1. Foreign substances such as chemical waste	○						
7-2. Waste and trash	○						
7-3. Smell	○						

ZAG-WTP01-MT	Revised version	Issued date	Page 1of 1

Plant Name: ZAGAZIG W.T.P.	Title: Raw Water Intake	SOP TAG No. ZAG-WTP01-MT

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1. Introduction

Facilities for raw water intake consist of the following.
(1) Intake gate and lifting device
(2) Intake channel
(3) Screen
(4) Raw water valve in the intake channel
(5) Dewatering pumps

2. Criteria for maintenance

Maintenance activity should be conducted according to O&M schedule, ZAG-WTP01-OPSC.

2.1 Maintenance activities

Examples of recovery for the raw water intake are shown below:

- Supplying oil or grease
- Repainting
- Removing mud or water grass in the raw water channel
- Removing water grass in the canal around the intake
- Removing harmful substances or waste around the intake area
- Replacing the whole facility or a part of it

2.2 Recovery to unusual condition

Expected unusual conditions are shown as follows:

- Foreign substances flow into the raw water pipe.
- Raw water flow rate is reduced.
- Mud in the raw water precipitates in the raw water pipe.
- Raw water valve can not be opened fully.
- Raw water intake can not be stopped.

ZAG-WTP01-QC	Revised version	Issued date	Page 1of 2

Plant Name: ZAGAZIG W.T.P.	Title: Raw Water Intake	SOP TAG No. ZAG-WTP01-QC

Issued		Developed by		Signature	
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1. Introduction

Water sources can be monitored for a change of condition, but not be able to be controlled by water supply utilities. Raw water intake is the first stage of water treatment. Hence, for early detection of change of raw water quality, monitoring should be conducted periodically. The monitoring should be conducted continuously, if possible.

The quality of the canal water will be changed in the upstream of rivers such as the Nile River. The quality of the canal water will also be changed by the water flow rate of the canal and seasonable fluctuation of physical characteristics of the water such as pH, alkalinity and water temperature.

The trend of the change regarding water quality should be grasped as daily, weekly, monthly or seasonal change. For example, in summer season, water temperature, algae account and turbidity will be higher in comparison with winter season.

Effectiveness of water treatment process is much affected by the above factors. Water quality control should be performed by the effective process control utilizing information about the prediction of change in the raw water quality.

2. Criteria for Water Quality Control

Criteria for water quality control are as follows:

- Frequency of monitoring of the raw water quality
- Items of analysis for the raw water quality
- Acceptable limit of above for intake
- Sampling point of the raw water intake

3. Activity of the water quality control

3-1. Monitoring and visual check

Monitoring and visual check of the intake area is very important activity. It should be conducted more than twice every day by prepared check list.

If unusual condition is found, corrective action should be conducted immediately. Especially, accident of water source contamination must be listed beforehand to avoid it.

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3-2. Water quality control

Activity of water quality control in the intake area may be called it water quality management or management of the raw water intake.

Information about the raw water quality in the raw water intake is essential to control of the whole of water treatment process.

Quantity or quality of the raw water can not be changed by the raw water intake facility. In the process of the raw water intake, shutdown of raw water intake into the water treatment is the only one and serious activity for the water quality control.

Criteria for shut down of the raw water intake should be determined.

4. Recovery from Unusual Condition:

Expected unusual conditions are shown below:

- The water level of the canal will be decrease unusually
- A big amount of mud will flow into the intake
- Foreign substances such as body of animal will flow in the canal
- Contamination such as oil waste in the upstream flow of the canal

5. Report and record

5-1. Record

Record for water quality control of the raw water intake should include the following:
(1) Record of water quality of the raw water intake
(2) Record of monitoring and visual check

5-2.Report

Report for water quality control of the raw water intake should include the following:

5-2-1. Trend of the canal water quality

(1) Monthly
(2) Annual
(3) Seasonal

5-2-2. Recommendation on the raw water intake

(1) Safety and security
(2) Improvement
(3) Research on the upstream area

ZAG-WTP02-OP	Revised version	Issued date	Page 1of 4

Plant Name: ZAGAZIG W.T.P.	Title: Raw Water Pump	SOP TAG No. ZAG-WTP02-OP

Issued		Developed by		Signature	
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1. Introduction

Raw water pump facility consists of the following equipment:
(1) Raw water basin (raw water pit and suction tank)
(2) Raw water pumps
(3) Vacuum pumps
(4) Pipes and valves
(5) Sampling pump
(6) Dewatering pumps
(7) Crane

ABBASA WTP has two pump stations and two raw water intakes. Raw water from the intake is led into the raw water pit and suction tank through two raw water pipes. Raw water in the raw water suction tank is sucked by the raw water pumps and transferred to distribution shaft though a raw water pipe.

Discharge pipes from the raw water pumps of old and new plants are connected each other, and after that separated to two pipelines for the two distribution shafts.

2. Features of process

2-1. Function of process

Function of the raw water facility is to transfer the raw water into the distribution shaft with the required quantity.

2-2. Impacts of process

For the correct starting for production process adjustment, the raw water flow rate shall be adjusted by the required chemical calculation. Chemical devices shall also be adjusted so that they can supply the dosage determined in the laboratory which are proportional to the raw water flow rate.

2-3 Relations between other processes

2-3-1. Raw water intake

Raw water intake is a preceding step of the raw water basin. Raw water is flown into the raw water basin by gravity. Water level and water quality in the raw water basin will be

almost the same as the water level and water quality of canal.

2-3-2. Receiving well (called as "Distribution shaft" in Egypt)

The distribution shaft is located after the raw water pump facility. The required quantity of the raw water should be fed from the raw water pump to the distribution shaft under controlled condition and required quantities.

3. Criteria for operation

3-1. Schedule for pump operation

Raw water pumps should be operated according to the operation schedule. Usually, one pump will be operated for 24 hours and after that stand-by pump is operated alternately so that operating hours can be evenly distributed to all the pumps.

3-2. preparation to start operating the pump

Prior to start a pump, air in the casing of the pump should be evacuated by vacuum pump. After water is filled in the pump casing, a pump will be able to start. Vacuum pressure indicator requires minus 0.3 bar or more to start a pump.

4. Operation under normal condition

4-1. Startup and shutdown procedures

4-1-1. Pre-start check

Pump operated should be selected and the following should be checked:

(1) Water level in the raw water basin
Water level should be sufficient for operating pump.
(2) Valves on suction pipeline
Valves in suction pipeline should be opened fully.
(3) Valves on discharge pipeline
Valves in discharge pipeline should be closed before starting operation.
(4) Valve for air evacuation by vacuum pump
Valve for air evacuation by vacuum pump should be opened fully.
(5) Electrical switch board
Power should be supplied.

4-1-2. Startup

(1) Operate vacuum pump to start
Vacuum pressure indicator should require 0.3 bar or more.
(2) Close valve for air evacuation and stop vacuum pump

(3) Operate start switch on switch board to start pump
(4) Confirm pressure gauge of discharge pipeline to be fully loaded
Indication of pressure gauge should be ----bar or more
(5) Check indicator of current meter on switch board to be fully loaded
Electrical current should be -----A or less
(6) Check unusual noise, vibration, temperature arise and water leakage
(7) Check condition of water leakage from part of gland packing in stuffing box
(8) Adjust tightening of gland packing as required

4-1-3. Shutdown

(1) Push stop button on switch board to stop pump
(2) Close discharge valve

4-2. Monitoring and visual check during operation

Monitoring and visual check of the intake area is very important activity. It should be conducted more than twice a day by the prepared check list. If unusual condition is found, corrective action should be immediately conducted especially in case of vibration, unusual noise and considerable decrease of pump flow rate due to the clogging caused by plastic bags.

5. Operation under unusual condition

5-1 Expected troubles and trouble shooting

- Clogging in the suction pipe or the discharge pipe
- Discharge pressure is not enough
- Discharge quantity is not enough
- The water level in the raw water basin is not enough
- Mechanical or physical trouble of the pump

Trouble shootings are shown in ABS-WTP02-OPTS.

6. Report and record

6-1. Record

Record for the raw water pump operation should include the following:

6-1-1. Record of pump operation

- Operation hours of each pump
- Operation condition
- Discharge pressure, quantity, electrical current, etc.
- Water level in the raw water basin

- Unusual condition of pump

6-1-2. Record of vacuum pump operation

- Operation hours of each pump
- Operation condition
- Vacuum pressure, electrical current, etc.

6-2 Report

Reports for operation of raw water intake should include the following:

6-2-1. Unusual condition in operation

Unusual condition, corrective action conducted and recovery time should be reported.

6-2-2. Monthly report

- Operation hours of each pump
- Recommendation on operation

6-2-3. Annual report

- Operation hours of each pump
- Recommendation on operation

Plant Name: **ZAGAZIG W.T.P.**	Title **Raw Water Pump**	SOP TAG No. **ZAG-WTP02-MT**

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1. Introduction

Centrifugal pump consists of two (2) main components of pump and motor. Pump has two main components:

(1) Rotating component comprised of impeller and shaft
(2) Stationary component comprised of casing, casing cover, and bearing

Also pumps include some auxiliary components as shown below:

- Evacuation system
- Stuffing box cooling pipe
- Oiling/greasing pump bearings
- Seal water drains and vents

Auxiliary piping systems include tubing, piping and isolating valves (control valves, relief valves, temperature gauges and thermocouples).

Maintenance activity for the pump should be conducted to main components and auxiliary components.

2. Criteria for maintenance

It is represented in the pump maintenance activity in addition to the general cleanness, painting, confirm that internal parts work in proper condition and avoid the pump from not working so we can recover any simple phenomena like increase or decrease of cooling water, continuous lubrication, and inspecting pumps when much noise , rise in temperature or vibration occur.

3. Maintenance activity

Daily monitoring and check, and periodical inspection should be required to keep the pump in proper working. Maintenance activity shown herein means activity for the routine maintenance. Description regarding activity for the corrective maintenance is shown in trouble shooting. Maintenance activity consists of 4 kinds of working components as following;

(1) Monitoring and checking during working of facility
(2) Periodical inspection during working or after shut down
(3) Evaluate and analysis regarding result of monitoring and check, and inspection

(4) Recovery e.g., repairing, replace, supply or change of oil and so.

3-1. Monitoring and visual check

3-1-1. Pump

Period	Monitoring and Check Item
Daily	1. Visual check for leaks
	2. Adjustment of glands as required to maintain proper leakage
	3. Hand test of bearing housing for any sign of temperature rise
Every week	1. Visual check for leaks
	2. Adjustment of glands as required to maintain proper leakage
	3. Hand test of bearing housing for any sign of temperature rise
Every month	1. Check for lubrication
	2. Check of packing and the replacement when needed
	3. Check and re-grease of bearing
Every 6 months	1. Check for alignment of the pimp and motor
	2. Check of holding down bolts for tightness
Every year	1. Check of rotating element for wear
	2. Check of wearing clearance
	3. Vibration test

3-2. Periodical inspection during operation or after shutdown

This includes monitoring of flow rate, pressure head for pumps and current consumption to confirm pump operation efficiency. When pump has stopped, oil/grease of bearings have to be checked and excessive amount should be cleaned.

3-3. Evaluation and analysis on the results of monitoring, check, and inspection

Generally, we can recognize the efficiency of the pump or the corrective actions needed in case of not applying the flow rate or the pressure head or increase current consumption rater than the design rate for the pump from the results of monitoring.

3-4. Recovery by such as repair, replacement, supply or change of oil, etc

This means keep the pump in its original condition or the nearest to this condition. This condition will happen by rapid repair or replacing damage parts and avoid the pump from not working.

4. Report and record

4-1. Record

Record of operation of the facility should include the following:

- Result of monitoring and check (check list)
- Result of periodical inspection
- Record during working of facility
  - Indication of discharge pressure
  - Indication of current meter
  - Measurement of vibration by vibration meter
  - Measurement of noise by noise meter
  - Measurement of temperature of motor and bearing

4-2. Report

Reports should include the following:

4-2-1. Report for recommendation

(1) Rehabilitation
- Repair or replacement
- List of spare parts that should be stored in the plant

(2) Upgrading of facility or system
- Change of capacity, material, and other specifications
- Addition of facility
- Modification of facility or system
- Proposal of preventive maintenance activity to be needed

4-2-2. Report of maintenance activity

(1) Annual report
- Repair and replacement for each facility
- Trouble and accident
  - Result of corrective maintenance
  - List of consumed spare parts in a year

(2) Corrective action to prevent trouble or accident

Plant Name: **ZAGAZIG W.T.P.**	Title **Receiving Well**	SOP TAG No. **ZAG-WTP03-OP**

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1. Description of the facility

1-1. Outline of facility

In ZAGAZIG WTP, raw water from the raw water pump is fed into distribution shaft through a raw water pipe. Alum and chlorine as coagulants are dosed into each raw water pipe. Chlorine is dosed prior to dosing of alum.

Raw water is distributed to four (4) sedimentation basins from distribution shaft

1-2. Function of the receiving well (called as "Distribution shaft")

Function of the distribution shaft is to receive raw water from the raw water pump and distribute the raw water evenly to sedimentation basins.

1-3. Impact of facility

Raw water quantity is one of essential data in the operation of water treatment plant. If the raw water quantity is distributed unevenly, load to coagulation and sedimentation basins will be different in each basin and water quality of effluent water from sedimentation basins will be different in each basin. Even distribution of raw water quantity should be conducted as much as possible.

1-4. Relation with other facilities

1-4-1. Raw water pump

Raw water is distributed to four (4) sedimentation basins from distribution shaft. Hence, raw water quantity fed into the distribution shaft should be changed according to the total quantity of distribution.

Distribution of raw water quantity in the raw water pipe should be controlled by opening degree of the valve before flow meter and raw water quantity to the each distribution shaft will be confirmed by flow indicator.

1-4-2. Coagulation and sedimentation facilities

Even flow rate of raw water is required to proper treatment through coagulation and

sedimentation according to the design criteria.

1-4-3. Alum and pre-chlorine dosing

Prior to flowing into distribution shaft of raw water, pre-chlorine and alum are dosed into the raw water pipe. Pre-chlorine will be dosed initially and alum dosing will be followed. Pre-chlorine oxidizes organics and other substances in the pipe and will decrease pH value of raw water slightly.

Contact time and well mixing of chlorine with raw water affects decrease of pH value. Proper coagulation by alum is performed within pH of 7.0-7.5. Generally, canal water shows high pH such as 7.6-8.0, pH decrease in raw water will lead to better coagulation.

2. The criteria for operation

Criteria for operation are not applied in this facility.

3. Operation under normal operation

Usually, raw water passes through distribution shaft and, inlet and outlet valves will be opened. Hence, only monitoring should be needed to confirm whether unusual condition exists or not. When sedimentation basin is cleaned, outlet valve for the sedimentation basin under cleaning should be closed.

When operation of the sedimentation basin is restarted, outlet valve should be opened gradually by confirming water quality in the sedimentation basin. The outlet valve can be opened after confirming that the water in the sedimentation basin has been stabilized.

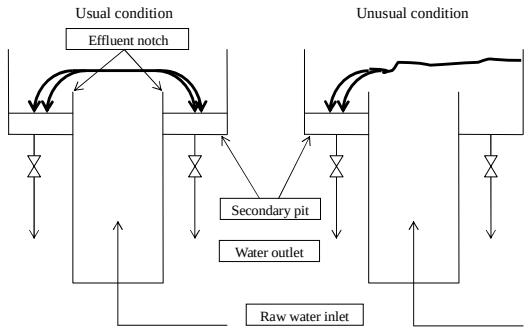
4. Operation under the unusual condition

4-1. Typical unusual condition

Unusual condition of the distribution shaft will occur when the function become insufficient, that is, insufficient uniform distribution of raw water quantity happens. Insufficient uniform distribution of raw water quantity can be confirmed by observation of water level in the distribution shaft.

Water in the distribution shaft falls down though the notch to the attached secondary pit and the water level of the central area of the distribution shaft is normally not affected by the water level of this pit.

However, when the outlet valve is closed or opening of the valve is not sufficient, water level of the secondary pit will arise and affect to the water level of the central area of the distribution shaft. In this condition, raw water will be distributed unevenly.



In case of the above condition, check opening degree of the outlet valve and open it as required.

4-2. Trouble shooting

Trouble shooting is referred to common trouble shooting sheets.

5. Report and record

5-1. Record

Record for operation of the distribution shaft should include the following:
(1) Record of monitoring and visual check
(2) Record of flow rate of the raw water for each distribution shaft

5-2. Report

Report for operation of the distribution shaft should include the following:
(1) Annual report
- Report of raw water quantity
- Report of corrective action (if any)

(2) Recommendation
- Rehabilitation and upgrading
- Review of operation procedures
- Review of unified record sheet

Plant Name: ZAGAZIG W.T.P.	Title: Receiving Well	SOP TAG No. ZAG-WTP03-MT

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1. Introduction

Receiving well will be operated continuously and not able to stop usually. Inspection, cleaning and recovering work of the inside of the distribution shaft will be difficult in usual operation period. The above-mentioned works may be conducted in the scheme of the rehabilitation work.

However, maintenance for the external area of the distribution shaft such as piping and valves can be conducted in the routine works.

2. Criteria for maintenance

- Frequency of inspection: Every three (3) years or as required

3. Maintenance activity

Monitoring, check and inspection should be carried out to judge necessity of recovering activity such as adjustment, repairing or replacing. Unusual condition of the sludge drainage facility will be confirmed by monitoring the following:
- The water condition in the distribution shaft
  - Turbidity or color
  - Foreign substances
- External condition for distribution shaft

Maintenance activity consists of four (4) kinds of working as following:
(1) Monitoring and checking work during working
(2) Inspection
(3) Evaluate and analysis regarding result of inspection
(4) Recovery after the inspection

3-1. Monitoring and visual check

Monitoring and visual check should be carried out according to “O&M schedule” and uniformed check list, and it will be conducted with the monitoring activities for the sedimentation basin.

3-2 Inspection

Inspection should be carried out according to “O&M schedule” and uniformed check list and

it will be conducted with the inspection activities for the sedimentation basin. Causes of the troubles to be occurred in the distribution shaft shown below should be checked and solved:
- Uneven distribution
- Damage of the valve and piping
  - External condition
  - Internal condition
  - Sealing condition
- Unusual of water sealing around the pipe
- Leak around pipe and pipe connection part

3-3. Evaluate and analysis regarding inspection result

After inspection, following items should be evaluated:
- Necessity of recover such as repairing and replacing
- Necessity of adjustment such as opening of the valve
- Necessity of the cleaning

3-4. Recovery after the inspection

After the inspection, recovery action shown below should be conducted as required:
- Repainting
- Cleaning of inside of the drainage pipe
- The valve
  - Supplying the grease as needed
  - Change of part as needed
  - Replace the valve as needed or periodically
- Repairing of leak part around the drainage pipe
- Repairing of leak part of the pipe connection

4. Report and record

4-1. Record

Record for maintenance of the distribution shaft should include the following:
(1) Record of monitoring and visual check
(2) Record of inspection
(3) Record of recovery

4-2. Report

Report for maintenance of the distribution shaft should include the following:
(1) Recommendation
- Rehabilitation
- Review of maintenance activities

Plant Name: ZAGIG W.T.P.	Title: Receiving Well	SOP TAG No. ZAG-WTP03-QC

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1. Introduction

Water quality control for the distribution shaft should be conducted in the following manner:
- Monitoring and visual check
- Taking sample of water in the receiving well mixed with pre-chlorine
- Jar test of above water sample

The sampling tap is available for each raw water pipe located just before the each distribution shaft. A sample of the raw water mixed with pre-chlorine can be sampled from this tap.

2. Criteria for water quality control

(1) Frequency of taking of sample:
- Once a day or more
- According to the requirements from the Holding company

(2) Time of taking of sample: Around 9 a.m. in a morning
(3) Volume of sampling water: 10 litters or more
(4) Procedures for jar test:
- According to the standard operation procedures

(5) Items of water quality should be analyzed
- According to the requirements from the Holding Company

3. Water quality control under normal condition

The activity of the water quality control should require the following:
- Monitoring and visual check
- Water quality analysis and the laboratory test for the treatment
  - Sampling
  - Water quality analysis
- Determination of the dosing rate for the pre-chlorine
- Adjustment of the dosing rate for the pre-chlorine

3-1. Monitoring and visual check of process

Monitoring and visual check should be conducted according to the unified list for the monitoring and check. Unified list is provided in ABS-WTP03QC-CH01.

3-2. Water analysis and the laboratory test for the treatment

Water analysis and laboratory test should be conducted according to the standard operation procedures. The standard operation procedures can be referred the documents of procedures for water quality control.

3-3. Determination of the dosing rate for the pre-chlorine

The dosing rate of pre-chlorine should be determined by result of laboratory test of the break point. The dosing rate of pre-chlorine will be determined with some additional margin onto the break point value such as 0.2-0.3 mg/L.

3-4. Adjustment of dosing rate for pre-chlorination

Dosing rate of pre-chlorine should be adjusted by evaluation of free chlorine residual of the water in actual facility of the distribution shaft. Results of laboratory test will not always correspond with actual results. Many factors will be related to the results in the actual facility (actual results for water quality) such as mixing condition, water temperature and pH of the raw water, and so.

4. Report and record

4-1. Record

Records for water quality control of the distribution shaft should include the following:

(1) Record of monitoring and visual check
(2) Record of water quality in the distribution shaft

4-2. Report

Reports for water quality control of the distribution shaft should include the following:

(1) Review of criteria
- ◆ Modifying
- ◆ Addition or delete

(2) Review of procedures for operation and control
- ◆ Modifying
- ◆ Addition or delete

(3) Recommendation
- ◆ Upgrading or rehabilitation of facility
- ◆ - Modification and arrangement
- ◆ - Repairing and replace
- ◆ - Additional of facility

(4) Annual report

Plant Name:	Title	SOP TAG No.
ZAGAZIG W.T.P.	**Coagulation Facility**	**ZAG-WTP04-OP**

1. Process Description

1-1. Function of coagulation processes in treatment process

Function of coagulation process is to make optimum condition aim for settling of particulate impurities in sedimentation basin.

1-2. Coagulation Process

Coagulation is the effect of chemicals added to the raw water reacting with the particulate impurities then pre-chlorine added to react with suspended materials then they negatively charged to attract positive ion from alum after dissolving it in water to form a flock.

A flock is the accumulation of the chemicals and the particulate matter to form small jelly-like particles which look like snowflakes in the water. As these pieces of flock clump together and combine with more particulate matter, they grow into larger and heavier flock which will settle out.

The coagulation process is a very complex chemical and physical reaction which depends on many factors of water quality, such as pH, turbidity, temperature, and hardness. It also depends on the chemicals and dosages of chemicals used for coagulation and physical treatment of water, such as rapid mixing, flocculation.

1-3. Impacts of process

Coagulation/sedimentation process is major process affect to treatment result in conventional filtration treatment plant. Coagulation process is completed by three (3) steps as follows:

1st step: Chemicals dosing step
Dosing of coagulant or other aid chemicals into raw water
2nd step: Flocks formation step
Rapid mixing of coagulant or other chemicals with raw water by flush mixer or stream
3rd step: Flocks growth step
Slow mixing by mechanical Flocculator or stream

Coagulation process will be successfully achieved by optimum results in all above-mentioned steps. Even if any one of the steps is not optimum, coagulation process will not be achieved properly.

1-4. Relation to other process

1-4-1. Preceding process

Intake and raw water distribution process
- ◆ Raw water quantity
  Number of raw water pump in operation, distributed water quantity
- ◆ Raw water quality
  Turbidity, pH, temperature, alkalinity, algae accounts, etc
- ◆ Water quality after dosing of pre-chlorine
  Residual chlorine, pH, alkalinity, etc

1-4-2. Following process: Sedimentation process

(1) Related factors
- ◆ Characteristics of flocks in outlet water from flocculation basin to sedimentation basin
  Weight, density
- ◆ Amount of settled sludge in sedimentation basin

(2) Factors to be affected
- ◆ Water quality of raw water
  Analysis conducted for raw water by achieving the jar test to determine proper alum dosage and the break point test to determine proper dosage for pre-chlorine. These analysis achieved in the laboratory by taking raw water samples then making the tests to determine proper dosage which realize best results to form flocks.
- ◆ Water quality after sedimentation
  - ➢ Turbidity
  - ➢ Residual chlorine concentration
  - ➢ pH
  - ➢ Alkalinity
  - ➢ Algae accounts
- ◆ Sludge drainage
  - ➢ Frequency of sludge drainage from sedimentation basin
  - ➢ Period of sludge drainage from sedimentation basin (every 2 hours)
  - ➢ Frequency of sludge drainage from sludge drainage basin
  - ➢ Period of sludge drainage in the period (3 to 5 minutes) or by calculating the clay content for raw water

2. Criteria for operation

Criteria are values to make a judgment to be maintain something or various your activities in proper. If criteria should not be prepared, you will not be able to judge something or various your activities in proper. We should know design criteria for operation and control of facilities.

Since, we show the design criteria for reference as following.

2-1. Design criteria

Design criteria use for initial design of facilities in water treatment plant to determine specifications such as capacity, ability, numbers and so. In other words, design criteria may mean limited ability of each facility.
- ◆ Rapid mixing
  - ➢ Rotation number per minutes of flush mixer
  - ➢ Detention time of raw water in mixing basin
  - ➢ Detention time of raw water in distribution shaft
- ◆ Slow mixing
  - ➢ Detention time of raw water in flocculation basin
  - ➢ Rotation number per minutes of flocculator
  - ➢ Working number of Flocculator in each flocculation basin
- ◆ Alum and pre-chlorine dosing
  - ➢ Detention time of raw water in raw water pipe after pre-chlorine dosing
  - ➢ Dosing range of pre-chlorine for pre-chlorinator
  - ➢ Dosing range of alum for alum dosing device
  - ➢ Concentration of alum solution for dosing

2-2. Operation criteria

Operation criteria should be used to judge a condition of the facility which is operating in proper or not. If operation criteria do not exist, we will not be able to judge operating condition of water treatment facility is proper or not. In other words, operation criteria may use as trigger to start of operation, control, repairing and so, activities for each facility.
- ◆ Rapid mixing
  - ➢ Judgment for necessity of continuous working
- ◆ Slow mixing
  - ➢ Judgment for rotation number per minutes of flocculator and collecting & thickening of flocks efficiency
  - ➢ Judgment for working number of flocculator
  - ➢ Working number of Flocculator in each flocculation basin
- ◆ Alum and chlorine facility
  - ➢ Refer to WTP11 and WTP12

3. Operation procedures under normal condition

3-1. Rapid mixing

Rapid mixing is the initial high speed agitation of the water to ensure a quick dispersion of the chemicals in processed water. This action causes the chemical to be distributed uniformly throughout the water. There is one mixing unit mounted over a smaller chamber having

proper detention time as range in 30sec to 60sec. It is desirable for the water to rapidly come into complete contact with chemicals so the chemical reactions begin; however, it is not desirable that any setting of chemicals or materials occur in this chamber.

Rapid mixer is electric driven motor having a long vertical shaft with propeller extending into the following though the chamber.

3-1-1. Start-up

(1) Pre-start check

Before operation, the following should be checked:

- Free shaft turning
- Check lubrication
- No unsafe conditions (e.g., exposed wires and so)
- MCB (circuit breaker) electrical power supply on

After determined pre-start check, push the Flocculator start button on switch board on site and check the rotation of the rapid mixer and its ability to mix water with chemicals.

3-1-2. Periodical check during working

Periodical check has to be achieved during the day to confirm continuous operation for the mixer, its operation condition and monitoring the temperature of the electric motor and no unusual noise or vibrations.

- Check items during working
- No sound during operation
  - No temperature rising of motor and drive unit
  - No leakage of oil or grease from parts of motor and speed reduction device
  - No loose or damage of shaft and paddle in mixing basin
  - No obstacles or foreign substances in mixing basin
- Monitoring rapid mixing condition
  - Mixing condition of alum with raw water in mixing basin by sampling
  - Mixing condition of chlorine with raw water by sampling

3-1-3. Control procedures

There are no items for mixer itself to be controlled, however, it should be required to judge mixer shall be operated or not, according to confirmation of flock formation in flocculation basin to distinguish the efficiency of the mixer.

Coagulation reactions are completed in very short moment especially under high water temperature in summer season. Since coagulation reaction may be proceed by mixing action by only water flow energy in upstream and/or downstream of mixer. In case of above, coagulation flocks will be broken by mixer or water flow energy in downstream of mixer and it is conceivable rapid mixing is harmful action for growth of flocks.

Generally, a relatively big amount of algae are contained in canal water in Egypt and these accounts will be increase in summer season (e.g., more than 15000 counts/ml in summer season). Coagulant flocks of algae origin are light and easily broken. Once flocks are torn apart, it is difficult to get them to reform to their optimum size and strength.

Details for control procedures refer to ABS-WTP4-QC SOPs for Water Quality Control.

3-2. Slow mixing

Slow mixing is next stage after rapid mixing of the water to ensure a gradual growth of the flocks in processed water. There are two or four mixing units mounted over a flocculation chamber having proper detention time as range in 20min to 30min each.

Although there are baffling slow mixers, the most common slow mixer is electric driven motor having a long vertical or horizontal shaft with paddles extending into the following though the chamber.

3-2-1. Start-up

(1) Pre-start check

Flocculator should be started approximately at the same time as the start-up of chemical dosing and rapid mixing. Prior to start-up, the drive unit should be visually checked.

- - Shaft turns freely
- - Check lubrication
- - Unsafe conditions (e.g., exposed wires and so on)
- - MCB (circuit breaker) electrical power supply

(2) Startup

After determined pre-start check, push the Flocculator start button on switch board on site and check the rotation of the slow mixer, its ability to mix water and forming heavy flocks.

3-2-2. Check items during working

- No sound of noise from motor or speed reduction device
- No temperature rising of motor and speed reduction device
- No leakage of oil or grease from parts of motor and speed reduction device
- No loose or damage of shaft and paddle
- No obstacles or foreign substances in mixing basin
- Formation of flocks in outlet water from flocculation basin
  (Visual check of configuration and density)

3-2-3. Control procedures of Flocculator

Control item of flocculator is checking that the flocculator operates all the time and monitoring the coagulation process to distinguish the efficiency of the mixer. There are many activities, tests, analysis and evaluations to control process as shown below:

- Result of water quality analysis of from this process
- Jar test results
- Analysis of current coagulation process condition
- Water quantity
- Pre-chlorine dosing rate and mixing, dispersion condition

Histories of revision

Rev.	Version	Revised Date	Description of revision
0	Original Version		

Plant Name: **ZAGAZIG W.T.P.**	Title **Coagulation Facility**	SOP TAG No. **ZAG-WTP04 -MT**

Issued	25/sept./07	Developed by		Signature	
Revised	01/oct./07	Approved by		Signature	

1. Criteria for maintenance activities

1-1. Criteria for frequency of preventive maintenance

Maintenance work should be conducted periodically as preventive maintenance. This is one of the criteria for preventive maintenance activity and these criteria are shown in Table-1.

Table -1 Category and Frequency for Maintenance Activity

Part name	Maintenance Work	Group	Frequency
1. Motor	Inspection	PM	Every 6 months
	Replace	CM	As required
2. Drive unit	Supply of lubricant	PM	Once a month
	Periodical overhaul	PM	Every 3 year
	Replace	CM	As required
3. Shaft, propeller	Inspection	PM	Once a year
	Polishing/painting	PM	Once a year
	Replace	CM	As required
4. Mixing basin	Cleaning inside	PM	Every 6 months
	Inspection inside	PM	Every 6 months
	Inspection pipe	PM	Every 6 months

PM: Preventive Maintenance activities
CM: Corrective Maintenance activities

2. Report and record

2-1. Record

Recording in the uniformed sheet should be required for all activities of O&M. Records should include working condition of facilities, maintenance results, troubles, causes and background of troubles, especially origin of causes, etc.

Items to be recorded should be as follows:

(1) Working condition of facility before and after maintenance
- Result of Monitoring and check
- Result of inspection

(2) Run time of facility in working
- Record of operation

(3) Information for maintenance activity
- Name of facility, parts in facility
- Items or kind of activity, e.g. repair, replace, adjustment, oil change etc,
- Picture of part before and after maintenance
- Others

(4) Unusual condition and recovery
- Description about unusual condition
- Damage part
- Date of occurring of unusual condition and completion of recovery
- Information for maintenance activity in the past
- Cause of unusual condition or trouble and damage
- Corrective action or preventive action

Maintenance history is technical record of a facility and we will be able to know characteristics, weak point and defect, age of used, etc.

Maintenance records are useful and they are important information to act the following matters:
- Realize and ensure a current condition
- Identify cause for unusual condition or damaged part
- Indicate procedures for recovery of unusual condition or damaged part
- Spare parts should be prepared in storing

Records should be utilized to prepare maintenance report such as annual report of O&M activity.

2-2. Report

Generally almost of technical records should be reported to staff in technical sections of WTP.

Any records are of no value unless they are utilized. Reports should be useful tool for next improvement activities by utilizing of records.

<Required Reports>
- Periodical maintenance report
- Corrective maintenance report
- Result of recovery of trouble or unusual condition

Plant Name: **ZAGAZIG W.T.P**	Title: **Coagulation Facility**	SOP TAG No.: **ZAG-WTP11**
Kind of document: **O & M Schedule**	Title of Document: **O & M Schedule for mixer and flocculator**	Document No. ABS-WTP04-MTOS-01

Issued	18/Sept./07	Developed by		Signature	
Revised		Approved by		Signature	

Operation and Maintenance Schedule

D: daily, W: weekly, M: monthly, 3M: every 3 month, 6M: every 6 month, Y: yearly, AN: as required

Name of Facility	Frequency						
	D	W	M	3 M	6 M	Y	AN.
1. Flush mixer							
1-1. Check sound of noise from motor or drive unit	○						
1-2. Check temperature rising of motor and drive unit	○						
1-3. Check no leakage of oil or grease	○						
1-4. Check no loose or damage of shaft and paddle	○						
1-5. Check no foreign substances in mixing basin	○						
1-6. Inspect corrosion, waste		○					
1-7. Inspection lubricant and supplying as needed			○				○
1-8. Cleaning and inspection of basin						○	
1-9. Repainting							○
2. Flocculator							
2-1. Check sound of noise from motor or drive unit	○						
2-2. Check temperature rising of motor and drive unit	○						
2-3. Check no leakage of oil or grease	○						
2-4. Check no loose or damage of shaft and paddle	○						
2-5. Check no foreign substances in mixing basin	○						
2-6. Inspect corrosion, waste		○					
2-7. Inspection lubricant and supplying as needed			○				○
2-8. Cleaning and inspection of basin						○	
2-9. Repainting							○

Plant Name: **ZAGAZIG W.T.P.**	Title **Coagulation Facility**	SOP TAG No. **ZAG-WTP04 –QC**

Issued		Developed by		Signature	
Revised		Approved by		Signature	

1. Criteria for water quality control

The water treatment process has to be effective starting from adding proper dosages proper coagulation ending by the disinfection according the water quality control criteria for each process.

Water treatment process consists of multi-number of processes and each process affects each other. The process condition in upstream affect processes in downstream. Since, we must set a treatment target value to be achieved in each process, and monitor and confirm the process condition comparing to the target usually and continuously.

1-1. Criteria for coagulation process

1-1-1. Water quality of clarified water
- Turbidity: not more than 2 NTU
- Free chlorine residual: not less than 0.5 mg/L

1-2. Criteria for coagulation facility

1-2-1. Rapid mixing

Judgment of working or not according to raw water quality unless it leads to break formed flocks, so that we have to check this condition in the laboratory according to the following changes in the raw water:
- Turbidity of raw water
- Algae accounts in raw water
- Temperature of raw water

1-2-2. Slow mixing
- Judgment of working number of flocculator in each flocculation basin
- 2 flocculators are working in usual
- Check that the turbidity in coagulation area more than that in the sedimentation area

1-2-3. Alum and pre-chlorine dosing
- Alum dosing rate
  - Same as dosing rate of the best choice from result of jar test
- Pre-chlorine dosing rate
  - Same as dosing rate of the break point value

- In summer season (May to October): 0.2 mg/L
- In winter season (November to April): 0.3 mg/L

(Note: Above values should be used for references.)

2. Water quality control items under normal condition

2-1. Monitoring of water condition in coagulation process

Water should be monitored in the following manner:
(1) Water in flocculation basin, about inlet and outlet
(2) Water in sedimentation basin, from upstream to downstream
(3) Scum in mixing basin, flocculation basin and sedimentation basin
(4) Foreign substances in mixing basin, flocculation basin and sedimentation basin

2-2. Coagulation condition check by sampled water after rapid mixing

(1) Laboratory test

3. Water quality control in unusual condition

(1) Unusual condition in coagulation process and activities for remedy
(2) Malfunctions of facilities and trouble shootings
(3) Trouble in the past, and cause and the sequence of events - for reference

4. Report and record

4-1. Records

Records should include the following:
- Daily visual check and monitoring results
- Jar test result
- Water analysis results

4-2. Reporting

Reports should include the following:
- Water analysis results and jar test results
- Result of happened unusual condition and process of recovery activities
- Periodical reports about water quality and water treatment condition
  - Monthly
  - Annually
  - Water analysis procedures
  - And so on

Plant Name : ZAGAZIG W.T.P.	Title: Coagulation Facility-Water Quality Control	SOP Tag No. ZAG-WTP04 –QC

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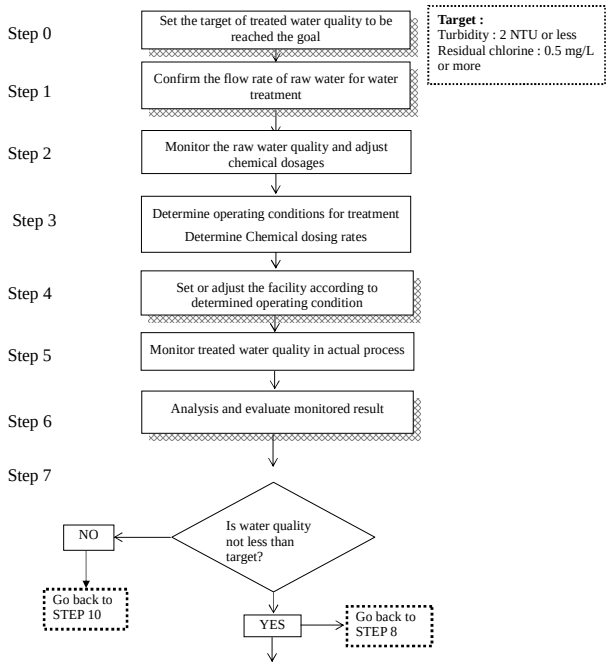

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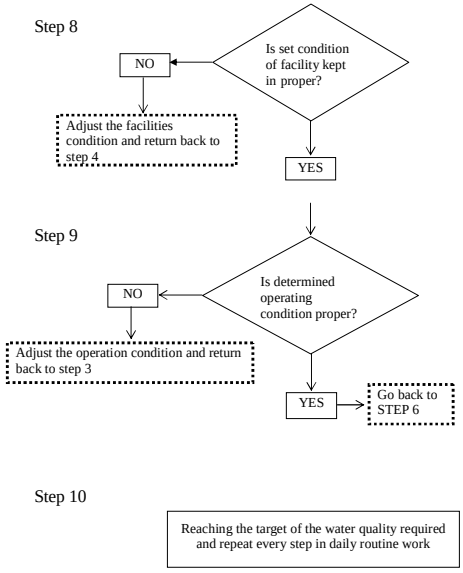

Figure-1 Required Steps for Water Quality Control for Coagulation facility

Plant Name: ZAGAZIG W.T.P.	Title: Sedimentation Basin	SOP TAG No. ZAG-WTP05 –OP

Issued	01/oct/07	Developed by		Signature	
Revised		Approved by		Signature	

1. Introduction

Condition of the water in a sedimentation basin and quality of effluent water from a sedimentation basin, should be checked and monitored. If quality is change to poor, check the operation condition of the process before sedimentation basin and modify the operation condition as needed.

Properness of coagulation process should be evaluated by quality of clarified water, density of precipitations inside the sedimentation basin, flow out of the flocks from the weirs of outlet water.

Water quality in the sedimentation basin should be checked to control the operation condition in the previous processes.

2. Features of process

2-1. Function of facility

Function of sedimentation basin is to settle and remove the flocks which produced by the coagulation and flocculation process.

2-2. Impacts of facility

(1) Result of coagulation process is indicated the water quality in a sedimentation basin.
(2) Change of water quality in a sedimentation basin will progress gradually and it will take approx. 2-3 days.

If control of coagulation process failed, operating condition of coagulation facilities will be changed. So, it will need 2 or 3 days to be evaluated the properness of control of coagulation process. Hence, it will need same days after changing of condition to make sure the result of change of operation condition.

- Detention time in sedimentation basin: Approx.2.5 hours
- Detention time in mixing basin and flocculation basin: Apprpx.0.5 hours
- Total detention time from start of coagulation to the end of sedimentation: Approx.3 hours

Though above mentions, changing place of water in a sedimentation basin will progress gradually. It will not be sufficient 3 hours and need more.

(3) High turbidities in the water leaving sedimentation are lead to poor performance of filtering.

2-3. Relations between other processes or other facility

(1) Water quality of clarified water affects to efficiency of filtering work.
Flocks, which should have been removed in the sedimentation basin, pass on to filters. This will result in reduced filter run times and poorer filtered water quality.
(2) The water treatment process is a chain of the several processes such as raw water intake and transferring, coagulation and flocculation, the sedimentation process.
(3) Water quality in sedimentation basin will be affected by operation condition of sludge drainage from the sedimentation basin. Insufficient of sludge drainage will cause of raise of flocks.
(4) Water quality in sedimentation basin will be affected by operation condition of sludge collector in the sedimentation basin. Insufficient of operation of sludge collector will cause of raise of flocks.

3. Criteria for operation

There is nothing to operate or control the sedimentation basin itself, but attached facilities such as sludge collector and sludge drainage facility. There are no criteria for operation or control of sedimentation basin.

Descriptions on water quality control refer to SOP of WTP05-QC, and sludge collector and sludge drainage facility refer to SOP of WTP06 and 07.

4. Operation under normal condition

4-1. Start-up and shut-down procedures

From previous process the water flows into sedimentation basin through openings around bottom in side of a flocculation basin. There are no valves and no gates.

4-1-1. Startup from a condition without water in sedimentation basin (e. g. Restart after cleaning of basin)

In early stage of water filling into sedimentation basin, condition of the water from a flocculation basin will be unstable by flow with shocks, turbulent flow or short circuit flow.

Hence, clarified effluent in early stage after restart should be drain out. During start up sequence, quality of clarified effluent should be monitored. Clarified effluent will be able to lead into filters by change the valves after clarified water be stable in well. Water quality should be confirmed refer to criteria. Until condition of clarified water will be stable in well, monitoring and check of water quality of effluent should be carried out periodically. It needs by intervals of approx. 30min – 60min in usual.

In this stage, flow rate of the water from the distribution tower should be reduced and after water condition will be stable, flow rate will be able to increase gradually.

Procedures for restart after cleaning of sedimentation basin are shown by steps of work in ZAG-WTP05-OPFC-01.

4-1-2. Shutdown of operation of a sedimentation basin

Shutdown of sedimentation basin will be carried out in case of activity of periodical maintenance. Stop the water flow into the basin and drain out the water in the basin. If a basin will be shut down, distributed flow rate to the each basin should be increased under the condition in same total of flow rate of raw water.

Flow rate of raw water should be adjusted to suitable flow rate for numbers of sedimentation basin in work. If raw water flow rate will be changed, alum and chlorine dosing flow rate should be changed suitably.

4-2. Monitoring and visual check of facility

The jobs of monitoring and visual check should be daily routine work in O&M activity. Unusual condition or trouble should be picked up in early stage by these jobs. Damage by unusual condition or trouble will be minimized by early detection and rapid response of recovery.

These jobs should be carried out and ensured effectively, suitably by valuable check items, significant value will come out from these jobs. This list should be reviewed periodically for maximize of value of jobs and improvement of works.

5. Operation under unusual condition

5-1. Prospect troubles and trouble shootings

5-1-1. During in working

Condition of sedimentation basin will be affected by the operation of the facility in sedimentation basin, such as sludge collector or facility of sludge drainage. Water condition should be monitored and operation condition of the facility in above should be changed if necessary.

- Unusual condition of the water in sedimentation basin
  - Raising of flocks
  - Raising of sludge
  - Short circuit flow
  - Change of color of water
- Cause of unusual condition
  - Raising of flocks

  - Insufficient of sludge drainage
  - Operation of sludge collector cause of light flocks
  - Improper velocity of inlet
- Raising of sludge
  - Produced air by decomposition from precipitated sludge
  - Structural defect of a basin (Matter of initial design)
  - Increase of the inlet water flow rate
  - The inlet opening becomes narrow because of the accumulating sludge
- Change of color of water
  - Change to whitey
    - Insufficient of coagulation
    - Insufficient dosing flow rate of alum
    - Change of raw water quality
    - High pH or alkalinity of raw water
    - Other substance affects to harm coagulation reaction
  - Change to green or blue
    - Too much dosing of alum
- Actions should be required to recover above as followings;
  - Proper frequency of sludge drainage
  - Proper time during sludge drainage
  - Proper dosing rate of alum
  - Control and confirm the raw water flow rate
  - Proper monitoring and analysis of raw water quality

5-1-2. Restart after long term stopping

In case of stop for a long term, such as for 2 weeks or more, preparations before stop should be required to be possible the facility in a sedimentation basin to work normally when restart operation will be carried out.

Prospects of trouble by a long term stop are as following

(1) Sedimentation of sludge
- Prospect of condition
  - Condensed and compressed of sludge on the bottom
  - Condensed and compressed of sludge in the pipe
- Prospect of trouble of the facility
  - Unable to operate the sludge collector by over load in starting
  - Unable to drain out the sludge by clogging of drainage pipe

(2) Actions before stop should be required to prevent from above as followings;
- Operate a sludge collector more than 2 hours.
- Carry out sludge drainage during above.

(3) Cause of reducing of free chlorine residual in water of sedimentation basin
- Prospect of trouble of the process

  - Insufficient of free chlorine residual in filtered water

(4) Actions before restart should be required to prevent from above as followings
- Monitor free chlorine residual in the effluent water
  - Drain out the effluent water until free chlorine residual will become sufficient (Sufficient free chlorine residual: 0.5 mg/L or more).

5. Record and Report

5.1 Record

The record for sedimentation basin should be required to know operation condition and quality of clarified water. Quality of clarified water should be acceptable compare with criteria. Operation condition should be acceptable compare with design criteria. For reference, records from water quality control of sedimentation basin will be as follows:

- Result of monitoring and check
  - Quality of clarified water
    - Turbidity
    - Free chlorine residual
    - Containing of aluminum
    - Color of the water in the basin
  - Unusual condition
    - Excess of criteria of turbidity
    - Excess of criteria of free chlorine residual as high or low
    - Excess of criteria of containing of aluminum
    - Unusual color of the water in the basin
    - Arising of flocks in the basin
- Operation condition
  - Flow rate into a sedimentation basin
  - Quality of raw water
  - Dosing rate and flow rate of alum and pre-chlorine
  - Frequency of sludge drainage
  - Operation condition of sludge collector
    - Time in work
    - Rink with sludge drainage or not

5-2. Report

Required reports for operation of sedimentation basin will be limited area and it will need to make a recommendation regarding to operation of sludge drainage and sludge collector. Report for operation of sedimentation basin will include the following:

(1) Recommendation for operation according to records of operation

(2) Report for corrective and preventive action

(3) Result of recovery of trouble or unusual condition

(4) Recommendations for improvement

Plant Name: ZAGAZIG W.T.P.	Title: Sedimentation Basin	SOP TAG No. ZAG-WTP05 -MT

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1. Criteria for maintenance

Main maintenance activity for sedimentation basin is to clean inside of the basin. This cleaning work is one of major events in WTP.

We can check and confirm the inside condition of the basin and submerged parts of facilities. We should check depth of precipitated sludge remaining in bottom of the basin.

(1) Frequency of cleaning and inspection of basin inside
- ◆ Cleaning work: Once 3-6 months
- ◆ Inspection and repairing: Once a year

Cleaning of effluent channel can be cleaned without drainage of water in a basin. So, it should be carried out higher frequency than cleaning of sedimentation basin as following;
- ◆ In winter season: Once a month
- ◆ In summer season: Once half month

(2) Judgment of effectiveness of sludge drainage and sludge collection
- ◆ By remaining sludge volume on bottom area in a sedimentation basin
- ◆ 3 steps of degree by external appearance: Big, medium, small

(3) Acceptable days during stop of sedimentation basin
- ◆ In winter season: 3 days
- ◆ In summer season: 2 days

2. Maintenance activity

2-1. Monitoring and visual check

Monitoring and visual check should be carried out according to “O&M schedule” and unified check list

2-2. Maintenance item

(1) External check of the basin
- ◆ Appearance of crack on a basin
- ◆ Leak of water from a basin
- ◆ Foreign substances such as wooden blocks, waste of vinyl materials and so.

(2) Cleaning of inside of the basin and effluent channel
- ◆ Flushing away remaining sludge by pressured water

- ◆ Brushing away to remove adherent algae on the wall

2-3. Procedures for maintenance activity

(1) Cleaning of a basin
- ◆ Make a plan and time schedule for cleaning
- ◆ Procedures for drainage of water in sedimentation basin
- ◆ Procedures for cleaning of a basin

(2) Cleaning of effluent channel

(3) Inspection procedure

Inspection check list of sedimentation basin should be required. Inspection check list should be provided on following items;
- ◆ Inspection of a basin
- ◆ Inspection of a sludge collector
- ◆ Inspection of a Flocculator
- ◆ Inspection of sludge drainage facility

3. Procedures under unusual condition after maintenance activities

3-1. Prospect troubles and trouble shootings

Unusual condition of facilities and actions of remedy is described in ABS-WTP05-QC.
- ◆ Not uniform flow from effluent notches
- ◆ A big amount of adhesion of algae on wall of a basin or effluent channel
  - ➢ Check free chlorine residual in clarified water
  - ➢ Review dosing rate of pre-chlorine and alum
  - ➢ Cleaning of effluent channel
- ◆ Leak of water from a basin
  - ➢ Repairing

4. Report and record

4-1. Records

Records for maintenance of sedimentation basin should include the following:
- ◆ Activity of cleaning
- ◆ Results of external check
- ◆ Result of internal check

4-2. Reports

Reports should be required for improvement of O&M activities. Reports should be improved are recommended as needed such as the following:

(1) Review of frequency of sludge drainage
(2) Review of operation methods of sludge collector
(3) Improvement of facility
(4) Upgrading or rehabilitation of facility
- ◆ Replacement of facility
- ◆ Repairing of facility

(5) Review of the criteria

Plant Name: ZAGAZIG W.T.P.	Title: Sedimentation Basin	SOP TAG No. ZAG-WTP05 –QC

Issued		Developed by		Signature	
Revised		Approved by		Signature	

1. Introduction

Condition of the water in a sedimentation basin and quality of effluent water from a sedimentation basin, should be checked and monitored. If quality is change to poor, check the operation condition of the process before sedimentation basin and modify the operation condition as needed.
Properness of coagulation process should be evaluated by quality of clarified water.

2. Criteria for water quality control

Criteria for treated water quality control are as follows:
(1) Turbidity: Less than 2 NTU
(2) Residual chlorine: More than 0.5 mg/L
(3) Aluminum contains: Less than 0.15 mg/L
(4) Other items specified in Egyptian potable water standard should satisfy the specified value in the standard.

Bases of the criteria are as follows:
- ◆ High turbidity of a clarified water causes of the shortening of run time of a filter.
- ◆ Lower value of free chlorine residual causes of the growth of algae in a filter.
- ◆ Aluminum contained in clarified water should not be removed by the filtering.
- ◆ Almost of dissolved materials should not be removed by filtering.

3. Water quality control under normal condition

3-1. Water quality control for sedimentation basin

The water treatment process in a sedimentation basin is affected directly by the result of coagulation process.

In water treatment process on coagulation and sedimentation, water quality control should be performed mainly in coagulation process. Water quality control should not be ale to perform in sedimentation basin but to monitor the result of coagulation result. Various results of control in the previous processes are indicated in the quality of water from a sedimentation basin. These previous processes are included such as raw water flow rate, alum dosing rate and chlorination dosing rate, rapid mixing and slow mixing.

It is sure that fundamental function of removal of impurities in water is condensed in

coagulation and sedimentation process.

3-2. Impact of process and relation between other processes

3-2-1. Impacts of process

(1) Result of coagulation process is indicated the water quality in a sedimentation basin.
(2) High turbidities in the water leaving sedimentation are lead to poor performance of filtering.
(3) Change of water quality in a sedimentation basin will progress gradually and it will take approx. 2-3 days.

If control of coagulation process failed, operating condition of coagulation facilities will be changed. So, it will need 2 or 3 days to be evaluated the properness of control of coagulation process. Hence, it will need same days after changing of condition to make sure the result of change of operation condition.

- Detention time in sedimentation basin: Approx.2.5 hours
- Detention time in mixing basin and flocculation basin: Apprpx.0.5 hours
- Total detention time from start of coagulation to the end of sedimentation: Approx.3 hours

Though above mentions, changing place of water in a sedimentation basin will progress gradually. It will not be sufficient 3 hours and need more.

3-2-2. Relations between other processes or other facility

(1) Water quality of clarified water affects to efficiency of filtering work. Flocks, which should have been removed in the sedimentation basin, pass on to filters. This will result in reduced filter run times and poorer filtered water quality.

(2) The water treatment process is a chain of the several processes such as raw water intake and transferring, coagulation and flocculation, the sedimentation process.

(3) Water quality in sedimentation basin will be affected by operation condition of sludge drainage from the sedimentation basin. Insufficient of sludge drainage will cause of raise of flocks.

(4) Water quality in sedimentation basin will be affected by operation condition of sludge collector in the sedimentation basin. Insufficient of operation of sludge collector will cause of raise of flocks.

The step of water quality control for sedimentation basin is shown in ABS-WTP05-QCFC-02 as flow chart.

3-3. Start-up and shut-down procedures

During start up sequence, quality of clarified effluent should be monitored. Clarified

effluent will be able to lead into filters by change the valves after clarified water be stable in well. Water quality should be confirmed refer to criteria. Until condition of clarified water will be stable in well, monitoring and check of water quality of effluent should be carried out periodically. It needs by intervals of approx. 30min – 60min in usual.

From previous process the water flows into sedimentation basin through openings around bottom in side of a flocculation basin. There are no valves and no gates.

3-3-1. Start up from a condition without water in sedimentation basin (e. g. Restart after cleaning of basin)

In early stage of water filling into sedimentation basin, condition of the water from a flocculation basin will be unstable by flow with shocks, turbulent flow or short circuit flow. Hence, clarified effluent in early stage after restart should be drain out. In this stage, flow rate of the water from the distribution tower should be reduced and after water condition will be stable, flow rate will be able to increase gradually.

Procedures for restart after cleaning of sedimentation basin are shown by steps of work in ZAG-WTP05-OPFC-01.

3-3-2. Shutdown of operation of a sedimentation basin

Shut down of sedimentation basin will be carried out in case of activity of periodical maintenance. Stop the water flow into the basin and drain out the water in the basin. If a basin will be shut down, distributed flow rate to the each basin should be increased under the condition in same total of flow rate of raw water.

Flow rate of raw water should be adjusted to suitable flow rate for numbers of sedimentation basin in work. If raw water flow rate will be changed, alum and chlorine dosing flow rate should be changed suitably.

3-4. Monitoring and visual check of process

The jobs of monitoring and visual check should be daily routine work in O&M activity. Unusual condition or trouble should be picked up in early stage by these jobs.

Monitoring and check list is provided in APPENDIX. This list should be reviewed periodically for maximize of value of jobs and improvement of works. Procedures for water analysis refer to documents in laboratory section.

4. Report and recording system

4-1. Records

Records should be kept under the following conditions:

(1) Operation condition

- Flow rate into a sedimentation basin
- Quality of raw water quality
- Dosing rate and flow rate of alum and pre-chlorine
- Frequency of sludge drainage
- Operation condition of sludge collector
  - Time in work
  - Rink with sludge drainage or not

(2) Unusual condition
- Excess of criteria of turbidity
- Excess of criteria of free chlorine residual as high or low
- Excess of criteria of containing of aluminum
- Unusual color of the water in the basin
- Arising of flocks in the basin

Records should require the following:

4-1-1. Results of water quality analysis

(1) Raw water
- Turbidity
- Break point and chlorine demands
- Other items as needed

(2) Clarified water
- Turbidity
- Free chlorine residual
- Containing of aluminum
- Color of the water in the basin

4-1-2. Raw water flow rate

- Total flow rate
- Flow rate into the No.1 distribution shaft
- Flow rate into the No.2 distribution shaft

4-1-3. Dosing rate of alum and pre-chorine

- Dosing rate of alum into the No.1 distribution shaft
- Dosing flow rate of alum into the No.1 distribution shaft
- Dosing rate of alum into the No.2 distribution shaft
- Dosing flow of rate of alum into the No.2 distribution shaft
- Dosing rate of chlorine into the No.1 distribution shaft
- Dosing flow rate of chlorine into the No.1 distribution shaft
- Dosing rate of chlorine into the No.2 distribution shaft
- Dosing flow rate of chlorine into the No.2 distribution shaft

4-1-4. Numbers of working of Flocculator

- Each sedimentation basin of new treatment line

4-2. Reports

Reports should be required for improvement of O&M and water quality control activities. Items should be improved are recommended as needed. Reports should include the following:

3-2-1. Analysis and evaluation regarding result of water quality analysis

3-2-2. Recommendation

- Review of water quality analysis works
- Review of O&M and water quality control works
- Review of the criteria
  - Modification of criteria
  - Additional criteria
  - Modification of utilize procedures of criteria
- Improvement of facility
- Upgrading or rehabilitation of facility

3-2-3. Materials for reports regarding general description

- Review of a plan for water quality control
- Review of O&M plan
- Review of training plan for O&M and water quality control works

ZAG-WTP05-QCFC01	Revised version	Issued date	Page 1 of 2

SOP Tag No. **ZAG-WTP05 – QCFC01**	Title **Sedimentation Basin-Steps for restart of sedimentation basin**	Plant Name : **ZAG W.T.P.**

Issued		Developed by		Signature	
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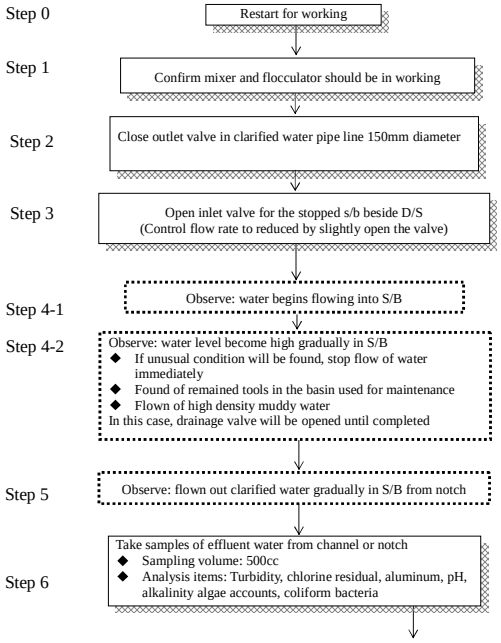
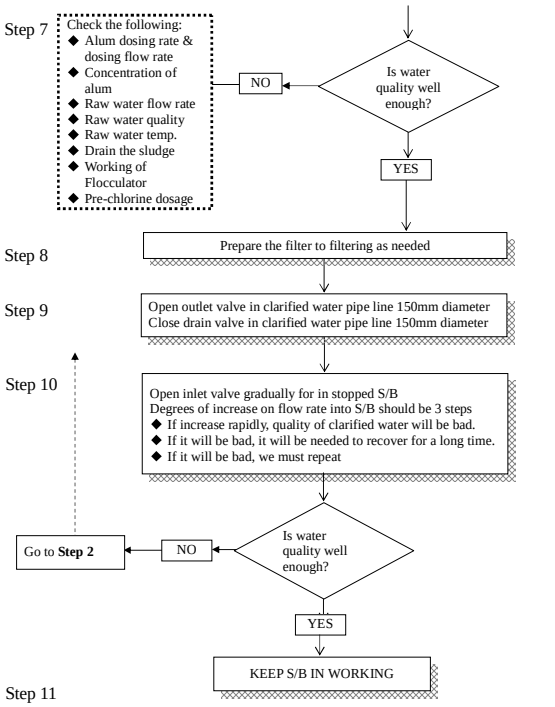


ZAG-WTP05-QCFC01	Revised version	Issued date	Page 1 of 2



Note:
D/S: Distribution Shaft
S/B: Sedimentation Basin

ZAG-WTP05-QCFC02	Revised version	Issued date	Page 1 of 1

SOP Tag No. **ZAGAZIG-WTP05 – QCFC02**	Title **Sedimentation Basin-Water Quality Control**	Plant Name : **ZAG W.T.P.**

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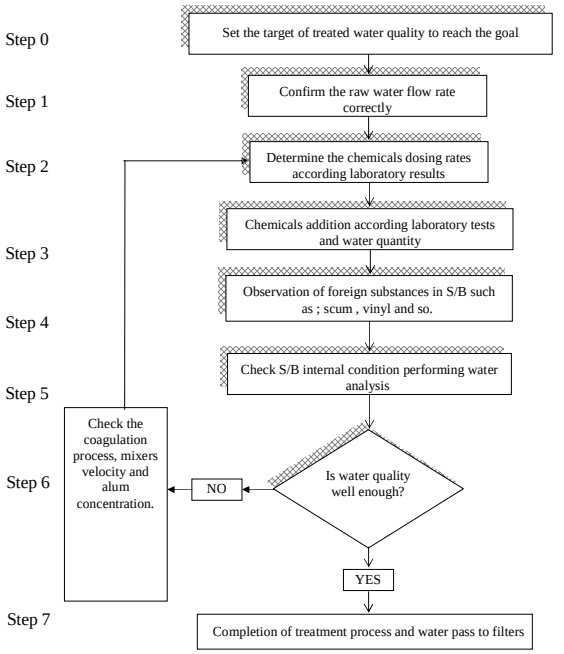

Plant Name: ZAGAZIG W.T.P.	Title: Sludge collector	SOP TAG No. ZAG-WTP06-OP

Issued		Developed by		Signature	
Revised		Approved by		Signature	

1. Description of facility

Sludge collector can be used to scrape the sludge on the bottom to the center part of the sedimentation basin. It consists of three (3) main parts and these are drive unit, scraper and moving bridge. The scraper is submerged under the water and moved with the moving bridge.

The drive unit is installed on the moving bridge and the scraper and the moving bridge is connected with steel arm. The settled sludge is scraped by scraper under the water with constant moving speed. The sludge collector will be operated continuously in a working period of the sedimentation basin.

Operation procedures of the sludge collector are very simple, that will be operation of ON/OFF switch on the switch board but operation to start must be conducted carefully. The outer end of the moving bridge of the sludge collector moves by a wheel on the inner edge of passageway of the sedimentation basin. If the moving bridge contacts with a person on the passageway, it will cause to sever damage of a human body. If the obstacles are there, it will be sever damage to the machine.

2. Impact of facility

The precipitated sludge is scraped by the sludge collector and gathered into the center gutter of the sedimentation basin and the gathered sludge is drained into the sludge drainage basin periodically. The sludge collector is essential auxiliary facility with the sedimentation basin same as the sludge drainage facility. It the sludge collector does not operate the sedimentation basin cannot be worked properly.

3. Relations with other facilities

3-1. Sedimentation basin

Operation of the sludge collector will be linked with operation of the sedimentation basin.

3-2. Sludge drainage

Operation of the sludge collector assists for working of the sludge drainage by gathering of the precipitated sludge to the center gutter.

4. Operation under normal condition

4-1. Start up and shut down

4-1-1. Pre-start check

(1) Check nobody is in a track of the bridge
- ◆ Nearby the passageway
- ◆ Nearby flocculator

(2) Check nothing obstacle is in a track of the bridge
- ◆ Nearby the passageway
- ◆ Nearby flocculator

(3) The sedimentation basin is working
(4) Electrical power supply is coming
(5) No damage of the machine and electrical wiring

4-1-2. Start up

After pre-start check completed the sludge collector can be operated by operation of a switch for ON/OFF on the switch board. If any unusual condition is found stop it immediately and cause of unusual condition should be investigated.

4-1-3. Shutdown

After stop working of the sedimentation basin the sludge collector should be kept working for 3 hours or more. Precipitation of the particles in the water of the sedimentation basin may need for 2 hours or more.

4-2. Monitoring and visual check

Monitoring should be required during operation to prevent from outbreak of serious situation by growth of slight trouble or unusual condition. Result of monitoring and check should be fed to the work for operation, maintenance or water quality control as feedback information.

Action of monitoring and check should be done securely in daily routine work. List of monitoring and check is provided in APPENDIX. Monitoring of the sludge collector will be mechanical part mainly.

5. Report and record

5-1. Record

Records for operation of the sludge collector should be required as following;

(1) Record of working time
(2) Record of trouble

5-2. Report

Reports for operation of the sludge collector during the day should include the following:

(1) Recommendation
- ◆ Upgrading or rehabilitation
- ◆ Recovery
- ◆ 3.Review of operation procedures

(2) Annual report
- ◆ Report of corrective action
- ◆ Report of preventive action

Plant Name: ZAGAZIG W.T.P.	Title: Sludge collector	SOP TAG No. ZAG-WTP06-MT

Issued		Developed by		Signature	
Revised		Approved by		Signature	

1. Introduction

Sludge collector usually consists of two (2) components, one submerged under the water and the other exposed in the air. Maintenance of the part in the air will be conducted under routine maintenance (oil leakage from drive unit). Maintenance of the part in the water will be conducted along with activities of cleaning of the sedimentation basin.

Maintenance for the part in the water will be difficult in routine work and chance of cleaning of the basin will not be conducted frequently. Frequency of maintenance chance for the part in the water will be once in 3 month or less. Hence, plan and schedule of maintenance activities for the part in the water should be prepared sufficiently.

2. Criteria for maintenance

(1) Frequency of inspection for the routine maintenance
(2) Frequency of inspection for the periodical maintenance
(3) Frequency of supplying of grease
(4) Frequency of overhaul of drive unit

3. Maintenance activity

Daily monitoring and check, and periodical inspection should be required to keep the machine in proper working. Maintenance activity shown herein means activity for the routine maintenance.

Maintenance activity consists of four (4) types of work components as follows:
(1) Monitoring and checking
(2) .Periodical inspection
(3) Evaluate and analysis regarding result of monitoring and check, and inspection
(4) Recovery e.g., repairing, replace, supply or change of oil and so.

3-1. Monitoring and visual check

Monitoring and visual check should be conducted for the part in the air such as the drive unit and moving bridge.

(1) External damage, vibration, temperature and unusual sound of the machine
(2) Overheating, leakage of oil or grease, unusual sound of drive unit

(3) Smooth moving of the machine
(4) Electrical current

3-2. Periodical inspection

Periodical inspection should be conducted for the part in the air such as the drive unit moving bridge and for the part in the water such as the scraper and the arm.

(1) Looseness, corrosion, wear, damage, condition of welding part, detached painting
(2) Leakage of oil or grease, quantity of oil or grease

3-3. Evaluation and analysis after monitoring and check, and inspection

Evaluation and analysis should be conducted under the thinking of prospect trouble and the risk, and a cost for maintenance activity.

3-4. Recovery

Activity of the recovery will be many kinds of work and part.

- Replace
- Repainting
- Adjustment and tightening
- Repairing
- Cleaning
- Change or supplying of oil or grease
- Overhaul of the drive unit

After inspection, evaluation and analysis optimum activity for recovery should be conducted. This activity should be conducted under the thinking of prospect trouble and the risk, and a cost for maintenance activity.

4. Report and record

4-1. Records

Records for maintenance of the sludge collector should include the following:
(1) Record of monitoring and visual check
(2) Record of inspection
(3) Record of recovery

4-2. Reports

Reports for maintenance of the sludge collector should include the following:
(1) Recommendation
- Recovery and rehabilitation

- Review of operation procedures
- Review of maintenance procedures
- Review of the criteria

(2) Annual report
- Report of corrective action
- Report of preventive action
- Report of the cost for activity of maintenance

Plant Name: **ZAGZIG W.T.P.**	Title **Sludge Drainage**	SOP TAG No. **ZAG-WTP07-OP**

Issued		Developed by		Signature	
Revised		Approved by		Signature	

1. Introduction

Sludge drainage facility is included and attached in the sedimentation process. Sludge in the sedimentation basin should be removed periodically and according to the proper frequency. It cannot be confirmed by visually that condition of the precipitation of the sludge in the sedimentation basin.

Improper frequency of sludge drainage should cause to a poor water quality in the sedimentation basin as it leads to rapid chlorine consumption and also cause clogging in pipes and so sludge is precipitated on the bottom of the sedimentation basin. It is possible to determine the sludge quantity by calculating the contained clay and detention time inside the basin.

And according to this, the decision of the frequency of sludge drainage and time of remaining the valves opened is proper.

2. Description of facility

2-1. Function

Function of the sludge drainage facility is to drain out the precipitated sludge from the sedimentation basin into the sludge basin.

2-2. Impact

Improper frequency of sludge drainage should cause to a poor water quality in the sedimentation basin and cause of increase of frequency of cleaning basin. And therefore the basin will be out of service for short period.

2-3. Relation between other facilities

2-3-1. Sedimentation basin

Sludge drainage facility will be recognized as a essential part of the sedimentation basin.

2-3-2. Sludge collector

Sludge precipitated on the bottom of the sedimentation basin is collected into the center gutter in the basin by sludge collector. Operation of sludge drainage will linked with operation of sludge collector. However, usually sludge collector will be operated continuously.

2-3-3. Sludge drainage basin

Sludge transfer from sedimentation basin and back washing water through sludge drainage network to sludge drainage basin. After receiving, a sludge water will be drain out to the canal by the drainage pump according to the water level of the sludge drainage basin.

Sludge drainage from the sedimentation basin should be conducted one by one about 6 sedimentation basins. Sludge drainage cannot be conducted at the same time with filter backwashing.

3. Criteria

3-1. Frequency of drainage

- In case of low or medium turbidity: At least once a day
- In case of high turbidity as more than 30 NTU: Twice a day or more

3-2. Time in operation of drainage

Operating time for drainage shall be 15 min or more. Monitoring should be needed for drained sludge at the sludge drainage basin.

4. Operation under normal condition

4-1. Startup and shutdown procedures

4-1-1. Pre-start check

The sedimentation basin operated should be selected.
(1) The water level in the sludge drainage basin
Water level should be sufficient for sludge drainage.
(2) Filter backwashing is not in progress
(3) The water level in the clear water reservoir is sufficient

4-1-2. Start and stop

(0) Supply the water into the ejector for vacuum arise
(For old plant line only)
(1) Operate the bridge in the sludge collector facility a complete cycle
(2) Open the valve for the sludge drainage
(3) Wait approx.15 min in drain out
Confirm the drained sludge by visually of by sampling
(4) Continue the drainage if necessary
(5) Close the valve for the sludge drainage
(6) Stop the supplying of the water into the ejector for vacuum arise
(For old plant line only)

(7) Check no leakage of the water at the end of pipe of the sludge drainage

4-2. Monitoring and visual check during operation

It should be conducted each sludge drainage by prepared check list. If unusual condition will be found, corrective action should be conducted immediately.

4-3. Operation for control

The only way to control the operation is visual check and monitoring of the drained water either for quantity or turbidity.

5. Operation under unusual condition

5-1. Prospect troubles and trouble shooting

(1) Clogging in the drainage pipe
(2) Sludge is not drained but only water is coming out
(3) Many flocks is arising in the sedimentation basin

Trouble shooting is shown as ABS-WTP07-OPTS-01.

6. Reports and records

6-1. Records

Records for operation of the sludge drainage should include the following:

(1) Time in operation of each drainage
(2) Operation condition
- Drained sludge quality and quantity

(3) Water level in the sludge drainage basin
(4) Unusual condition of the sludge drainage

6-2. Reports

Reports for operation of raw water intake should include the following:
(1) Unusual condition in working
(2) Monthly report
- Time in operation of each sludge drainage
- Recommendation on operation

(3) Annual report
- Time in operation of each pump
- Recommendation on operation

Plant Name: ZAGAZIG W.T.P.	Title: Sludge Drainage	SOP TAG No. ZAG-WTP07-MT

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Revised		Approved by		Signature	

1. Introduction

Maintenance for the sludge drainage facility will be conduced with a cleaning work of the sedimentation basin mainly. However the precipitated sludge should be drained out from the sedimentation basin through the drainage pipe, once in a while the remaining sludge on the bottom or the center gutter of the sedimentation basin will be observed.

Activity for maintenance of the sludge drainage facility will be to keep the work of sludge drainage sufficient and smooth. Clogging of the drainage pipe will be connected to a stop working of the sedimentation basin and if main drainage pipe will be clogged all of the sedimentation basins will be stopped.

2. Criteria for maintenance

- Frequency of the pipe flushing of the drainage pipe: Once a year

3. Maintenance activity

Monitoring, check and inspection should be carried out to judge necessity of recovering activity such as adjustment, repairing or replacing. Unusual condition of the sludge drainage facility will be confirmed by the monitoring results of the following:
(1) Water condition under treatment in the sedimentation basin
- Turbidity
- Condition of flocks in the water

(2) Condition of the drained sludge
- Quantity
- Quality

Maintenance activity consists of four (4) kinds of works as follows:
- Monitoring and checking work during working
- Inspection
- Evaluate and analysis regarding result of inspection
- Recovery after the inspection

3-1. Monitoring and visual check

Monitoring and visual check should be carried out according to “O&M schedule” and unified

check list, and it will be conducted with the monitoring activities for the sedimentation basin.

3-2. Inspection

Inspection should be carried out according to “O&M schedule” and unified check list and it will be conducted with the inspection activities for the sedimentation basin. Causes of the trouble in operation for the sludge drainage should be removed in such manners as follows:

- Depth of the remaining sludge on the bottom and the center gutter
- Foreign substances such as wooden block or vinyl
  - On the scraper of the sludge collector
  - On the bottom
  - In the center gutter
- The drainage valve
  - External condition
  - Sealing condition
- Leak or clogging around pipe

3-3. Evaluate and analysis regarding inspection result

After inspection, following items should be evaluated.
- Operation pattern of the sludge collector
  - Frequency and time in operation of the sludge drainage
- Monitoring items of the sedimentation basin
- Operation condition of the drainage valve

3-4. Recovery after the inspection

After the inspection, recovery action should be conducted as follows when needed:
- Repainting
- Cleaning of inside of the drainage pipe
- The drainage valve
  - Supplying the grease as needed
  - Change of part as needed
  - Replace the valve incase of repeating or difficulty of repairing

4. Reports and records

4-1. Records

Records for maintenance of the sludge drainage should include the following:
(1) Record of monitoring and visual check
(2) Record of inspection
(3) Record of recovery

4-2. Reports

Reports for maintenance of the sludge drainage should include the following:

4-2-1. Recommendation

(1) Modifying of operation of the sludge drainage
- Frequency
- Time in operation of the sludge drainage

(2) Frequency of cleaning of the sedimentation basin
(3) Activity of recovery and rehabilitation
- Drainage valve
  - A part of the valve
  - Valve itself
- Drainage piping
  - Pipes
  - Gasket
  - Bolt and nut
- Repairing
- Repainting

(4) Upgrading and improvement
- Modifying of the system
  - Addition or delete of facility
  - Change of a shape or a structure
  - Change of a type or diameter

(5) Review
- Criteria
- Operation procedure
- Maintenance procedure

4-2-2. Annual report

(1) Analysis report for trouble and recovery
(2) Waste water quantity by sludge drainage

Plant Name: ZAGAZIG W.T.P.	Title: Rapid Sand Filter	SOP TAG No. ZAG-WTP08 –OP

Issued	30/Sept./07	Developed by		Signature	
Revised		Approved by		Signature	

1. Features of process

1-1. Function of the filtration in the treatment processes

The function of the filtration process in the treatment processes is the complete removal of flocks and suspended materials from the water resulted after sedimentation basin by restrain these materials in the sand layer and getting the required quality of water according the International and Egyptian Standard for potable water.

1-2. Description of process

Filtration is the removal of flock and solid suspended from the water after it has passed thorough the sedimentation basin.

The filtration process is more complex than to described as a straining but the light flock carried on the filter media from sedimentation basin adheres to the grain of the filter media and this coating penetrates into the filter bed. This coating on the filter media attracts the suspended particulate matter which enhances the filtered water quality. This coating continues to build on the filter media and attracts more of the flock and suspended particulate matter. Then the water passes through the deep filter layer then to the ground reservoir.

When this layer reaches the density that avoids the water passages then we need to start back-washing to start forming a new coat layer which increase the efficiency of filtration.

1-3. Impacts of process

Filtration is the final process for treatment processes, removing impurities and suspended materials to reach the required degree of transparency to get safe potable water. Then the last stage is to inject the post chlorine in the ground reservoir to disinfect water and make an amount of residual chlorine exist inside distribution system.

1-4. Relation between other processes

(1) Previous process (sedimentation process)
- Removing algae and suspended materials
- Existence of residual chlorine to disinfect filter sand
- Quantities of water transferring to filters

(2) Subsequence process (disinfect by post-chlorine)
- Relation factor

  - Characteristics of the water outlet water from sedimentation basin
  - Quantity and volume of flocks escaping from this water
- Affecting factor
  - Quality of water after sedimentation
    - Turbidity
    - Volume and quantity of flocks
    - Concentration of residual chlorine
- Back-washing for filters
  - Runtime for filter
  - Efficiency of back-washing
  - Adjusting water level over filter media
  - Compensate the flown out sand from filter media resulting after repeating back-washing

2. Characteristics of operation activity

Characteristics of the operation activities are the indicators concerns the operator knowledge extent of correct operation rules and in case of not existing of these characteristics, we can not judge the efficiency of operation and therefore no corrective actions can be achieved to oblige the operator following these characteristics and reaching best operation.

We have to know the design criteria and characteristics to determine the operation criteria. We use characteristics of design at the beginning of design stage and during the construction of the water treatment facilities and from these characteristics flow rate, number of proper units, operation limit and so on.

These facilities include:

(1) Filter
- Filter dimensions (length-width-depth)
- Filter bed (Filter under drain-nozzle-H-block etc.)
- Filter surface load (flow rate/surface area)

(2) Filter media
- Filter sand (depth-grading-effective size)
- Gravel (depth-grading-effective size)

(3) Operation, monitoring, and control device for a filter
- Head loss meter
- Control device for filtering rate
- Gradual start mechanism

(4) Filtering backwashing equipment
- Blowers
- Backwashing pumps
- Flow meters

(5) Auxiliary equipment

- Compressor for hydraulic actuation of the valves
- Piping and valves
- Filtered water basin

3. Criteria for operation

We use operation criteria to judge the operation efficiency and to obligate the operators to operate the facility with proper operating parameters for the water treatment facilities and processes witch include;

- Filtration rate: 120 - 150 (m3/m2/d)
- Head loss should be wash: 2 (m) or less
- Operation target of filter washing frequency: 24 hours at least
- Treatment target of filtered water quality:
  - Turbidity: 0.5 NTU or less
  - Free chlorine residual: 0.5 mg/l or more and 1.5 mg/l or less
  - Dissolved Aluminum: 0.15 mg/l or less
- Replacing frequency of filter media: Once 10 years or less
- Scouping frequency of filter media: Once 6 months or less
- Filter washing water:
  - Air scouring flow rate: 0.8 – 1.5 (m3/m2/min)
  - Backwashing flow rate: 0.6 - 0.8 (m3/m2/min)
  - Air scouring operating time: 7 min
  - Combined wash operating time: 3 min
  - Backwashing operating: 10 min
- Reference criteria
  Following criterion is for coagulation and sedimentation process, but this criterion has tight relation with efficiency of filtering process. Treatment target of clarified water quality
  - Turbidity 2.0 NTU or less
  - Free chlorine residual: 1.5 mg/L or less
  - Dissolved Aluminum: 0.15 mg/L or less

4. Operation under normal condition

4-1. Operation for a filter

Following operations should be required for a filter;

(1) Startup for filtering
(2) Shutdown for filtering
(3) Startup for washing of a filter
- Air scouring
- Combined washing of air scouring with backwashing

- Backwashing

(4) Shut down for washing of filter
- Stop back-washing
- Clarified water inlet and continuous closing outlet valves
- Gradual opening for out let valves after formation of surface coating

(5) Control the filtering rate

5. Reports and records

5-1. Records

Records for operation of filter should include the following:

(1) Operating condition
- Flow rate
  - Raw water
  - Clarified water
  - Filtered water

(2) Data of background on operation
- Filtering rate in each line of old and new
- Dosing rate and flow rate of alum and pre-chlorine
- Specifications of back wash and air scouring
- Frequency of filter washing
- Head loss at starting of filter washing
- Disinfection data in the past
  - Name of applied disinfectant such as bleach and sodium hypo-chloride
  - Date of recent implementation
  - Method and procedures for disinfection

5-2. Report

Reports for water quality control of filter should include the following:

4-2-1. Recommendation as needed

(1) Maintenance of filter layer
- Change of filter media
- Supplying of filter sand
- Scooping of surface of filter sand
- Disinfection of filter layer
- Cleaning of inside of filter basin

(2) Change of dosing rate and flow rate of alum and pre-chlorine
(3) Change of frequency of filter washing
(4) Change of head loss at starting of filter washing
(5) Change of specifications of back wash and air scouring

- Time of air scouring, backwashing and combined washing
- Flow rate of air for air scouring
- Flow rate of air for backwashing

(6) Change of specification of disinfection of filter layer
- Frequency
- Methods and procedures

(7) Change of target of filtered water quality
(8) Change of target of clarified water quality

4-2-2. Result of recovery of trouble or unusual condition

(1) Description of unusual or trouble condition
(2) Sequence event leads to unusual or trouble condition
(3) Damage of influence
- - A damage of human body
- - A damage of facility
- - A damage of water quality
- - A damage of environment
- - The amount of damage
- - The influence area of damage
- - Others

(4) Activity for recovery
- Procedures according to steps of activity
- Parts or facility for recovery
- Days to solve the trouble

(5) Description of similar case in the past

4-2-3. Corrective and preventive action for water quality control

- Unusual condition happened in ABBASA WTP
- Essential cause and background
- Steps to prevent from a similar event lead to unusual condition

Plant Name: ZAGAZIG W.T.P.	Title: Rapid Sand Filter	SOP TAG No. ZAG-WTP08 –MT

Issued		Developed by		Signature	
Revised		Approved by		Signature	

1. Introduction

Relationship between operation and maintenance, and the water quality control is tightly each other especially in filtering process. Activity and result of the operation and maintenance affects to effectiveness of facility and quality of water, especially in filtering, O&M activity.

2. Criteria for maintenance

Criteria for maintenance of rapid sand filter are shown below:

2-1. Criteria of frequency for maintenance

(1) Inspection of sand layer
(2) Replacing of sand layer
(3) Inspection of under drain
(4) Disinfection of filter media
(5) Inspection of control device of filtration rate

2-2. Criteria for judgment

(1) Improper of filter sand
(2) Improper of filter basin
(3) Improper of filtration rate
(4) Improper of filter washing

3. Maintenance activity

Monitoring, check and inspection should be carried out to judge necessity of recovering activity such as adjustment, repair or replacement. Maintenance activity consists of four (4) kinds of works as follows:

(1) Monitoring and checking during the maintenance work
(2) Inspection
(3) Evaluation and analysis regarding the result of inspection
(4) Repair or replacement including check after the work

3-1. Maintenance of filter layer

Improper condition of filter layer may make filtered water quality worse and connect to acceleration of waste in filter layer further more. As a result, we will have to replace whole of filter sand in a short period. To avoid above, conduct periodical monitoring and check about filter layer should be required periodically.

When unusual condition is found about filter layer, prompt corrective action should be carried out such as improvement of filter washing formation or supply of filter sand. Investigation of filter layer should be included as following;
- Distribution of degree of sand grain
- Waste degree of filter layer
- Existing of mud ball
- Existing of algae
- Existing of other waste such as adhesion substances
- Irregularity of filter layer
- Existing of crack or crater
- Existing of clearance beside of wall

A plan for maintenance of filter layer should be issued and maintenance activities for filter layer should be carried out according to this plan.

3-2. Monitoring and check

3-2-1. Usual monitoring and check

Description of inspection	Interval
(1) Check of water level in filter basin	Daily
(2) Check of filtered water quantity, filtration rate, head loss of filter layer, filter run time	Daily
(3) Check of filtered water quality (turbidity, free chlorine residual, pH, alkalinity, etc.	Daily

3-2-2. Periodical inspection

Description of inspection	Interval
(1) Check waste adhesion on inside wall, drain trough in filter basin	Every 2-6 months
(2) Check water leak, cracks, damage of filter basin inside	Every 2-3 years
(3) Check of filter layer quality (waste, mud ball, effective diameter and, uniformity, depth of filter sand layer)	Every 1-3 years
(4) Check of moving of the gravel layer	Every 1-3 years
(5) Check working condition of flow rate controller	Once a year
(6) Check working condition of head loss meter	Once a year
(7) Check of condition of under drain	Every 10-15 year

(8) Check of flow rate and time formation for filter washing	Every 2-6 months
(9) Monitoring of filter washing (e.g. flow out of filter media, malfunction of filter washing facility, improper condition of filter layer after washing such as crater, and so)	Every 3-4 days
(10) Check turbidity of water of filter washing waste	As required

3-2-3. Detail inspection and check (rehabilitation)

Description of inspection or rehabilitation	Interval
(1) Additional supply of filter sand	As required

3-3. Evaluate and analysis of result after inspection

Description of inspection	Criteria
(1) Check of water level in filter basin from sand surface	1.0 m or more
(2) Check of clarified water quantity	According flow rate
◆ Turbidity	5 NTU of less
◆ Residual chlorine	1.5 mg/L or more
◆ Aluminum content	0.15 mg/L or less
(3) Check of filtration rate	120 m^3/m^2/day or less
(4) Check of head loss of filter layer	2 m or less
(5) Check of filter run time	24 hours or more
(6) Check of filtered water quality (turbidity, residual chlorine, pH, alkalinity, etc.)	
◆ Turbidity	0.5 NTU of less
◆ Residual chlorine	0.5 mg/L or more
◆ Aluminum content	0.15 mg/L or less
◆ pH, alkalinity, etc.	Not more than Egyptian standard for potable water quality
(7) Monitoring of filter washing (e.g. flow out of filter media, malfunction of filter washing facility, improper condition of filter layer after washing such as crater, and so)	According to the situation
(8) Check of flow rate for filter washing	Turbidity of washed drain: 5 NTU or less
(9) Check of time formation for filter washing	Turbidity of washed drain: 5 NTU or less
(10) Check turbidity of water of filter washing waste	Turbidity of washed drain: 5 NTU or less
(11) Volume of sand layer	Decrease of 10% or less of initial volume

4. Reports and records

4-1. Records

Records for maintenance of rapid sand filter should include the following:

(1) Monitoring and visual check
- ◆ Check list for monitoring

(2) Inspection
- ◆ Check list for inspection

4-2. Reports

Reports for maintenance of rapid sand filter should include the following:

(1) Periodical maintenance report
(2) Corrective maintenance report
(3) Result of recovery of trouble or unusual condition
(4) Recommendation to O&M and improvement of facility

Plant Name: **ZAGAZIG W.T.P.**	Title **Rapid Sand Filter**	SOP TAG No. **ZAG-WTP08-QC**

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1. Criteria for water quality control

1-1. Filtered water quality

Filtered water quality should satisfy the following criteria:
- ◆ Turbidity: 0.5 NTU or less
- ◆ Free chlorine residual: 0.5 mg/L or more and 1.5 mg/L or less
- ◆ Containing of aluminum: 0.15 mg/L or less

1-2. Turbidity of drained water by backwashing

Filtered water quality should satisfy the following:
- ◆ Turbidity: 5 NTU or less

2. Procedures for water quality control under normal condition

2-1. Monitoring and check

Monitoring and checking are conducted to confirm change of water quality and change of operating condition in the process. The process can not be controlled without monitoring and criteria to judge something in proper.

Filtration process is the final stage to remove turbidity in the process water. Hence, we must deliver the filtered water with same or higher quality than the Egyptian standard for potable water quality. After filtration post-chlorine should be dosed into the water to adjust final free chlorine residual in water of transmission and customer's tap. Monitoring steps are shown by flow chart in ZAG-WTP08-QCFC-01

3. Procedures for water quality control under unusual condition

3-1. Prospect troubles and trouble shootings

Refer to WTP08-QCTS-01 "Trouble Shooting for Filter".

Trouble shootings consist of four (4) categories as follows:

(1) Unusual water quality and actions of remedy
(2) Unusual water quantity and actions of remedy
(3) Unusual filter layer and actions of remedy

(4) Other unusual and actions of remedy

4. Reports and records

4-1. Record

Records for water quality control of filtering process should include the following:

(1) Water quality of raw water
(2) Water quality of clarified water
(3) Water quality of filtered water
(4) Water quality of drain water after filter washing
(5) Data for background of water quality
- ◆ Filtering rate and flow rate of raw water in each line of old and new
- ◆ Dosing rate and flow rate of alum and pre-chlorine
- ◆ Specifications of back wash and air scouring
- ◆ Frequency of filter washing
- ◆ Head loss at starting of filter washing

4-2. Report

Reports for water quality control of filtering process should include the following:

(1) Periodical report for water quality control
- ◆ Trend of change of raw water quality
- ◆ Change according to weather such as seasonal change
- ◆ Change according to water level of canal
- ◆ Change of source basically
- ◆ Trend of change of filtered water quality
- ◆ Change according to clarified water
- ◆ Change according to filtration rate
- ◆ Change according to loss head
- ◆ Change according to other condition

(2) Result of recovery of trouble or unusual condition
- ◆ Description of unusual or trouble condition
- ◆ The Sequence event leads to unusual or trouble condition
  - ➢ Damage of facility
  - ➢ Damage of water quality
  - ➢ Damage of environment
  - ➢ Amount of damage
  - ➢ Influenced area of damage
- ◆ Activity for recovery
  - ➢ Procedures according to steps of activity
  - ➢ Parts or facility for recovery
  - ➢ Days to solve the trouble

  - ➢ Description of similar case in the past

(3) Corrective and preventive action for water quality control
- ◆ Unusual condition happened in ZAGAZIG WTP
- ◆ Essential cause and background
- ◆ Steps to prevent from a similar event lead to unusual condition

(4) Recommendation
- ◆ Modification or arrangement of O&M activity
- ◆ Recovery and rehabilitation of facility such as repair and replacing.
- ◆ Improvement of facility such as upgrading or modification.
- ◆ Modification for activity of water quality control
- ◆ Review of SOP document

Plant Name: ZADAZIG W.T.P.	Title: Filter Wash Facility	SOP TAG No. ZAG-WTP09 –OP

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1. Introduction

Filtration is the last treatment stage that can physically remove contaminants before disinfection. The effectiveness of this stage is therefore very important on water quality control, because particles in the water hinder germs being killed by the disinfectant, and because the large germs that cannot be killed by chlorine have to be physically removed.

Filter backwashing affects to filtering efficiency. Since this facility is important same as filtering facility we must check, maintain, and monitor and control the water quality usually.

2. Features of process

2-1. Function of facility

Function of filter washing facility is to cleanse the filter media of flock and particulate matter. Filtration coating builds and penetrates into the filter bed, and the head loss across the filter becomes greater until the flow rate is greatly reduced and at the time the head loss reach the allowable maximum limit or the minimum filtration flow rate, the filter must be backwashed to clean the media and renewing the filtration effect.

2-2. Impacts of facility

Filer washing must be carried out periodically to keep the function of filtration in proper. Therefore, filter backwash facility should be united with rapid sand filter. Filter washing facility is indispensable one for filtering process.

2-3. Relations between other processes

2-3-1. Water for backwashing

Water for backwashing is used filtered water in filtered water basin in new plant line. In old plant line backwash water is supplied to head tank through branched pipe from network pipe line.

2-3-2. Backwashing drainage from filter

Drainage from the filter in old plant line flows into old drainage basin. Drainage from the filter in new plant line flows into new drainage basin.

3. Criteria for operation

Control of filtering process should require the following;

(1) Water quality
- ◆ Monitoring of clarified water
- ◆ Monitoring of filtered water

(2) Flow rate of the water
- ◆ Control of flow rate of filtered water
- ◆ Control of flow rate of clarified water

(3) Loss head of filter layer
- ◆ Monitoring of loss head
- ◆ Upper limit of loss head for running of a filter

(4) Filter washing
- ◆ Control of frequency of filter washing
- ◆ Procedure for filter washing cycle

(5) Turbidity of drain water after filter washing
- ◆ Monitoring of turbidity

Only three (3) items can be controlled in operation of filter as follows:
- ◆ Flow rate of filtered water
- ◆ Frequency of filter washing
- ◆ Procedure and specification for filter washing

The capability required to activity of filter washing is following;
- ◆ Suitable quantity for backwashing water
- ◆ Suitable time in operation for filter washing
- ◆ Flown out of filter sand does not appear

3-1. Filter backwashing criteria

(1) Air flow rate for air scouring: 0.8-1.5 8m^3/m^2/min)
(2) Water flow rate for backwashing: 0.6-0.8 (m^3/m^2/min)
(3) Run time for air scouring: 5 (min)
(4) Run time for combined washing: 5 (min)
(5) Run time for backwashing: 5 (min)

3-2. Upper limit of loss head for running of a filter: 2 (m) or less

3-3. Water level in starting of air scouring: 15-20 cm as depth from sand surface

3-4. Reference criteria

(1) Turbidity of drain water after filter washing: 5 NTU or less
(2) Properness of filter washing should be evaluated by turbidity of drain water after filter

washing. And also it should be evaluated the flown out of filter sand does not appear.
(3) Filter sand should be checked periodically to confirm properness of filter washing.
(4) Procedure and specification for filter washing cycle should be modified by result of above to be effective and suitable furthermore.

4. Operation under normal condition

4-1. Startup and shutdown procedures for filter washing

Startup and shutdown procedures for filter washing are referred to ZAG-WTP09-OPFC01.

4-2. Monitoring and visual check of facility

Steps and monitoring and visual check are shown in ZAG-WTP09-OPFC-01.

4-3. Control of filter washing

Controllable operation should be the following:
(1) Frequency of filter washing
(2) Procedure and specification for filter washing

4-3-1. Frequency of filter washing

Frequency of filter washing should affect to efficiency of operation in water treatment plant such as volume of waste water and electrical power consumption. And it will affect to chemical and chlorine consumption indirectly.

Frequency of filter washing should be reduced as possible as we can. However, too long of run time of filter will cause of waste of sand layer up to deep zone or break through of particle to the filtered water. In the filter of single filter media type, filter run time will be less than approx. 72 hours. Suitable run time as target goal of improvement of performance will be 48 hours.

4-3-2. Procedure and specification for filter washing

Following works are required for achievement of above targets:
(1) Severe control of water quality of clarified water by severe control of coagulation and sedimentation process
(2) Severe control of filtration rate
(3) Optimization of filter washing operation

5. Operation under unusual condition

Trouble shooting is shown in ZAG-WT08-QCT5.

6. Reports and records

6-1. Records

Records for filter washing facility should include the following:

6-1-1. Records of filter washing

- ◆ Filter washing procedure
- ◆ Time and flow rate of air scouring
- ◆ Time and flow rate of backwashing
- ◆ Time and flow rate of combined washing
- ◆ Head loss at starting of filter washing
- ◆ Result of Monitoring and check
- ◆ Turbidity of drain water after backwashing

6-1-2. Record of blower for air scouring

- ◆ Time of start and stop
- ◆ Number in operation
- ◆ Electrical current during operation
- ◆ Result of monitoring and check

6-1-3. Record of pump for backwashing

- ◆ Time of start and stop
- ◆ Number in operation
- ◆ Flow rate of backwashing
- ◆ Electrical current during operation
- ◆ Result of monitoring and check

6-2. Reports

Reports should include the following:

6-2-1. Recommendation

- ◆ Filter washing procedure and specification
- ◆ Replace or supplying of sand
- ◆ Inspection of under drain
- ◆ Maintenance of facility such as blower or pump and so.
- ◆ Cleaning of filter basin

6-2-2. Operation report

- ◆ Consumption of water volume use for backwashing
- ◆ Free residual chlorine in backwash water
- ◆ Turbidity of backwashing

Plant name	Title:	SOP No.
ZAGAZIG W.T.P.	**Filter Washing Facility**	**ZAG-WTP09-OP**
Document Name	Document Title	Document No.
Flow Chart	**Steps for Filter washing in plant line**	**ZAG-WTP09-OPFC-01**

Issued		Developed by		Signature	
Revised		Approved by		Signature	

1. Facility for filter washing

Facilities for filter washing are as follows:

- Air scouring: By roots blower
- Backwashing: By backwash pump
- Valve: Pneumatic valve

2. Steps for the filter washing

2-1. Trigger of filter washing

Filter washing will start by which backwash pump is driven.

(1) Filter washing by fixed time in a day
In this mode of filter washing, the filter wash will be started by trigger of fixed time in a day. Filter running time will be fixed as 24 hours and it is preferable not to be done at the peak hourly demand.

(2) Filter washing by head loss
In this mode of filter washing, the filter wash will be started by trigger of indication of specified head loss of filter sand. Filter run time will be not fixed.

2-2. Steps for filter washing in new plant line

STEP 1: Close the pneumatic valve for inlet of clarified water to a filter.
Keep opened the valve of outlet of filtered water.
Wait until water level will decrease to approx.15cm depth from sand surface.
STEP 2: Check the water level in filtered water basin of 1st extension.
STEP 3: Select the pump and blower to be operated and turn the change over switch to the selected side on the switch board.
STEP 4: Confirm the manual operated valve should be opened or closed.
STEP 5: Open the pneumatic valve for backwashing drainage and start the blower.
STEP 6: Confirm the condition of air bubbling by watching the surface water in a filter, and it should be sufficient of air discharge volume and uniformly bubbling.
STEP 7: Start backwashing pump to be operated and open the pneumatic valve for backwashing. Start of combined washing and keep above 3 min.
STEP 8: Close the pneumatic valve for inlet of air scouring valve for a filter.
After closed the valve, blower should be stopped immediately.
Keep above 10 min. Start of backwashing.
STEP 9: Close the pneumatic valve for backwashing.
After closed the valve, back washing pump should be stopped immediately.
STEP10: After flown out the backwashing drainage from drain gutter in a filter basin, close the pneumatic valve for backwashing drainage.
STEP11: Keep the filter in condition of after filter washing water level for approx.10 min.
STEP12: Open the pneumatic valve for clarified inlet valve and outlet for rinsing from a filter and rinsing should be conducted for approx.15 min pneumatic valve for outlet for rinsing.
STEP13: After rinsing, open the pneumatic valve for inlet of clarified water to a filter.
STEP14: Open the pneumatic valve of outlet of filtered water.
Control the control valve for flow rate of filtered water.

Plant Name:	Title	SOP TAG No.
ZAGAZIG W.T.P.	**Filter Washing Facility**	**ZAG-WTP09 –MT**

Issued		Developed by		Signature	
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1. Introduction

Filter backwashing facility consists of the following:

- Old plant line: Head tank for backwash
- New plant line: Backwash pump
- Blower for air scouring
- Trough for backwashed water
- Under drain facility (common facility with filtering facility)
- Filter layer (common facility with filtering facility)
- Pipes and valves

2. Criteria for maintenance

Criteria for maintenance are as follows:
(1) Inspection interval and inspected facility or part of facility
(2) Acceptable limit value for using
(Time in working, pipe thickness, etc)
(3) Interval for periodical entire replacement of facility or part of facility

Criteria for maintenance of facility should be referred to manufacturer's instruction manuals.

3. Maintenance activity

Maintenance activity shown herein means activity for the routine maintenance. Description regarding activity for the corrective maintenance is shown in trouble shooting. Maintenance activity consists of four (4) kinds of working components as follows:
(1) Monitoring and checking during working of facility
(2) Periodical inspection during working or after shut down
(3) Evaluate and analysis regarding result of monitoring and check, and inspection
(4) Recovery e.g., repairing, replace, supply or change of oil and so.

3-1. Monitoring and visual check

3-1-1. For backwash pump

Every week	1. Visually check for leaks
	2. Check for lubrication
	3. Adjust glands as necessary to maintain proper leakage
	4. Hand test bearing housing for any sign of temperature rise
Every month	1. Check bearing temperature with a thermometer
Every 6 months	1. Check the packing and replace if necessary
	2. Check alignment of the pimp and motor
	3. Check holding down bolts for tightness
	4. Check coupling for wear
Every year	1. Check rotating element for wear
	2 Check wear ring clearance
	3. Check and re-grease bearings
	4. Vibration testing

3-1-2. Blower

Every week	1.Check for lubrication
	2.Hand test bearing housing for any sign of temperature rise
Every month	1.Check bearing temperature with a thermometer
Every 6 months	1.Check alignment of the belt/coupling
	2.Check holding down bolts for tightness
	3.Check coupling for wear
	4.Check belt tension condition
Every year	1.Check rotating element for wear
	2.Check and re-grease bearings
	3.Clean air filter and replace if necessary
	4.Vibration testing

3-2. Periodical inspection

3-3. Recovery

4. Reports and records

4-1. Records

Records should be as follows;

(1) Record of filter washing

- Sequence of filter washing procedures
- Specification of filter washing
- Time at the start and the end of filter washing
- Turbidity of drain water after backwashing
- Head loss during work of a filter

(2) Record of working of the facility (Pumps, Air blowers etc.)
- Result of monitoring and check (check list)
- Result of periodical inspection
- Record during working of facility
- Flow rate of backwash water
- Indication of discharge pressure
- Indication of current meter
- Measurement of vibration by vibration meter
- Measurement of noise by noise meter
- Measurement of temperature of motor and bearing

3-2. Report

Report should include the following:

(1) Report for recommendation
- Rehabilitation
  - Repairing or replace
  - List of spare parts that should be required to stock in the plant
  - For proposal of newly additional parts
- Upgrading of facility or system
  - Change of capacity, material, and other specifications
  - Addition of facility
  - Modification of facility or system
  - Proposal of preventive maintenance activity to be needed

(2) Report of maintenance activity
- Annual report
  - Repairing and replace for each facility
  - Trouble and accident
  - Result of corrective maintenance
  - List of consumed spare parts in a year
- Corrective action to prevent the trouble or accident

Plant Name: ZAGAZIG W.T.P.	Title: Clear water Reservoir	SOP TAG No. ZAG-WTP10-OP

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1. Introduction

Clear water reservoir (ground reservoir) is the basin to store the treated clear water and to keep it clean. Filtered water is led into the clear water reservoir through the filtered water basin and filtered water pipe after post-chlorine dose.

Dosed post-chlorine is mixed and contact with filtered water through the baffling water way in the reservoir. Contact time of chlorine with the water should be needed sufficiently. The water in the reservoir is final treated water in the plant. Hence, the water in the clear water reservoir must be kept it clean.

Activity of water quality control is the most important event in operation of the clear water reservoir, especially monitoring of free chlorine residual must be conducted by suitable frequency.

Operation about the clear water reservoir will be valve operation and monitoring check. However, valve operation will need only maintenance of inside of the reservoir such as cleaning. Main activity of operation for the reservoir will be monitoring and visual check.

2. Features of process

2-1. Function of process

Functions of the process are as follows:
- To store the purified clear water
- To contact post-chlorine with filtered water
- To keep the purified clear water clean and safety
- To achieve balance between production and consumption during peak hours and least demand

2-2. Impacts of process

In the clear water reservoir, the water should be finished for purification process to the potable water after dosing of post-chlorination and, mixing and contacting of post-chorine with filtered water.

The water in the clear water reservoir is real potable water. Hence, the water must be cleaned and safety condition. Any contamination is never accepted.

2-3. Relations between other processes

(1) Chlorination process

Post-chlorine is dosed into the filtered water in previous step of the clear water reservoir and free chlorine residual is adjusted to the target of free chlorine residual of transmission water, and that is final control of free chlorine residual.

(2) Filtration

Filtration is the last stages that can physically remove contaminants before disinfection. The effectiveness of this stage is therefore very important, because particles in the water hinder germ being killed by the disinfectant, and because the large germs that cannot be killed by chlorine have to be physically removed.

3. Criteria for operation

(1) Frequency of water analysis for turbidity, free chlorine residual and pH
- Frequency: Every 2 hours in a day or more

(2) Frequency of monitoring and visual check
- To prevent from contamination: Twice a day or more

(3) Water level
- To keep the water level to make the pumps operate safely at minimum level and ensure that no water loss will happen from the overflow pipe at the highest level Alarm should be operated in both cases.

(4) Frequency of cleaning inside of the reservoir
- Frequency: Once a year or as required

4. Operation under normal condition

4-1. Startup and shutdown procedures

Operations regarding clear water reservoir will be as follows:
(1) Operation of inlet and outlet valves for clear water reservoir
(2) Draining out of the water in clear water reservoir
(3) Cleaning of the inside of clear water reservoir
(4) Draining out of the water after cleaning
(5) Leading of purified water into clear water reservoir
(6) Disinfection of the inside of clear water reservoir

Procedures for the above are shown in flow chart of ZAG-WTP10-OPFC-01.

4-2. Monitoring and visual check

Monitoring and visual check of clear water reservoir should be conducted in the following manner:
(1) Routine monitoring and check
(2) Monitoring and check in the operation

Standard form for monitoring and check list is provided in ZAG-WTP10-OPSC-01.

4-3. Operation for control

Equipment for control of the clear water reservoir is nothing in the facility of the clear water reservoir facility such as quality, quantity or water level. The water quality and water level of the clear water reservoir should be controlled by the operation of other facilities in the previous processes such as chlorination, filtration, coagulation, and raw water pump and transmission pump facility. Water quality control is described in ZAG-WTP10-QC.

Water level in the clear water reservoir will be changed by consumption in the network and inside of the plant, and quantity of treated water. Main consumption in the plant is the supplied water for backwashing of the filter.

The consumption tendency of the clear water should be grasped to control the water level in the clear water reservoir. This tendency is essential information and it should be utilized for the operation plan of almost facility in the water treatment plant.

For example, in a period of high consumption, filter backwashing will not be able to carry out and quantity of treated water will be increased. And in a period of low consumption, filter backwashing will be able to carry out and quantity of treated water will be decreased and the number of working of transmission pump will be deduced.

Control like above is carried out as total quantity control and the water level in the clear water reservoir is base and essential information for this control. Total quantity control for treated water is described in ZAG-WTP10-OPFC-02.

5. Operation under unusual condition

5-1. Prospect troubles and trouble shootings

Trouble shooting for the clear water reservoir is provided in ZAG-WTP10-QCTS-01.

6. Reports and records

6-1. Records

Records for operation of clear water reservoir should include the following:

(1) Record of monitoring and visual check
(2) Record of water level in the clear water reservoir

6-2. Reports

Reports for operation of clear water reservoir should include the following recommendation:

- Upgrading or rehabilitation of facility
- Modification and arrangement
- Repairing and replace
- Additional of facility
- Review of criteria
- Review of procedures for operation and control

Plant Name: ZAGAZIG W.T.P.	Title: Clear Water Reservoir	SOP TAG No. ZAG-WTP10-MT

Issued		Developed by		Signature	
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1. Introduction

The clear water reservoir is important facilities to keep the water quality. Hence facilities must be maintained by periodical inspection. It will be found to need for recovery such as water leak or crack of basin, rapid action for recovery should be needed.

It had better that the activity of the inspection and cleaning of the clear water reservoir will be carried out in a season of small amount consumption in the network such as a winter season. In the activity of inspection and cleaning, the capacity for the clear water for storage should be reduced. Therefore, the activity should be conducted in a short period as possible according to the planed procedures.

The attached valves with the clear water reservoir will be not necessary to operate usually. Under this situation if these valves will not be operated for a long period, these valves will be damaged by corrosion of metal part. Hence periodical operation and supplying of grease should be needed for the valve.

2. Criteria for maintenance

(1) Frequency of monitoring and visual check
  - Frequency for preventing from contamination: Twice a day or more

(2) Periodical operation of the valve: Once a month

(3) Frequency of cleaning and inspection inside of reservoir: Once a years or as required

3. Maintenance activity

Maintenance activity consists of four (4) kinds of activities as follows:
(1) Monitoring and checking work during working
(2) Inspection
(3) Evaluate and analysis regarding result of inspection
(4) Recovery after the inspection

3-1. Monitoring and visual check

Monitoring and visual check should be carried out according to "O&M schedule" and unified check list

3-2. Inspection

Inspection should be carried out according to "O&M schedule" and unified check list.

3-3. Evaluate and analysis regarding inspection result

After inspection, following items should be evaluated:
- Waste of the inside
- Operation of the valve
- Crack of the basin
- Leak of the water from outside

3-4. Recovery after the inspection

After the inspection recovery action should be conducted as follows;
(1) Waste of the inside
  - Cleaning of inside of the basin
  - Disinfection inside after cleaning
(2) Operation of the valve
  - Supplying the grease as needed
  - Change of part as needed
  - Replace the valve as needed or periodically
(3) Crack of the basin
  - Repairing
(4) Leak of the water from outside
  - Repairing

4. Reports and records

4-1. Records

Records for maintenance of clear water reservoir should include the following:
(1) Record of monitoring and check
(2) Record of inspection
(3) Record of recovery
(4) Record of disinfection

4-2. Report

Reports for maintenance of clear water reservoir should include the following:
(1) Recommendation
  - Review of the criteria
  - Review of procedures
  - Replacement and rehabilitation
(2) Annual report

Plant Name: ZAGAZIG W.T.P.	Title: Clear Water Reservoir	SOP TAG No. ZAG-WTP10-QC

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1. Criteria for water quality control

1-1. Frequency of water analysis

Frequency of water analysis should be based on Egyptian potable water standards and the prepared methods from HCWW and it includes;
- Turbidity, residual chlorine and pH: Frequency of each 2 hours in a day or more
- Other water quality items: Once a day

1-2. Frequency of monitoring and visual check

- Conditions that should prevent contamination: Twice a day or more

1-3. Water quality of the water in clear water reservoir

In order to keep the water quality of the water in clear water reservoir good enough compared with the Egyptian potable water standard, especially following water quality should be satisfied with the SHAPWASCO's own standard.
- Residual chlorine of water at the inlet and the outlet of clear water reservoir
  - Inlet: 2.5 mg/L or more and less than 3.0 mg/L
  - Outlet: 1.5 mg/L or more and less than 2.5 mg/L
- Turbidity of inlet water of the clear water reservoir
  - Inlet and outlet: 0.2 mg/l or less
- Aluminum contain of inlet water of the clear water reservoir
  - Inlet and outlet: 0.15 mg/l or less

1-4. Frequency of cleaning inside of the reservoir

Frequency: Once a year or as required

2. Operation under normal condition

2-1. Start-up and shut-down procedures

Water quality control regarding clear water reservoir will be as follows:
(1) The water quality analysis of turbidity, chlorine residual, pH
(2) Disinfection inside of the clear water reservoir

2-2. Monitoring and visual check

Monitoring and visual check of clear water reservoir should be conducted in the following manner:

(1) Routine monitoring and check
(2) Monitoring and check in the operation

2-3. Operation for water quality control

The water quality and water level of the clear water reservoir should be controlled by the operation of other facilities in the previous processes such as chlorination, filtration, coagulation, and raw water pump and transmission pump facility.

2-3-1. Control of turbidity, pH, aluminum contain

Control of turbidity pH, aluminum contain should be conducted in the process of filtration.

2-3-2. Control of free chlorine residual

Control of free chlorine residual should be conducted by control of post-chlorination. Control of post-chlorination is based on measurement result of free chlorine residual at inlet and outlet point of the clear water reservoir.

Consumption of free chlorine residual will be small amount that in the water through the pipe from filtered water basin to the clear water reservoir, and in the clear water reservoir. Hence, almost of dosed post-chlorine will be added as free chlorine residual.

And difference of free chlorine residual at inlet and outlet in the clear water reservoir, that is full covered basin, will be small amount. If big difference of free chlorine residual from inlet and outlet such as reduction of 0.3-0.5mg/L will be appeared it should be result of unusual condition in the clear water reservoir. Situation like above will be out of control. Investigation should be needed and cause of reducing of free chlorine residual must be removed.

3. Reports and records

3-1. Records

Records for operation of clear water reservoir should include the following:

(1) Record of monitoring and visual check
(2) Record of water quality in the clear water reservoir

3-2. Reports

Reports for operation of clear water reservoir should include the following:

(1) Recommendation
- ◆ Upgrading or rehabilitation of facility
  - ➢ Modification and arrangement
  - ➢ Repairing and replace
  - ➢ Additional of facility
- ◆ Review of criteria
- ◆ Review of procedures for operation and control

(2) Annual report

Plant Name: **ZAGAZIG W.T.P.**	Title **Alum Dosing Facility**	SOP TAG No. **ZAG-WTP11-OP**

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1. Features of process

1-1. Function of process and facility

Aluminum sulfate (abbreviate as Alum) dosing facility is one of important element facility in coagulation process. Function of alum dosing action is to make a flock by neutralizing of negative charges on dispersed non-settling solids such as clay and organic substances. Once the charge is neutralized, the small suspended particles are capable of sticking together.

Function of alum dosing facility consists of three (3) woks as follows:

(1) Store of alum as solid or solution
(2) Measuring and control of flow rate of alum dose
(3) Transferring and dosing of alum into dosing point

1-2. Impacts of process

Coagulation process is affected by effectiveness of the alum dosing. The whole of water treatment process is affected by effectiveness of coagulation process. Failure of coagulation process is never recovered by any other functions of facilities or processes for particles removal.

1-3. Relations between other processes

Alum dosing facility has tight relation to coagulation process. Generally alum is dosed into location of just before rapid mixing. After adding of alum into the process water coagulation reaction will start immediately. Coagulation reaction will be affected mainly by the following:

- ◆ Characteristics of raw water
  - ➢ Turbidity
  - ➢ pH
  - ➢ Alkalinity
  - ➢ Contained algae
  - ➢ Water temperature
- ◆ Effectiveness of mixing
  - ➢ Detention time in mixing basin
  - ➢ Dosing point of alum

In above factors, water temperature of raw water and efficiency of mixing should be affect

strongly as physical condition. And coagulation process is based on following condition of operation and control;

- ◆ Proper water quality analysis, test, monitoring and control
  - ➢ Grasp of raw water characteristics by examination such as water analysis
  - ➢ Determination of required alum dosing rate by examination such as jar test
- ◆ Proper rapid mixing and detention time
  - ➢ Effective mixing and dispersion of alum with the raw water
  - ➢ Detention time of raw water
- ◆ Proper operation, monitoring and control of alum dosing facility
  - ➢ Adjustment and keeping to required alum dosing rate
  - ➢ Monitoring and keeping of dosed alum quality

2. Criteria for operation

2-1. Making of aluminum sulfate solution used by solid aluminum sulfate

C: Concentration of aluminum sulfate solution:10 (W/W%)
Dimension of aluminum sulfate solution tank: 3.5m(length) 4.0m(width) 2.8m(depth)
V: Effective capacity of aluminum sulfate Solution tank:30 (m3)
W_b: Capacity weight of a baggage of aluminum sulfate solid: 50 kg/bag
D_d: Density of 10 % aluminum sulfate solution: 1.05 (kg/l)
($D_d = 1+ 0.0049C$)
Solid aluminum sulfate $Al_2(SO4)_3\ 18H_20$
Solid aluminum sulfate includes 48.7(w/w%) of water

$W_{solution}$: Weight of 30 m3 volume of 10 % aluminum sulfate solution: 31470 kg
W_{alum}: Required aluminum sulfate without water in solid for above: 3147kg
$W_{solid\ alum}$: Required solid aluminum sulfate included water in solid: 4,680kg
($W_{solid\ alum} = W_{alum} + (W_{alum} \times 48.7/100)$)
W_{water}: Weight of water including in solid aluminum sulfate: 1,533kg
($W_{water} = W_{solid\ alum} - W_{alum}$)
$N_{solid\ alum}$: Required number of bag of aluminum sulfate solid: approx. 94 bags
($N_{solid\ alum} = W_{solid\ alum} / 50$kg)
Required water for solution: 30,000-1533 =28,467 kg
H: Water level in solution tank required for above: 28,467/(3.5×4)= approx.2m

Procedure for making solution
1. Put the water into the solution tank up to depth of 2 m
2. Put 63 bags of solid aluminum sulfate in to solution tank
3. Keep the solution in above status for 1 hour
4. Put in the switch to start a agitator for solution tank
5. Keep running the agitator for 1 hour.

6. Stop the agitator.

2-2. Calculation formula for dosing flow rate

Calculation formula for dosing flow rate is as follows:

Dosing flow rate (m^3/h)

= Raw water flow rate (l/sec) x 60 x 60 x Dosing rate (mg/L) x $1/D_d$ (kg/L) x 1/1000000

2-5. Response time to adjust dosing flow rate when raw water flow rate is changed

Alum dosing flow rate should be changed simultaneously with change of raw water flow rate. And time of delay to be changed will be acceptable as following;

- In case of increase the dosing flow rate: Within 3 min
- In case of decrease the dosing flow rate: Within 5 min

3. Operation under normal condition

3-1. Startup and shutdown procedures

(1) Receiving of liquid alum
Refer to Flow Chart - No.WTP11-OPF01

(2) Transfer of liquid alum
Refer to Flow Chart - No.WTP11-OPF02

(3) Dilution of alum solution
Refer to Flow Chart - No.WTP11-OPF03

(4) Dosing and adjustment of alum solution
Refer to Flow Chart - No.WTP11-OPF04
Refer to characteristics graph of dosing pump

3-2. Monitoring and visual check

Monitoring and visual check should be conducted to confirm the proper dosing of alum. Check list should be required to ensure the confirmation. Details and frequency for monitoring and check should be referred to ZAG-WTP11-OPIP-01.

(1) Alum solution tank
- Solution level indication of each tank
- Condition of covering of tank top
- Condition of leak from tank, valve and connection part
- External damage and corrosion
- Indicate condition of tank as “in working” or “stand-by”

(2) Alum dosing device

- Dosing flow rate
- Leak of alum and water from pump
- External damage and corrosion

(5) Pipe and valve
- Leak from valve and connection part
- External damage and corrosion

3-3. Operation procedures for control of facility

Controlled item is dosing flow rate of alum. Dosing flow rate of alum is controlled by changing adjustable dial of stroke length manually.

Controlled alum flow rate is not able to monitor. Hence, accuracy of alum dosing flow rate have to be checked periodically. Accuracy check is conducted by validation that difference between consumed solution volume and integrated volume calculated by dosing flow rate of metering pump. If difference of above mentioned will be 10% or more, pump and/or level meter for solution tank should be checked and took maintenance if necessary. This accuracy check is called as calibration activity.

4. Operation under unusual condition

Prospected troubles and trouble shootings are as follows:

(1) Trouble in the common activity
- Observation of leakage
- Observation of external damage or corrosion

(2) Trouble in the activity of storage
- Waste of aluminum sulfate solution
- Unusual reducing of storage volume

(4) Trouble in the activity of adjusting of dosing
- Clogging of inside of pipe or valve
- Clogging of flow meter
- Insufficient of dosing
- Overflow from upper tank or dosing tray of dosing device
- Waste of dosing tank or upper tank of dosing device
- Damage of the control valve
- Leak of alum

5. Reports and records

5-1. Records

Records should include the following:

(1) Daily record
- Dosing rate and flow rate of alum
- Raw water flow rate into the each distribution shaft
- Solution level
  - Alum storage tanks
  - Alum dosing tanks
  - Concentration of alum

(2) Other record
- Concentration of solution
- Check list for daily monitoring and check

5-2. Reports

Reports should include the following:

(1) Consumption data of alum
- Weight of alum used each 24-hour period during a month
- Total weight of alum used for a month
- Average weight of alum dosed during a 24-hour period for a month
- Maximum weight of alum used during any 24-hour period during a month
- Minimum weight of alum used during any 24-hour period during a month

(2) Recommendation on facility
- Rehabilitation and upgrading
  - Repairing
  - Replacement
  - Additional facility
- Spare parts should be stored

(3) Recommendation on modification of the criteria
(4) Recommendation on training for persons
(5) Recommendation on review of O&M plan
(6) Supplying of materials for review of water quality control plan

Plant Name: **ZAGAZIG W.T.P.**	Title of SOP: **Alum Dosing Facility**	SOP TAG No. **ZAG-WTP11-OP**
Kind of Doc. **O & M Schedule**	Title of Document **O & M Schedule**	Document No. **ZAG-WTP11-OPSC-01**

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Operation and Maintenance Schedule

D: Daily, W: weekly, M: Monthly, 3M: Each 3 month, 6M: Each 6 month, Y: Yearly, AN: As needed

Name of Facility	Frequency						
	D	W	M	3 M	6 M	Y	AN.
1.Liquid Alum S Tank							
1-1.Check liquid level in duty and in standby	○						
1-2.Check covering over the tanks	○						
1-3.Check tank and valves for leaks	○						
1-4.Check waste in the tanks						○	
1-5.Inspect tank inside for corrosion, waste						○	
1-6.Inspect tank outside for corrosion						○	
1-7.Inspect specifications of liquid alum							○
2.Alum Dosing Pump							
2-1.Check oil leakage	○						
2-2. Inspect pump inside for corrosion, waste						○	
2-3. Inspect pump outside for corrosion		○					
2-4. Discharge pressure	○						
2-5. Set value of adjustable dial for stroke length	○						
2-6. Noise, vibration and temperature of pump and motor	○						
2-7. Leakage of solution from pump	○						
2-8.Calibaration						○	
3. Alum Solution Agitator							
3-1.Damage of shaft and paddles	○						
3-2.Leakage of lubrication oil	○						
3-3.Noise, vibration and temperature of pump and motor	○						
3-4.Addesion of foreign substances to shaft, paddle	○						
4. Pipe and valve							
4-1.Damage and leakage	○						
4-2.Clogging inside of pipe						○	

ZAG-WTP11-OPFC-02	Revised version	Issued date	Page 1of 2

Plant Name: ZAGAZIG W.T.P.	Title: Alum Dosing Facility – Alum Dosing Control	SOP TAG No. ZAG-WTP11-OP

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1. Purpose

This flow chart provides to know procedures on alum dosing control.

2. Application

Required Steps for Control of Alum Dosing Quantity

3. Preparation

STEP 0

Confirm raw water flow rate in L/sec and m^3/day	Raw water flow meter
	Raw water pump numbers in working

STEP 1-1

Confirm level of solution of solution tank in cm Confirm density of solution in solution tank in kg/l	No,1 tank No.2 tank No.3 tank

STEP 1-2

Check condition of valves attached to solution tank, in opened or closed	No,1 tank No.2 tank No.3 tank

STEP 1-3

Check condition of valves around distribution shaft, in opened or closed	

STEP 2. Start the Dosing

Open the valves around dosing pump

Set the Control Target: Alum flow rate in m^3/h	Measure the flow rate: Read adjustable dial of dosing pump
Order the flow rate change	Adjust flow rate to the control target Change adjustable dial of dosing pump
Type of Alum dosing facility is manually controlled.	

STEP 3. Control the Dosing

Calculate alum dosing flow rate in m^3/h for target flow rate of alum 1. Raw water flow rate Q: Flow rate (m^3/day)or (L/s) 2. Alum dosing flow rate V: Flow rate (m^3/h) 3. Refer to graph for calculation of alum dosing flow rate	Followings need to calculate • Raw water flow rate, dosing rate • Density and concentration of alum solution will be dosed • Density 1.05

Open outlet valve and dosing valves in alum dosing pipe line	Line to D/S
Open outlet valve and dosing valves for alum dosing pump	Line to D/S
Confirm and read adjustable dial of alum dosing pump Refer to graph of relation between indication of adjustable dial and dosing flow rate of dosing pump	Line to D/S

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Plant Name: ZAGAZIG W.T.P.	Title: Alum Dosing Facility	SOP TAG No. ZAG-WTP11-MT

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1. Introduction

Chemical of alum solution is high corrosive acid liquid. This is key point for maintenance activities of alum dosing facility. We should avoid leak of alum and if it leaks it is necessary to act early detection and rapid response of repairing. And after repairing, clean up around leaked area by water and clean away moisture to keep drying by cloth.

Character of alum solution as cloggy solution, is another key for maintenance. Alum solution will be clogged inside of pipe by using for long time. We should clean away and remove it periodically. We also must clean and remove the precipitations on the bottom of tanks such as storage tank or dosing tank.

2. Criteria for maintenance

Criteria for maintenance are shown as follows:

(1) Inspection interval for facility or parts should be inspected
(2) Acceptable limit value for using (e.g. run time in working)
(3) Interval for replace of facility or parts

3. Maintenance activity

3-1. Facilities for maintenance

(1) Alum solution tank
(2) Alum dosing pump
(3) Alum solution agitator
(4) Pipes and valves

3-2. Maintenance activity

Maintenance activity consists of four (4) kinds of works as follows:

(1) Monitoring and check during working
(2) Inspection
(3) Evaluate and analysis regarding result of inspection
(4) Repair or replacement including check after the work

Monitoring, check and inspection should be carried out to judge necessity of recovering

activity such as adjustment, repairing or replacing.

3-2-1. Monitoring and visual check

Monitoring and check should be conducted to keep the facility in satisfactory condition during working. Satisfactory condition in the alum dosing facility is required following conditions;

- Alum dosing flow rate is kept in required amount and correct.
- Alum dosing flow rate should be able to change in required variable range.
- A foreign substance does not exist in the solution
- External damage does not observe on the facility.
- Unusual over flow does not happen.
- Concentration of solution is kept in required condition.
- Solution level in a tank is kept in satisfactory condition.
- Leak of alum does not exist.

3-2-2. Inspection

Inspection should be conducted to ensure that facility should go on with satisfactory working. Inspection should be required not only by external check but internal check of the facility. In inspection the facility should be looked closely at parts especially to check that everything is satisfactory.

Inspection should be conducted periodically and frequency of inspection will be different from characteristics of facility or parts by importance, load in working, and possibility of occurring of trouble, and so.

3-2-3. Evaluation and analysis regarding result of inspection

Evaluation should be conducted by suitable point of view such as cost performance and risk assessment and time in working. Hence, preparation of the spare part should be needed before maintenance activity. Time of replacing of the part should be recognized by the record of maintenance. Early detection of unusual condition and rapid recovery may lead to the elongation of the facility life.

3-2-4. Recovery after inspection

Alum dosing facility cannot stop anytime in working of water treatment. When recovery action will be needed after inspection, preparation for recovery without stop of alum dosing should be planned such as temporary piping. Prospect recovery action will be following;

- Change or cleaning of valve or strainer
- Change or cleaning of pipe
- Cleaning in the tank including of removal of precipitations on the bottom.
- Repairing of leaked part or damaged part
- Cleaning of the flow meter
- Repainting to prevention of corrosion

- Replacing of equipment

4. Recovery from unusual condition after maintenance activities

4-1. Expected troubles and trouble shootings

4-1-1. Unusual condition of facilities and actions for remedy of process control

Expected unusual conditions are shown below:

- Leak of alum
- Dosing flow rate is unable to control
- Flow rate of alum solution does not increase to required flow rate
- Flow rate of alum solution does not decrease to required flow rate
- Alum does not be dosed
- Alum solution does not supply into alum dosing pump from solution tank
- Unusual over flow from solution tank

5. Reports and records

5-1. Records

5-1-1. Records for maintenance

Main records for maintenance of alum dosing facility should include the following:

- Alum solution tank
  - External condition
  - Corrosion, leak and so on
- Alum dosing pump
  - External condition
  - Corrosion, leak and so on
  - Calibration
  - Discharge pressure
  - Unusual noise and/or vibration
- Alum solution agitator
  - External condition
  - Corrosion, leak and so on
  - Leakage of lubrication oil
  - Unusual noise and/or vibration
- Pipes and valves
  - Leak of alum solution
  - Looseness of connection part in piping
  - Clogging of inside of pipes, valves and strainers

5-1-2. Records of recovery

Records of recovery work after monitoring and check should include the following:

- Results of recovery work of adjustment, repairing and replacement

  - Stop position of inlet valve with ball tap for attached tank
- Results of recovery work of repairing
  - Name of facility and name of part including a No. of facility
  - Indication of location of part in facility by drawing or sketch
  - Reason of repairing
  - Date of repairing
  - Name of person in charge of repairing work

Contents of records are the same as those of repair work, but the word of "repair" should be changed to "replacement".

5-1-3. Results of inspection

Records of inspection should be required as the records of monitoring and check.

5-2. Reports

Reports should include as follows:

5-2-1. Report for recommendation

(1) Rehabilitation
- Repairing or replace
- List of spare parts that should be required to stock in the plant
  - For supplementation
  - For proposal of newly additional parts

(2) Upgrading of facility or system
- Change of capacity, material, and other specifications
- Addition of facility
- Modification of facility or system
- Proposal of preventive maintenance activity to be needed

4-2-2. Report of maintenance activity

(1) Annual report
- Repairing and replace for each facility
- Trouble and accident
- Result of corrective maintenance
- List of consumed spare parts in a year

(2) Corrective action to prevent the trouble or accident

Plant Name: **ZAGAZIG W.T.P.**	Title **Alum Dosing Facility**	SOP TAG No. **ZAG-WTP11-QC**

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1. Introduction

In ZAGAZIG WTP, alum solution is used as coagulant. Alum is received as solid alum and stored in the storage yard. Stored alum will be put into alum solution tank. Put solid alum is dissolved in the solution tank, and the concentration of solution is to be 10% which is equivalent to 1.6% concentration Al_2O_3 (effective element). This job is carried out as water quality control by a chemist.

2 Criteria for water quality control

Water quality control in alum dosing facility is to check and monitor alum specifications especially concentration of contained Al_2O_3.

Criteria of alum dosing facility are the following;

(1) Effectiveness of received solid alum: More than 16 (w/w %) as Al_2O_3
(2) Concentration of dosed alum solution: Not less than 1.6 (w/w %) as Al2O3

3. Water quality control under normal condition

3-1. Monitoring and check

Concentration of alum solution should be monitored as following:

- Monitor alum solution in the solution tank

4. Water quality control under unusual condition

4-1. Prospect troubles and trouble shootings

(1) Unusual condition of process and actions of remedy for process control

Unusual condition of concentration of alum will be following;

- Concentration of alum solution will be lower than specified concentration
- Concentration of alum solution will be higher than specified concentration
- Unusual color of solution

5. Reports and records

5-1. Records

Records should include the following:

- Concentration of alum solution in storage tank after receiving
- Periodical check
- Concentration of alum solution in dosing tank after dilution
- Periodical check

5-2. Reports

Data of concentration of alum solution will be used for calculation of consumption amount. Hence, following report should be required about diluted solution:

- Average concentration of alum solution during a 24-hour period for a month
- Maximum concentration of alum solution used during a month
- Minimum concentration of alum concentration used during a month

Plant Name: ZAGAZIG W.T.P.	Title: Chlorination Facility	SOP TAG No. ZAG-WTP12-OP

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1. Features of process

1-1. Function of process

Two kinds of functions are provided to chlorination facility, one of them is pre-chlorination and another is post-chlorination.

Function of pre-chlorination is to oxidize metal and organic matter and so contained in raw water.

Function of post-chlorination is to destroy disease causing organics, also called pathogenic organics contained in clear water and to make the water continuously disinfected in the network until reaching the customer.

1-2. Impacts of process

Pre-chlorine is dosed into raw water prior to dosing of alum. Pre-chlorine aid the coagulation and sedimentation process by oxidation of metal or organics in raw water.

Post-chlorination performs disinfection of clear water and the free chlorine will continue to react with the impurities in the water, such as organic materials and organisms, until all the impurities and organisms are destroyed and there is an excess of free chlorine.

It is important to recognize that the combination of sufficient free chlorine residual and adequate contact time are essential for effective killing of the pathogenic organisms.

1-3. Relations between other processes

Pre-chlorine dosing rate is varied by raw water quality especially organic matter and ammonia contained quantity in raw water. Pre-chlorination affects to coagulation process. Post-chlorination dosing rate is varied by filtered water quality. Pre-chlorination affects to final quality of produced potable water contained free residual chlorine concentration.

2. Criteria for operation

(1) Treatment target of residual chlorine for water in the transmission line
1.5 mg/L or more and less than 2.0 mg/L
(2) Target of residual chlorine for water at the tap of distribution network

0.5 mg/L or more and less than 1.5 mg/L
(3) Treatment target of free chlorine residual for clarified water
0.5 mg/L or more and less than 1.0 mg/L
(4) Treatment target of residual chlorine for filtered water
0.2 mg/L or more and less than 0.5 mg/L
(5) Treatment target of free chlorine residual for water in ground reservoir
1.5 mg/L or more and less than 2.5 mg/L
(6) Response time of change of the dosing flow rate for chlorination after change of raw water flow rate

Chlorine dosing flow rate should be changed simultaneously with change of raw water flow rate. And delay of change for response will be acceptable as following;

- Pre-chlorine
  - In case of increase: Within 5 min
  - In case of decrease: Within 5 min
- Post-chlorine
  - In case of increase: Within 5 min
  - In case of decrease: Within 5 min

3. Procedures for operation under normal condition

Basically, operation procedures for facility such as chlorinator should be kept strictly according to manufacturers recommendations in instruction manuals.

3-1. Operation of chlorination facility

Operate chlorine facility by persons with certificate of working knowledge and skills on handling of chlorine and chlorination facility must be required for persons to handle chlorination facility. Persons to operate chlorination facility must be trained on chlorine , chlorination facility and handling skills on them.

3-2. Early detection and rapid response to chlorine leak accidents

Basically, early detection and rapid response as corrective action of chlorine leak is very important action for operation of chlorination facility.

3.3. Close all doors in chlorination house when chlorine leakage accidents occur

We must operate chlorine facility with the greatest care to prevent from happening of chlorine leak. But in case of happening of chlorine leaked, we must try to avoid diffusing leaked chlorine to outside of chlorination house. Therefore, all doors must be closed usually in chlorination house.

3.4. Periodical practice on activity in emergency situation

Emergency case means situation of accident with severe chlorine leak. Under emergency situation, we must act immediately according to prepared action plan and program. Safety devices and tools must be provided and maintained and kept in proper condition to use any time. And they should be stored in the room without chorine such as chlorine neutralization room.

3.5. No smoking in the room of chlorination house

No need to explain.

4. Report and record

4-1. Records

Records for operation condition should include the following:

(1) Chlorine gas feed
- Pressure gauge indication of chlorine gas feed before pressure reducing valve
  - Line-1, Line-2
- Pressure gauge indication of chlorine gas feed after pressure reducing valve
  - Line-1, Line-2
- Weight indication of the chlorine container
  - Set -1, Set-2
- Water temperature in the evaporator
- Water flow meter indication

(2) Records for Chlorinator
- Pre-chlorine dosing flow rate
- Post-chlorinator dosing flow rate
- Water supply pressure fed to the chlorinator

(3) Indication of chlorine gas leak detector
- For container room
- For chlorinator room

4-2. Report

Reports should include the following:

(1) Consumption tendency of the chlorine
- Weight of chlorine used each 24-hour period during a month
- Total weight of chlorine used for a month
- Average weight of chlorine dosed during a 24-hour period for a month
- Maximum weight of chlorine used during any 24-hour period during a month
- - Minimum weight of chlorine used during any 24-hour period during a month

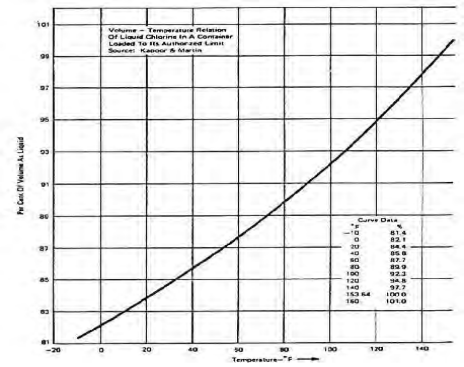
(2) Recommendation on facility
- Rehabilitation and upgrading
- Repairing
- Replacement
- Additional facility
- Spare parts should be stored
- Recommendation on modification of the criteria
- Recommendation on training for persons
- Recommendation on review of O&M plan

Plant name ZAGZIG W.T.P.	Title: Chlorine Gas Properties	SOP No. WTP12-OP TI-01

Issued		Developed by		Signature	
Revised		Approved by		Signature	

1. Chlorine Gas Properties

Elemental chlorine is a greenish-yellow gas about 2.5 times heavier than air. Therefore, it will sink to the floor if released from its container. It is sold to the water supplies as a compressed liquid. If liquid chlorine is unconfined, it rapidly vaporizes to gas (one volume of liquid chlorine equals about 450 volumes of gas) so the maximum allowable limit for the chlorine gas to be withdrawn from the cylinder not exceeding 9kg/hr to avoid the temperature decreasing and forming ice which may clog the pipe.



Volume-Temperature Relation of Liquid Chlorine in a Container Loaded to Its Authorized Limit

Chlorine is only slightly soluble in water; its maximum solubility is approximately one percent at 49° C. When the water supply to a gas chlorinator is below normal room temperature, it may cool the chlorine gas to the point at which chlorine ice is formed and accumulates on the needle valve and gas outlet tube, resulting in erratic feed results.

Chlorine reacts with many compounds. Because of its great affinity for hydrogen, it removes hydrogen from some compounds, such as hydrogen sulfide. It also reacts with ammonia or other nitrogen-containing compounds to form various mixtures of chloramines. It reacts with organic materials.

Although it is neither explosive nor flammable by itself, chlorine is capable of supporting the combustion of certain substances. It should be handled and stored away from compressed gases, such as ammonia and other flammable materials.

Most common metals are not affected at normal temperatures by dry chlorine, either gas or liquid. Chlorine is, however, reactive with aluminum and ignites carbon steel at temperatures above 450° F. Moist chlorine is corrosive to all common metals with the exception of gold, silver, platinum, titanium, and certain specialized alloys.

2. Physical Effects of Exposure to Chlorine Gas

Chlorine gas is primarily a respiratory irritant and concentrations in air above one ppm can usually be detected by most persons. Chlorine causes varying degrees of irritation of the skin, mucus membranes, and the respiratory system, depending on the concentration and the duration of exposure. Severe exposure can cause death, but the severe irritating effect makes it unlikely that anyone would remain in the chlorine-containing atmosphere unless trapped or unconscious.

Liquid chlorine may cause skin and eye burns upon contact with these tissues. Chlorine produces no known cumulative or chronic effect, and complete recovery usually can be expected to occur shortly following mild, short term exposure.

3. Use of Combined Residual Chlorination

Combined residual chlorination involves the addition of chlorine to water to produce, with natural ammonia present or with ammonia added, a combined available chlorine residual. Combined available chlorine forms have lower oxidation potentials than free available chlorine forms and are less effective as oxidants. They are also less effective as disinfectants. In fact, 25 times more combined available residual chlorine must be obtained to meet the same disinfectant level as a free available residual. The contact time has to be up to 100 times greater to obtain the ame level of bacterial kill at the same pH and temperature conditions.

When combined available residual chlorine is desired, the character of the water determines

how it can be accomplished. These conditions may have to be considered:

- If the water contains sufficient ammonia to produce the desired level of combined residual.
- 2. If the water contains too little or no ammonia, then addition of both chlorine and ammonia is required.
- 3. If the water has a free available chlorine, all that is required is the addition of ammonia alone.

4. Use of Free Residual Chlorination

The free residual chlorine is the residual amount of chlorine after oxidization with all impurities, chloroamines formation and exceeding the break point.-a free available chlorine residual and to maintain the water disinfected while passing through the pipes, tanks and distribution system.

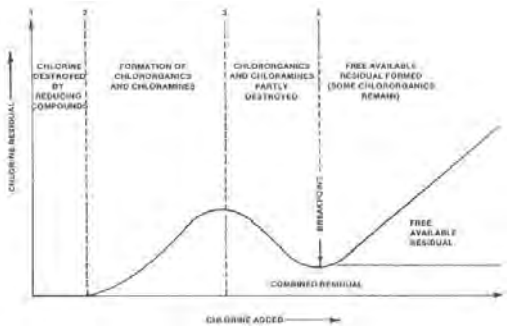
Free available residual forms have higher oxidation potentials than combined available chlorine forms and are more effective as disinfectants.

5. Breakpoint Chlorination

Breakpoint chlorination is the point which the residual chlorine starts to appear and at this point the chlorine finished all its reactions. The existence of this residual chlorine to assure that all reactions have been achieved and also a sufficient amount exist to continue disinfecting water until reaching the customer taps.

Breakpoint chlorination is the name of the process of adding chlorine to water until the chlorine demand has been satisfied. Chlorine demand equals the amount of chlorine used up before free available residual chlorine is produced.

Further additions of chlorine will result in the residual chlorine that is directly proportional to the amount of chlorine added beyond the breakpoint. Public water supplies normally chlorinate past the breakpoint.



Breakpoint Chlorination

When chlorine is initially added to water, the following may happen:

(1) If the water contains some iron, manganese, organic matter, and ammonia, the chlorine reacts with these materials and no residual is formed, meaning that no disinfection has taken place.

(2) If additional chlorine is added at this point, it will react with the organics and ammonia to form chloramines. The chloramines produce a combined chlorine residual. As the chlorine is combined with other substances, it loses some of the disinfection strength. Combined residuals have poor disinfection power and may be the cause of taste and odor problems.

(3) With a little more chlorine added, the chloramines and some of the chlororganics are destroyed.

(4) With still more chlorine added, a free residual chlorine is formed.

Free available chlorine is the best residual for disinfection. It disinfects faster and without odor. The common practice today is to go just beyond the breakpoint to a residual of about .2 to .5 ppm.

A variety of reactions take place during chlorination. When chlorine is added to a water containing ammonia (NH3), the ammonia reacts with hypochlorous acid (HOCL) to form monochloramine, dichloramine, and trichloramine.

The formation of these chloramines depends on the pH of the water and the initial chlorine-ammonia ratio.

Ammonia + Hypochlorous acid ----> Chloramine + Water

NH_3 + HOC1----------> $NH_2C1 + H_20$ Monochloramine

NH_2C1 + HOC1---------- > $NHC1_2 + H_20$ Dichloramine

$NHC1_2$+ HOC1---------- > $NC1_3 + H_20$ Trichloramine

At pH of most natural water (pH 6.5 to 7.5), monochloramine and dichloramine exist together. At pH levels below 5.5, dichloramine exists by itself. Below pH 4.0, trichloramine is the only compound found. The monochloramine and dichloramine forms have a definite disinfection power. Dichloramine is a more effective disinfecting agent than monochloramine.

However, dichloramine is not recommended as a disinfectant due to the possibility of the formation of taste and odor compounds. Chlorine reacts with phenol and salicylic acid to form

6. Injection Points

The points of application of chlorine must be selected carefully, considering the different reactions that may occur at different points of the water treatment process. The common application points are:

6.1. PRE-CHLORINATION

Pre-chlorination is the application of chlorine ahead of any other treatment process. It provides the following benefits:

- Control of algae and slime growths.
- Control of mud ball formation in the filters.
- Improved coagulation.
- Reduction of tastes and odors.
- Increased safety factor in disinfection of heavily contaminated waters.

6.2. POST-CHLORINATION

Post-chlorination is the application of chlorine after treatment and before it enters the distribution system. The purpose is to disinfect water and saving it until reaching customers taps.

6.3. TANKS AND RESERVOIRS

Usually tanks and reservoirs are not chlorinated continuously, but they must be disinfected after any maintenance has been done on the inside of the tank.

Plant Name: ZAGAZIG W.T.P.	Title: Chlorination Facility	SOP TAG No. ZAG-WTP12-MT

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1. Introduction

Chlorine has the potential to cause serious injury, even death in the worst case. Concentration of 1000 ppm, or one percent by volume will lead to a fatal accident for a very short time. Since the odor of gas chlorine is noticeable in very small amount, it is generally easy to avoid the heavy concentrations that will cause injury. Detail on chlorine gas properties are shown in technical information sheets of WTP12-MTTI01.

Chlorine gas shall not be leaked by sufficient maintenance and careful handling and operation. All the persons should be well trained in the use of self-contained breathing equipment, the methods of detecting leaks, and emergency procedures.

2. Criteria for maintenance

Criteria for maintenance are listed as follows:

2-1. Inspection interval and inspected facility or part of facility

Refer to “Inspection List for maintenance” ZAG-WTP12-HTIP-01.

2-2. Acceptable limit value for using

(For example, accumulating time in working, dimension of pipe thickness, and so)

2-3. Frequency of periodical replace of facility or part of facility

Refer to “Inspection List for maintenance” ZAG-WTP12-HTIP-01.

3. Maintenance activity

Maintenance activity consists of four (4) kinds of work components as follows:

3-1. Monitoring and check during working of facility as routine work

- Frequency of monitoring and check, such as after each working, daily, weekly.

3-2. Inspection

- Inspection works should require the following jobs and these jobs are shown in the

inspection list of ZAG-WTP12-MTIP01.

- Objects of inspection, such as parts and facility
- Inspection method
- Frequency of inspection

Records of inspection results are required.

3-3. Evaluate and analysis regarding inspection results

Results of inspection should be applied to recovery jobs such as repairing, adjustment, or replacing of parts or facilities. There are some criteria that we cannot provide numerical values such as degree of corrosion.

3-4. Recovery by repairing or replacing work including checking after the work

Recovery action itself will be not difficult but we should judge not only technical performance but cost performance. Under this situation, we should introduce thinking way of risk. Risk is indicated by multiplied result that chance of happening by scale of damage if it will be happened. High risk items should be recovered by evaluated priority.

3. Reports and records

3-1. Records

Records for maintenance of the chlorination should include the following:

(1) Records of inspection

(2) Records of recovery
- Replace of the parts or facility
- Repairing of the parts or facility
- Adjustment of the parts or facility
- Tightening or fixing of the connection parts or fixing parts
- Repainting
- Supplying or change of the grease or oil

3-2. Reports

Reports on maintenance of the chlorination should include the following:

(1) Recommendation
- Rehabilitation as the preventive action
  - Replace
  - Repair
  - Repainting
- Review of the SOPs
  - Procedures

  - The criteria
  - Record and report
- Training for the operator
  - Check and handling skill as routine operation
  - The manuals for the O&M activity
- Review of procedures under the emergency situation

(2) Annual report
- Reports of the trouble or unusual situation
- Reports of recovered parts or facility and the cost for recovery
- Plan for the maintenance activity

Plant Name:	Title of SOP:	SOP TAG No.
ZAGAZIG W.T.P.	**Inspection List for Maintenance For Chlorination Facility**	**ZAG-WTP12-MTIP-01**

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Inspection List for Chlorination Facility

D: Daily, W: Weekly, M: Monthly, 3M: Each 3 month, 6M: Each 6 month, Y: Yearly, AN: As needed

Name of Facility & inspection item	Frequency					
	D	W	M	3M	6M	Y
1.Stand frame for chlorine container						
1-1.External corrosion		○				
1-2.Tightenig of bolts & nuts		○				
1-3.Smooth rotation of rotor		○				
1-4.Stopper of rotor				○		
1-5.Condition of foundation						○
2.Evaporator	----	----	----	----	----	----
2-1.Leak of water			○			
2-2.External corrosion of heater					○	
2-3.Damage of lead cable					○	
2-4.Insulation resistance of cable					○	
2-5.External corrosion of thermometer					○	
2-6.Smooth moving of needle of thermometer					○	
2-7.External corrosion of pressure gauge					○	
2-8.Waste of inside part of pressure gauge					○	
2-9.Sealing of connection part			○			
2-10. Smooth moving of needle of pressure gauge				○		
2-11.Working of thermostat				○		
2-12.Damage of cable and cable connection part				○		
2-13.Rooseness of cable at terminal part				○		
3.Chlorinator						
3-1.Pressure gauge						
3-1-1.External corrosion			○			
3-1-2.Waste of inside part			○			
3-1-3.Sealing of connection part			○			
3-1-4. Smooth moving of needle			○			
3-2.Pressure reducing valve						
3-2-1.External corrosion				○		
3-2-2.Waste of inside part				○		

Name of Facility & inspection item	Frequency					
	D	W	M	3M	6M	Y
3-2-3.Sealing of connection part			○			
3-2-4.Pressure reducing value (bar)		○				
3-3.Control valve for chlorine flow rate						
3-3-1.External corrosion				○		
3-3-2.Clean of needle and seat inside the valve				○		
3-3-3.Waste of inside part				○		
3-3-4. Sealing of connection part			○			
3-4.Flow meter for chlorine gas						
3-4-1.Cleaning inside				○		
3-4-2. Sealing of connection part				○		
3-5.Ejector						
3-5-1.Extenal damage and corrosion				○		
3-5-2.Sealing of connection part			○			
3-5-3.Proper working				○		
4.Piping						
4-1.Chlorine gas line of steel pipe						
4-1-1.Extenal damage and corrosion				○		
4-1-2.Crack, deformation, and wear				○		
4-1-3.Tightenig of bolts & nuts				○		
4-1-4. Sealing of connection part			○			
4-2. Chlorine gas line of copper tube						
4-2-1.Bending, cut area reducing by irregularity			○			
4-2-2.External corrosion				○		
4-2-3.Waste of inside part				○		
4-2-4. Sealing of connection part			○			
4-2-5.pressure reducing valve		○				
4-2-6. Cleaning of contact face of connection				○		
4-3.Ordinary line						
4-3-1.Extenal damage and corrosion			○			
4-3-2.Crack, deformation, and wear						○
4-3-3.Tightenig of bolts & nuts						○
4-3-4. Sealing of connection part			○			
4-4.Supprt for pipe						
4-4-1.Extenal damage and corrosion						○
4-4-2.Check terminal pipes safety						○
4-4-3. Crack, deformation, and wear						○
5.Container lifting beam						
5-1.Extenal damage and corrosion			○			
5-2.Crack and wear			○			

Name of Facility & inspection item	Frequency					
	D	W	M	3M	6M	Y
5-3.Deformation of hook			○			
5-4.Tighten of bolts for hook			○			
6.Crane						
6-1.Push button swich						
6-1-1.Damage of terminal contact			○			
6-1-2.Tighten of screws at terminal			○			
6-1-3.Smooth actions of push buttons, correct moving			○			
6-2.Cable						
6-2-1.External damage			○			
6-2-2.Twisting and bending			○			
6-2-3.Damage of cable end finishing			○			
6-3.Limit switch (L/S) for over winding prevention						
6-3-1.Condition of contact			○			
6-3-2.Fixing condition			○			
6-3-3.working of arm lever			○			
6-3-4.Confirm lifting margin after operation of L/S			○			
6-4.Wire rope						
6-4-1.Damage			○			
6-4-2.Wear			○			
6-4-3.Twisting and bending			○			
6-4-4.External corrosion			○			
6-4-5.Confirm finishing end of wire			○			
6-4-6.Application of oil for wire			○			
6-5.Hook						
6-5-1.Crack and wear			○			
6-5-2.Deformation of opening of hook			○			
6-5-3.supplying oil in bearing part			○			
6-5-4.Normal rotation			○			
6-6.Cabtire cable						
6-6-1.Looseness of wiring connection at terminal			○			
6-6-2.External damage			○			
6-6-3.Twisting and bending			○			
6-6-4.Confirm finishing end of wire			○			
6-7.Trolley and drive unit						
6-7-1.Wear of guide roller			○			
6-7-2.Oil supplying into gear box for lifting			○			
6-7-3.Oil supplying into gear box for traveling			○			
6-7-4.External corrosion		○				

Plant Name:	Title	SOP TAG No.
ZAGAZIG W.T.P.	**Transmission Pump**	**ZAG-WTP13-OP**

Issued		Developed by		Signature	
Revised		Approved by		Signature	

1. Features of process

1-1. Function of process

The function of the transmission pump is to feed the potable water to the network with adequate quantity, adequate pressure and reliable quality.

1-2. Impacts of process

The transmission pump process is the final stage in the water treatment process. The transmission pump facility must be working for 24 hours in a day and 365 days in a year.

Quantity and pressure of the distribution water should be controlled in this process. Insufficient control of quantity of the distribution water will be cause of the suspension of water supply or wasteful operation of the water treatment plant such as unnecessary consumption of chemicals and electrical power.

Insufficient control of pressure in the pipe of the network will be cause of the water leakage or increasing of leak quantity from the network pipe, or contamination from outside of the network pipe.

1-3. Relations between other processes

(1) The clear water reservoir

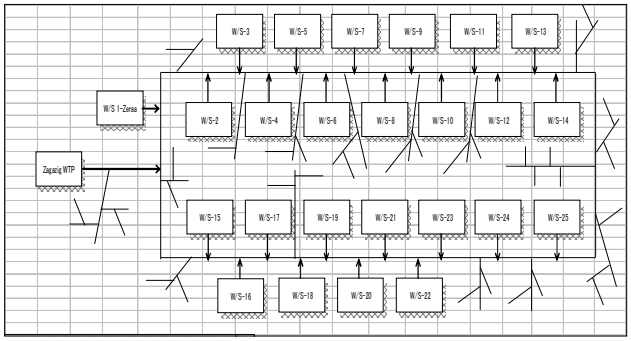
The clear water to distribute for the network is fed into the clear water basin from the clear water reservoir, and this is the suction tank for the transmission pump. The water in the clear water reservoir and the clear water basin must be kept clean and safety. These basin or reservoir must be covered to isolate from the air outside to avoid contamination by dust or sprayed agricultural chemical.

(2) Network

The operation of the transmission pump relates to the function of the network. Hence, condition of the network such as pressure of pipe inside should be monitored usually in the operation of the transmission pump.

From ZAGAZIG WTP, the clear water is distributed to following one (1) network:

The transmission water from ZAGAZIG WTP is mixed with transmission water from 25 well stations.



The names of well stations in ZAGAZIG city are shown as below table.

	Zagazig City	No of pump
	station name	Total
1	Mogamaa El Zeraa	13
2	El Magzar El Alee	4
3	Sooq El Talat	2
4	El Mahad El Deni 1	3
5	El Mahad El Deni 2	4
6	El Galaa 1&2	6
7	El Galaa 3	4
8	El Sagha	2
9	Amn El Dawla	2
10	El Qawmia	2
11	Gamal Abd El Naser	3
12	El Sadat	2
13	Mawqaf El Mansoura	2
14	Abu Amer	2
15	El Shams	2
16	El Hamla	2
17	El Moalimat	4
18	El Moasasa	2
19	El Mabara	2

20	El Zagazig El Bahari	2
21	Abd Alah Fekri	1
22	Kafr Abd El Aziz	2
23	Mawqaf Faqus	4
24	Qouta (inside Zagazig WTP)	3
25	El Tagneed	0
26	Makhazen Magles El Madina	0
27	Rafeea El Zeraa	1
		76

2. Criteria for operation

2-1. Acceptable pressure inside of the network

The pressure in the main pipe: 3.2-3.5 Bar or less

2-2. Schedule for working of pump

The transmission pump should be operated according to operation schedule. Usually a pump will be operated for 24 hours and after that changed to stand by pump.

2-3. Indication of vacuum meter be possible for starting of pump

Prior to start a pump air in the casing of a pump should be sucked out by the vacuum pump. After pump casing will be in condition of filled water, a pump is possible to start. Vacuum indicator should be required -0.5 lb/in2 or more to start a pump.

3. Operation under normal condition

3-1. Startup and shutdown procedures

3-1-1. Pre-start check

The pump will be operated should be selected.

(1) The water level in the clear water basin
Water level should be sufficient for working of pump.

(2) Valves in suction line should be opened fully while valves in discharge line should be closed in the beginning of the operation.

(3) Valve for air sucking by the vacuum pump
Valve for air sucking by the vacuum pump should be opened fully.

(4) Electrical switch board
Power should be supplied. Starting regulator should be in starting position.

3-1-2. Start

(1) Operate vacuum pump to start

Wait approx.15 min in working of the vacuum pump. Confirm vacuum indicator -0.5 lb/in^2.

(2) Close valve for air sucking and stop the vacuum pump

(3) Operate the start switch on switch board to start the pump

(4) Open the discharge valve gradually

(5) Confirm the pressure gauge of discharge line.
Indication of pressure gauge of discharge should be 5 bar or less.

(6) Check indicator of current meter on switch board

(7) Check unusual noise, vibration, temperature arise and leak of water

(8) Check dripping condition of water from part of grand packing in stuffing box
Adjust tightening of grand packing as needed (10-15 points per minute).

3-1-2. Shutdown

(1) Close the pump discharge line

(2) Operate the stop switch on switch board to stop the pump

3-2. Monitoring and visual check during operation

It should be conducted more than twice every day by prepared check list. If unusual condition will be found, corrective action should be conducted immediately.

3-3. Operation for control

The control of the transmission pump should be conducted mainly by change of working number of the pumps and quantity and pressure in the network should be controlled. The water level in the clear water basin and the clear water reservoir should be monitored periodically.

4. Operation under unusual condition

4-1. Expected troubles and trouble shootings

(1) Clogging in the suction pipe or the discharge pipe

(2) Discharge pressure is not enough

(3) Discharge quantity is not enough

(4) The water level in the raw water basin is not enough

(5) Mechanical or physical trouble of the pump

(6) Unusual pressure in the network

(7) Electrical power failure

Trouble shootings are shown in ZAG-WTP13-OPTS-01.

4-2. Trouble in the past and cause, background and events for recovery

- Trouble history -

5. Report and record

5-1. Record

Records for operation of the transmission pump should include the following:

5-1-1. Record of working of the pump

(1) Time in operation of each pump

(2) Operation condition
- ◆ Discharge pressure, quantity, electrical current, and so

(3) Water level in the raw water basin

(4) Unusual condition of the pump

5-1-2. Record of working of the vacuum pump

(1) Time in operation of each pump

(2) Operation condition
- ◆ Vacuum pressure, electrical current, and so on.

5-2. Report

Reports for operation of the transmission pump should include the following:

5-2-1. Unusual condition in the maintenance work

5-2-2. Monthly report

(1) Time in operation of each pump

(2) Recommendation on operation

5-2-3. Annual report

(1) Time in operation of each pump

(2) Recommendation on operation

Plant Name: ZAGAZIG W.T.P.	Title: Transmission Pump	SOP TAG No. ZAG-WTP13-MT

Issued		Developed by		Signature	
Revised		Approved by		Signature	

1. Introduction

A centrifugal pump consists of two (2) main components as a pump and a motor. The pump has two main components as follows:

(1) A rotating component comprised of impeller and shaft
(2) A stationary component comprised of a casing, casing cover, and bearing

Auxiliary components generally include the following systems for the following services:

- (Seal flushing, cooling, quenching system)
- Seal drains and vents
- Bearing lubrication, cooling system
- (Seal chamber) or stuffing box cooling, heating system

Auxiliary piping systems include tubing, piping, isolating valves, (control valves, relief valves, temperature gauges and thermocouples), pressure gauge, (sight flow indicator, orifices, seal flush coolers, dual seal barrier/buffer fluid reservoirs), and all related vents and drain.

Maintenance activity for the pump should be conducted to main components and auxiliary components.

2. Criteria for maintenance

It is represented in the pump maintenance activity in addition to the general cleanness, painting, confirm that internal parts work in proper condition and avoid the pump from not working so we can recover any simple phenomena like increase or decrease of cooling water, continuous lubrication, and inspecting pumps when much noise , rise in temperature or vibration occur.

3. Maintenance activity

Daily monitoring and check, and periodical inspection should be required to keep the pump in proper working. Maintenance activity shown herein means activity for the routine maintenance. Description regarding activity for the corrective maintenance is shown in trouble shooting.

Maintenance activity consists of four (4) kinds of working components as follows:

(1) Monitoring and checking during working of facility

(2) Periodical inspection during working or after shut down
(3) Evaluate and analysis regarding result of monitoring and check, and inspection
(4) Recovery e.g., repairing, replace, supply or change of oil and so.

3-1. Monitoring and visual check

3-1-1. Pump

Daily	1. Visually check for leaks
	2, Adjust glands as necessary to maintain proper leakage
	3. Hand test bearing housing for any sign of temp. rise
Every week	1. Visually check for leaks
	2. Adjust glands as necessary to maintain proper leakage
	3. Hand test bearing housing for any sign of temperature rise
Every month	1. Check for lubrication
	2. Check the packing and replace it if necessary
	3. Check and re-grease the bearing
Every 6 months	1. Check alignment of the pimp and motor
	2. Check holding down bolts for tightness
Every year	1. Check rotating element for wear
	2. Check wear ring clearance
	3. Vibration testing

3-2. Periodical inspection during working or after shut down

It includes monitoring of flow rate, pressure head for pumps and current consumption to recognize the pump operation efficiency. When the pump stopped, oiling/greasing of bearings have to be checked and cleaning the excesses.

3-3. Evaluate and analysis regarding result of monitoring and check, and inspection

Generally, we can recognize the efficiency of the pump or the corrective actions needed in case of not applying the flow rate or the pressure head or increase current consumption rater than the design rate for the pump from the results of monitoring.

3-4. Recovery e.g., repairing, replace, supply or change of oil, etc

This means keep the pump in its original condition or the nearest to this condition. This condition will happen by rapid repair or replacing damage parts and avoid the pump from not working.

4. Reports and records

4-1. Records

Records should include the following:

4-1-1. Records of the maintenance work for the facility

- Result of monitoring and check (check list)
- Result of periodical inspection
- Record during the maintenance work of facility
  - Indication of discharge pressure
  - Indication of current meter
  - Measurement of vibration by vibration meter
  - Measurement of noise by noise meter
  - Measurement of temperature of motor and bearing

4-2. Reports

Reports should include the following:

4-2-1. Report for recommendation

(1) Rehabilitation
- Repairing or replace
- List of spare parts that should be required to stock in the plant

(2) Upgrading of facility or system
- Change of capacity, material, and other specifications
- Addition of facility
- Modification of facility or system
- Proposal of preventive maintenance activity to be needed

4-2-2. Report of maintenance activity

(1) Annual report
- Repairing and replace for each facility
- Trouble and accident
  - Result of corrective maintenance
  - List of consumed spare parts in a year

(2) Corrective action to prevent the trouble or accident

Plant Name: ZAGAZIG W.T.P.	Title of SOP: Transmission water pumps	SOP TAG No. ZAG-WTP13-OP
Kind of Doc. Trouble Shooting	Title of Document: Trouble Shooting for the Pump	Document No. ABS-WTP13-OPTS-01

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PROBLEM	POSSIBLE CAUSE	RECOMMENDED REMEDY
No water delivered No flow No pressure	Delivery or suction valve closed	Open the closed valve
	The pump is not primed	Prime the pump
	Suction left is too high	Increase water level in suction sump
	Suction strainer is locked	Clean suction strainer
	Foot valve is partially closed	Clear the clog
	Air leak into suction line	Tight all flanges and packing
	Air buckets in suction line	Open air vent valves in suction pipe
	Leaks in the shaft seal	Replace the seal or tighten gland
	Air leak through stuffing box	Seal the stuffing box properly
	Impeller damaged	Replace the impeller
	Rotation direction is incorrect	Reverse the phases
Low flow and low pressure	Gasket for casing is leaking	Replace the gaskets
	Suction pressure close to vapor	Close partially the discharge valve
	Excessive amount of air in liquid	Open air vent to release air
	Wearing ring worn	Replace new wearing ring
	Foreign maters in the impeller	Open pump and clean impeller
	Foot valve is too small	Replace foot valve
	Parallel operation effect the pump	Check the system design
	Glands is too tight	Loosen the gland nuts
	Packing improperly installed	Replace the backing
	Shaft or shaft sleeve worm	Replace with new shaft and sleeves
	Shaft running off-center	Rectify the shaft centering
	Pump start and stop frequently	Adjust the system control
	Water seal pipe clogged	Clear water seal pipe
	Gland is too tight	Loosen gland nuts
	Seal cage improperly located	Check the location and correct
	Dirt or grit in sealing liquid	Use clean water for sealing

	Cooling liquid is not provided	Repair or install cooling liquid pipe
	Clearance between casing and shat is too excessive	Open the pump and adjust the clearance to the designed value
	Lack of lubricants	Add more grease or oil
Short lifespan for bearing, noisy operation	Misalignment between motor and pump shafts	Adjust the alignment of motor and pump shafts
	Dirt getting into bearing	Check the bearing seal and correct
	Lack of lubrication	Add more grease or oil
	Bearing rusted	Clean and cover protect hosing
	Bearing worn out	Replace the bearing
	Foundation not rigid enough	Repair and tighten foundation bolts
	Excessive grease in bearing housing	Remove some of the grease from bearing hosing
	Shaft is bent	Replace the shaft with new one
	Rotor of pump or motor out of balance	Change the motor and pump shaft with the impeller and check balance
	Rotating parts are rubbing	Check and replace necessary parts
Pump trip Stopped by itself	Electrical overload settings are incorrect	Check and correct setting
	Bearing jammed	Change the bearing
	Impeller obstructed	Clear obstruction from the impeller

SOP for Kafr Farag FMRP

Plant Name: **Kafr Farag FMRP**	Title **Overview for Kafr Farag Iron and Manganese Removal Plant**	SOP TAG No. **KFR-FMR00-OV**

Issued		Developed by		Signature	
Revised		Approved by		Signature	

1. General information of the plant

1-1.General information

1-1-1. Location
Kafr Farag Iron/Manganese Removal Plant (KFR-FMRP) exists in Menia Al Qamah Markaz in North East of Menia Al Qamah City. It is Located at 30°30’ 56.7” North and 31°20’20.4” East .

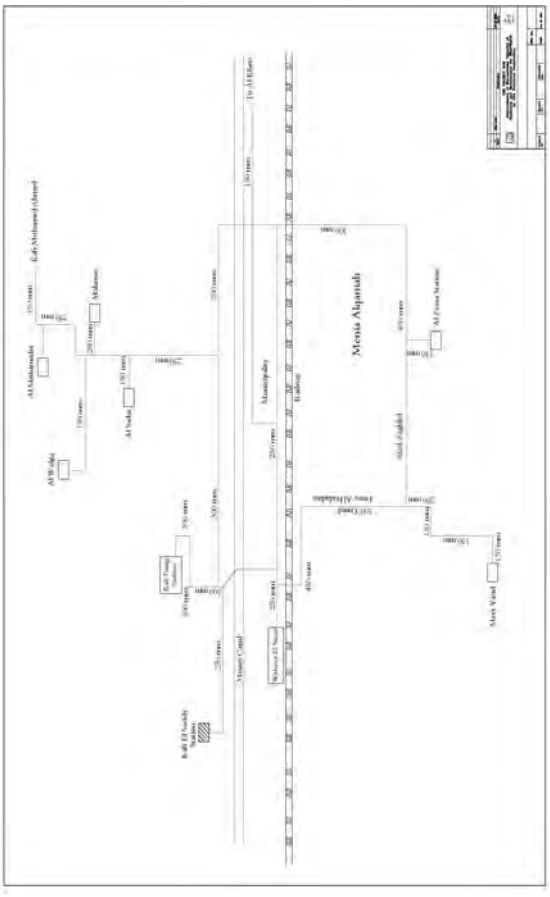
1-1-2. Construction Phases
Kafr Farag Iron/Manganese Removal Plant was constructed in 2002 as one of the standadized model plants in Egypt.

1-1-3. Source of water
The source of raw water for this plant is well water. Four wells of approximately 80 meter depth and 25 cm diameter casing and screen, are available in this plant but three of them are currently used as production well. Two of them are used alternately on duty and another one well is stand-by. A new well for this plant is being prepared inside the plant area.

1-1-4. Type of treatment process
Iron/manganese removal plant is a treatment plant reducing the iron and manganese contents contained in the source ground water by applying the aeration and chlorine oxidization and contact oxidization filtering process.

1-1-5.Nominal treatment capacity
Nominal Capacity for the plant is 6000m^3 per day with two units of oxidization tower and three units of filter tank.

1-1-6. Service areas and connections to the distribution network



1-1-7. Organization and stuff formation

In the organization of SHAPWASCO, responsible person for the final water quality of the Plant to the network is _____.

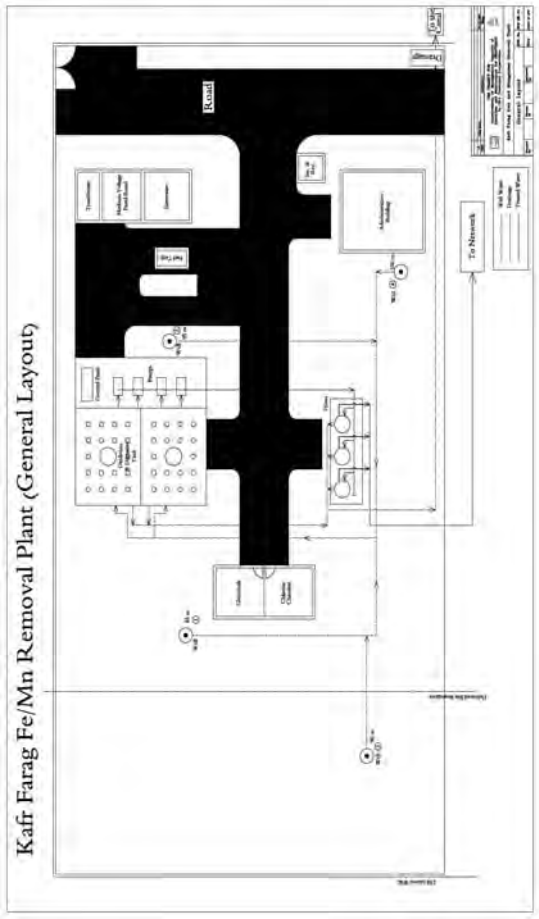
Operation/Maintenance Team in Kafr Farag Iron/Manganese Removal Plant

No.	Name	Position	Remarks
1	Mr. Emam Abd El Mawgoud Abd El Atie	Plant Manager	All of them Responsible for both Kafr Farag FMR and WPS
2	Mr. El Saied Mohamed Kamal	Technical Supervisor	
3	Mr. Aly Gouda Al Saied	Technical Supervisor	
4	Mr. Fatehey Mohamed Hassan	Technical Supervisor	
5	Mr. Eissa Mohamed Fahmey	Technical Supervisor	
6	Mr. Abd El Rahman Abd El Hameed Mostafa	Technical Supervisor	
7	Mr. Saied Ibrahim Abdo	Labor	
8	Mr. Awni Abd El Mohsen Amer	Labor	
9	Mr. Farouk Abd El Ghani Awad	Labor	
10	Mr. Adel Ahmed Afifi	Labor	
11	Mr. Ibrahim Al Dsouki Mohamed	Labor	

Members of Laboratory and Maintenance of Chlorine Facility in the Branch

No.	Name	Position	Remarks
1	Mr. Abd El Hady Ali Basuoni	Laboratory manager	Responsible for all of the branch
2	Ms. Eman Galal Mahdi	Chemist	
3	Mr. Sedki Hassan Araffat	Cl. Maint. Supervisor	For Menia Al Qamah and Mashtool AlSooq
4	Mr. Saied Ahmed Abd El Rehiem	Cl. Maint. Supervisor	
5	Mr. Mohamed Faried Gaweish	Cl. Maint. Supervisor	
6	Mr. Hussein Mohamed Hassan	Cl. Maint. Supervisor	

1-1-8.General Layout



1-2.Components of process and facility in iron manganese removal plant

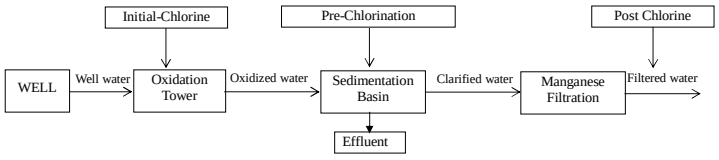
There are relations and connections between unit processes in iron manganese removal plant (abbreviate as FMRP) .

1-2-1 Components of unit process

Six (6) unit processes are provided in Kafr Farag FMRP as follows;

-1. Production wells
-2. The water feeding process by well pump
-3. Chlorine dosing process
-4. Oxidization Towers
-5. Sedimentation Tank
-6. Filter Process

1-2-2. Block flow diagram



1-2-3 Components of facility in each process

Components of facility in unit process are as follows;

-1. Production wells
This process includes following;
- Wells with sufficient yield capacity

-2. The water feeding process by well pump
This process includes following;
- The well pump

-3. Chlorine dosing process
This process includes pre-chlorine, intermediate and post-chlorine facility as follows;
- Chlorine cylinder
- Chlorine gas piping and valve
- Chlorinator
- Feeding pump
- Chlorine leakage detector
- Chlorine gas neutralization system

-4. Oxidization Towers
This process includes following;
- Upper tank
- Aeration tower

-5. Sedimentation Tank
This process includes following;

- Detention tank
- Inlet piping for filter pump
- Intermediate chlorination
- Effluent drainage piping of oxidized iron particles

-6. Filter Process
This process includes following;
- Filter pump
- Contact oxidization filter tank
- Backwashing system
- Post chlorination
- Transmission piping to the network

1-2-4.Specifications of all machines and devices in each facility
Refer to attached facility list in APPENDIX.

1-3.Basic system on facility operating and process control

1-3-1.Basic system on unit process control
- Process control: All unit processes are controlled manually
- Water quality control

Water quality analyses in the various processes should be carried out manually by chemists as scheduled. Free chlorine residual in the various process points are monitored continuously by the instrument of free chlorine residual meter.

1-3-2. Basic system
- Operation of facility
- Start and stop of the well pump will be operated manually
- Control of process: Manual control for all process
- Monitoring of water quality: Refer to above mentions

1-3-3. System of processes

-1. Production wells
- Four wells are available and any two wells are able to yield water plant design capacity.

-2. The water feeding process by well pump
- Total four pumps are available, one pump installed for each well with sufficient capacity and head.
- Feeding water to the Plant can be controlled by the number of operated pumps

-3. Chlorine dosing process
- Chlorine cylinder: 500kg
- Chlorinator

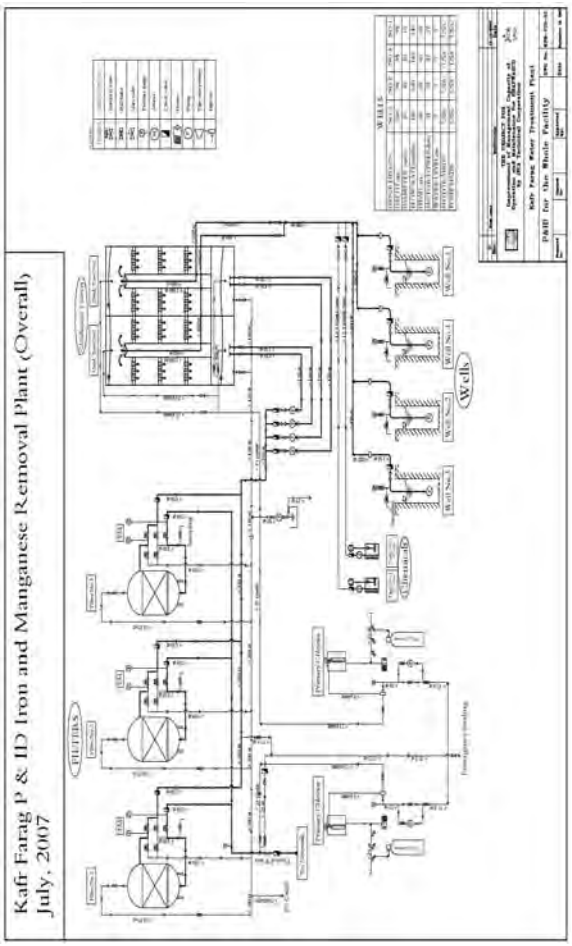
Two sets of chlorinators are available and one will be used for duty and the other for stand by.
- Type of chlorinator: Injector vacuum type
- Type of operation: Manual operation
- Type of dosing flow rate control: Manual control

Three dosing points are prepared.
- Initial-chlorination: Feeding pipe of the Oxidation Tower
- Pre-chlorination: Sedimentation tank
- Post-chlorination: Outlet pipe of filter

-4. Oxidization Towers
Two units of reinforced concrete oxidization towers are available and used in parallel or independently.
- Upper tank: 200 m3
- Aeration tower: three stages with each height of seven (7) meters

-5. Sedimentation Tank
Two units of reinforced concrete sedimentation are equipped under the oxidization towers.
- Detention tank
  - Capacity: 300m3 with a baffling chamber
  - Detention time: 2 hours
- Intermediate chlorination

-6. Filter Process
Three units of sand filter and filter pump system are available and two units are used for the design flow rate of the Plant.



1-3-4. General P&ID Diagram

2. Overview of the SOPs of the KFR-FMRP

2-1 Purpose of SOPs

Purpose of SOPs is to provide assistance to the water supplier in the operation & maintenance (O&M) and water quality control (WQC) procedures for the equipment, facility or process in the iron manganese removal plant.

2-2. Priority Issues to be addressed in SOPs

According to the results of current field survey of the plant, priority issues for the O&M to be addressed in these SOPs are identified as follows;

2-2-1. New Egyptian Potable Water Standards
According to the Decree 258 by Ministry of Health, new "Limits of the criteria and specifications of the potable and domestic water" (Egyptian Potable Water Standards hereinafter) were regulated dated October 21st, 2007 and new limits of Fe and Mn concentrations are as follows;

Maximum allowable limit
Fe: 0.3 mg/litter
Mn: 0.4 mg/litter

Current operation results of the Plant shows that new limits are not satisfied and a certain efforts are required on increasing treatment efficiency, including the examination on upgrading of the facility.

2-2-2. Function of Sedimentation Tank
There equipped a sedimentation tank under the oxidation tower with a chlorination injection point and effluent drainage piping but actual effect of this sedimentation in the process is not clear while effluent is drained every fifteen days in current operation and water qualities in this process were not analyzed in detail. Clarification of the function of the sedimentation tank and formulation of correct operation procedures for the Kafr Farag well water are important.

2-2-3. Full-utilization of Filter Equipment
As described in detail in the SOPs of the following chapter, the contact oxidization process applied for this filter system of the Plant requires strict free chlorine residual control for activating manganese sand to achieve effective manganese removal. Effort on full-utilization of the filter system shall be made by both operation (process water control) and maintenance (filter media conditioning).

2-2-4. Chemical Injection Equipment
In this plant, chemical injection equipment applying the potassium permanganate for the oxidization was considered at the time of construction. it shall be confirmed in the course of SOP activities weather or not that necessary oxidization can be secured by chlorination for the Iron and Manganese removal of the source well water. This SOP also agrees to omit this system from the operation.

2-3. Application of SOPs

SOPs should be applied surely to actual O&M and WQC. However, SOPs are not necessarily constant and subject to change. SOPs should not only be kept as documents but also be utilized as tools for O&M and WQC activities. Since SOPs must be utilized in actual

activities, they should be reviewed and revised so that they can be suitable and useful anytime in any situation for water supplier according to evaluation of utilized results. We should find improved results of O&M and WQC activities whenever we review and revise SOPs.

2-4. Component of SOPs

SOPs for FMRP consist of eleven (12) SOPs component units and these components are shown in "SOPs Headline". Each SOP consists of three (3) SOPs packages as follows:
- SOPs for operation
- SOPs for maintenance
- SOPs for water quality control

2-4-1. SOPs for Operation

Documents which require criteria and procedures for operation and control activities of facility are provided in this SOPs and include the following:
- Explanation of process and relation between other process
- Criteria for operation activity and design
- Operation and control procedures for facility in normal condition and unusual condition
- Monitoring and visual check items for facility
- Reporting and recording system

2-4-2. SOPs for Maintenance

Documents which require criteria and procedures for maintenance activities of facility are provided in this SOPs and include the following:
- Criteria for maintenance activity
- Maintenance procedures for facility in normal condition and unusual condition
- Monitoring and visual check items for facility
- Reporting and record system

2-4-3. SOPs for Water Quality Control

Documents which require criteria and procedures for water quality control and process control are provided in this SOPs and include the following:
- Criteria for water quality control activity
- Water quality control and process control procedures in normal condition and unusual condition
- Monitoring and visual check items for water quality and process
- Reporting and record system

2-5. Review of SOPs and O&M plan

SOPs is one of tools to perform optimum O&M and WQC activities and results and as the result to improve management of iron manganese removal plant operation. We can realize and find in our O&M activities should be modified or arranged for improvement such as more simple, effective or suitable method, by utilizing of SOPs. When we find part to be modified or arranged for improvement in SOPs, we should approach to review SOPs to be proper according to prepared procedures, as soon as possible if necessary.

2-5-1. Review of O&M and WQC activities

Review of SOPs should be carried out periodically not less than once a year and properly if

necessary. After review of SOPs, SOPs should be updated to revised version. Records of SOPs review and histories of review must be required to issue and keep them. Records of view should include the following:

- Activities before review and after review and reviewed reasons
- Signatures of approved persons, date of review
- Results of review
- Marking of reviewed part and description of reviewed histories in revised SOPs documents

2-6. Preparation for making of O&M plan

O&M plan is developed to provide a material that can be easily referred to for guidance in operating a water system. The O&M plan will also provide ready reference for following;

- All equipment data which is necessary for performing normal maintenance
- Ordering replacement parts and supplies
- Organized system for keeping records of O&M of the system
- Water sampling, analysis and testing which required for compliance with regulations
- Monitoring of the treatment process for compliance with accepted waterworks procedures.
- Information regarding start-up and normal operating procedures and emergency operating procedures

O&M plan will become a training manual to provide personnel which handy source reference while they learn to operate the facilities. The experienced operator will usually refer to the O&M plan for confirmation of normal operation and maintenance procedures and as a reference guide for unusual operating conditions. The entry level operator should frequently refer to the O&M plan for guidance and instruction.

Plant Name: **Kafr Farag FMRP**	Title **Water Well**	SOP TAG No. **KFR-FMR01-OP**

Issued		Developed by		Signature	
Revised		Approved by		Signature	

Introduction

Iron and manganese removal plant is a treatment plant reducing the iron and manganese contents contained in the source ground water.

In Kafr Farag Iron and Manganese Removal Plant (KFR-FMRP), the source of supplying water is well water. Four wells with approximately 80 meter depth and 10" diameter iron screen, are available in this plant but three of them are currently used as production well. The fourth well is replaced by a new one with 100m depth and 12" plastic diameter with pump flow rate of 50 l/sec.

The quality of the well water must be within limits of Standard Potable Water Specifications except for iron and manganese as the removal process occurs by the oxidation tower and some additional chemicals (potassium permanganate – sodium hydroxide – chlorine)

Production capacity of the wells (safe yield capacity) must be higher than the design treatment capacity of the plant of 6000 m3 per day and draw-down of dynamic water level must be less than the design figure for the horizontal pump (6m).

Draw-down of dynamic water level must be more than the design figure for the submersible or with above motor pump (5m).

Current well water quality and static water level by Inventory Survey in 2007 are as follows;

- TDS: 365 - 465 mg/l
- Iron: 0.39 - 0.52 mg/l
- Mn: 1.0 - 1.1 mg/l
- S.W.L: - 4.8 m from ground level

1. Features of process

1-1.Function of process

Function of the well is to produce water of design quantity and design quality within the design groundwater draw-down. The static water level in the well affects to the discharge pressure and quantity and if the water quality in the well is not in a good condition, it affects to the removal efficiency, survival of filtering media inside filters and chemical consumption rate.

The well water is fed from the wells by well pumps to the oxidation tower to start the aeration, oxidation and removal process.

1-2.Impacts of process

Wells are the first stage process in Kafr Farag Iron and Manganese Removal plant (KFR-FMRP).

Production capacity of the wells and water quality are essential value for the iron and manganese removal plant deciding the treatment capacity and operation procedures of the following processes.

Dosing flow rate of chlorine is linked with the sedimentation basin in the oxidation tower, well water flow rate and quality.

1-3.Relations between other processes

The static water level in the well affects to the efficiency, pump flow rate and produced well water.

.

2. Criteria for operation

2-1. Water level

Static and dynamic water levels shall be not lower than the designed/planned figures for pumps . When the designed/planned water levels are not available at the initial stage of this SOP application, tentative static water levels are set up using current records of water levels and treatment operation and as follows :

1- Static water level should be recorded for each well
2- Dynamic water level should be recorded during operation for each well
3- Well Discharge flow rate should not exceed the design limits
4- The pump flow rate should not increase the safe yield capacity for the well
5- Check the well water level every 3 months to check the well efficiency and pump condition.

2-2. Well water quality

Water quality of raw well water shall be not higher than the designed/planned figures . When the designed/planned water qualities are not available at the initial stage of this SOP application, tentative water quality are set up using current records of water quality and treatment operation and reference figures will be finalized as soon as possible.

Since this plant has limited functions to reduce Iron and Manganese concentrations, The maximum acceptable figures for well water are as follow :

other water quality items than these two items shall not be higher than the Egyptian

potable standards.

Iron: 0.6 mg/l

Manganese: 1.2 mg/l

Sampling and analysis of raw well water quality should be conducted by daily routine work for main items and by monthly analysis for full standard items according to QC procedures..

2-3. Clean well sites

Well sites shall be kept clean from any contamination derived from either surface water or ground water. Visual check of cleanness of the well sites should be conducted by daily routine work.

3. Operation under normal condition

3-1.Start-up and shut-down procedures

3-1-1. Visual check of well sites
Well sites shall be checked visually and confirmed that surface water drainage and other well facilities are kept properly

3-1-2. Water level
Static water level in the observation well (old well) shall be measured and confirmed the value not lower than the designed/planned level.

3-1-3. Well water quality
Quality of raw well water shall be checked by the record of analysis of the previous day and confirmed their values no more than the designed/planned ones. Water sample shall be prepared for analysis for the day immediately after the pump operation.

3-1-4. Well change-over program
Based on the production plan of the day, well change-over program shall be fixed considering the optimum effect to the aquifers and wells.

3-2.Monitoring during operation

3-2-1. Water level
Static water level in the observation well (old well) shall be measured and confirmed the value not lower than the designed/planned level.

4. Operation under unusual condition

4-1 Prospect troubles and trouble shooting

4-1. Contamination

When any contamination such as surface rainwater flowing-in may be found, the plant shall be stopped immediately and remedial measures such as sterilization at well site.

Discharge to the network shall be resumed only after the effect of the action would be confirmed.

4-2. Water level

There are two kinds of abnormal draw-down of groundwater level, i.e. extreme draw-down of dynamic water level and long term static water level draw-down.

4-2-1. Clogging

Ground water flow may be reduced by clogging of inlet screen and/or surrounding aquifer layer and extreme draw-down will occur by pumping.

In this case, 1) pump operation shall be restricted to the level of normal draw-down, or 2) pumping well shall be changed to sound one where backwashing the concerned well may be applicable to restore or new complete well drilling may be required.

4-2-2. Long term static water level draw-down

With many reasons considered, ground water level may be drawn down in long term and may exceed the design/planned level. In this case, 1) operation by a value less than the design flow rate and 2) increasing pump total head capacity or adding new well shall be considered to secure the discharge capacity of the wells.

4-3. Water Quality

4-3-1. Iron and Manganese concentrations

When iron and manganese concentrations in well water exceed the design/planned figures, the plant shall be stopped immediately and it shall be confirmed whether remedial measure can be taken within the modification of operation procedures such as increasing chlorine dosing rate and oxidization time or total shut-down and full scale upgrading of the plant may be required.

4-3-2. Other water quality items other than Fe and Mn

When other water quality items other than Fe and Mn in well water exceed potable water standards, the plant shall be immediately stopped and the reason of worsened quality and remedial measure shall be clarified.

5. Report and record

5-1.Record

The Record for operation of the well sites should be required as follows;

5-1-1.Record of monitoring and visual check

Monitoring and visual check list should be prepared

Objects of monitoring and recoding are as follows:

-1.Visual check of the well sites and the oxidation towers.

-2. The water levels

- Static water level
- Dynamic water level

-3. Raw well water quality

- Iron and Manganese concentration
- Other potable water standard items

When unusual condition will happen, it should be recorded with immediate actions, remedial measures taken.

5-2.Report

Reports for operation of wells should be required as follows;

- Monthly and annual ground water extraction volume in the plant
- Monthly and annual ground water level fluctuation
- Monthly and annual ground water quality fluctuation
  - Iron and Manganese
  - Other items
- Required maintenance of wells
  - Washing well and screen for clearing clogging
  - Painting or replacing well casing, piping, valves etc.
  - Maintenance of surface water drainage at well sites

Plant Name: **Kafr Farag FMRP**	Title **Water Well**	SOP TAG No. **KFR-FMR01-MT**

Issued		Developed by		Signature	
Revised		Approved by		Signature	

Introduction

Generally, maintenance activity of the water wells will be conducted not in a routine maintenance but conducted along with the periodical maintenance of the plant by cooperation with the responsible person from the branch and HQ

HQ Well team will put maintenance schedule for wells and revising it with the branch team.

1. Criteria for maintenance

Major maintenance activity for the wells is to secure the safe yield capacity required to produce planned treated water volume without negative effect .

Criteria

- Keeping the well yield capacity by periodical monitoring for static and dynamic well water level .
  Timing: according to the maintenance schedule
- Maintaining outlet pipes and valves properly painting or replacing.
  Frequency: Every 6 months
- Keeping well sites clean avoiding contamination by surface water and others for a distance not less than 5 m from each side around the well and in the same time monitoring of the well site has to be achieved by the operation team.
  Frequency: Once a month

2. Maintenance activity

Based on the above criteria, the maintenance activity consists of following three categories;

- When an observable draw down for the dynamic water level occurs while operation of well pump

  The following procedures have to be achieved :

  a) backwashing for the wells

  a-1) backwashing for wells of slotted bridge pipe

  a-2) wounded wells have to be replaced by new wells.
- Maintenance of the well casing, piping and valve, etc.

- Keeping well sites clean

2-1. Securing safe yield capacity

In order to secure the yield capacity, wells shall be backwashed regularly by the well section of the branch office. Frequency and timing shall be decided by examining the static and dynamic water level monitoring report prepared by plant operation team. When backwashing interval will be shortened and yield capacity can not be recovered by backwashing, new well drilling shall be prepared for the replacement.

2-2. Maintaining well casing and piping

As a part of maintenance activity for the piping and valves inside the plant, well casing and piping at well sites shall be maintained as below.

Inspection should be conducted regularly to ensure that facility should go on without accident during operation. Inspection list for well casing and piping shall be prepared as a part of plant piping and valves.

- Repairing
- Painting
- Replacing

2-3. Well sites cleaning

Around the well there shall be kept clean from any contamination by others. Daily visual checking shall be conducted on the following points and necessary maintenance shall be made as required.

- Surface water drainage
- Protection from oil and grease
- Protection from animals

3. Report and record

Hence, the record and report are essential for O & M in FMRP. All the maintenance activities done shall be recorded and summarized monthly and annually together with operation records of the whole plant. These reports can be taken into consideration for the preparation of O&M plan for the next year.

Plant Name:	Title	SOP TAG No.
Kafr Farag FMRP	**Well Pump**	**KFR-FMR02-OP**

Issued		Developed by		Signature	
Revised		Approved by		Signature	

Introduction

The four wells (two wells of four are used interchangeably) are used as the water source and supply the ground water to this plant.
The ground water in the well is sucked by the well pumps installed beside or inside of the wells and discharged to the oxidation tower though the well water pipe.

The well pump facility is consists of following equipment;
-1.The well pump: Submersible pump and horizontal pump
-2.Pipes and valves: Carbon steel, sluice valve and the swing type check valves

Four discharge pipes from the four well pumps are connected each other, after that distributed to two lines for the two oxidation towers. Sampling tap for raw well water is provided on the discharge pipe of each well pump.

1. Features of process

1-1. Function of process

Function of the well pump is to transfer the ground water into the oxidation tower with required quantity and water pressure.

1-2. Impacts of process

The well water flow rate is essential value for iron and manganese removal process.
For determination of capacities of facility are based on the well water flow rate based on the safe yield capacity of the wells.

1-3. Relations between other processes

1-3-1.The well
The water level in the well affects to the discharge pressure and quantity and water quality in the well affects to the removal efficiency.

1-3-2.The oxidation tower
The oxidation tower is located after the well pump facility.
The well water is fed by the well pump to the oxidation tower.

2. Criteria for operation

2-1.Schedule for working of pump

The well pumps shall be operated according to the operation schedule.
Usually a pump will be operated automatically depends on the water level in the sedimentation basin. Four well pumps are available and one or two of them are operated depend on the demand in the network.
Working pump shall be changed periodically so that working cycle of pump is 24 hours

2-2.Indication of discharge pressure gauge of pump

Proper pressure gauge indication: Lower limit -----bar
Upper limit-----bar

3. Operation under normal condition

3-1.Start-up and shut-down procedures

3-1-1.Pre-start check
The well and well pump shall be selected before start-up operation.
-1.The Valve in discharge line
All valves in discharge line of the well pump shall be kept in working condition because that pump will start and stop automatically.
The sampling tap in discharge line shall be closed.
-2.Electrical switch board
Power shall be supplied.

3-1-2.Start-up
-1. Under automatic mode
Usually the well pumps shall be started and stopped by the level sensor automatically depends on the water level in the sedimentation basin.
The valves in the discharge pipes of the well pump are opened usually.
The well water supplied to the oxidation tower will be sprinkled from holes of upper tank of the oxidation tower immediately after the start of the well pump.
-2. Under manual operation mode,
The start switch on switch board is turned on to start the well pump and the common checking, unusual noise and vibration of the well pump and leak of water are followed after start.
Pressure of discharge line is confirmed by the pressure gauge;
Indication of pressure gauge shall be ----bar or more.

3-1-2.Shut down
-1. Under automatic mode
The well pumps are usually stopped automatically depends on the water level in the sedimentation basin.
-2. Under manual operation mode
The stop switch on switch board is turned off to stop the well pump and common checking are followed after stop
Water level in the sedimentation basin is monitored and pumps shall be operated so that the water level is within proper range.
The water in the sedimentation basin shall be discharged through the effluent from the basin when the water level will not be detected by the level sensor correctly.
Working time of the well pumps shall be checked from start to stop of each well pump.

3-2.Monitoring and visual check during operation

Monitoring and visual check of the well water pump is a very important activity.
It shall be conducted not less than twice a day by prepared check list.
If unusual condition will be found, corrective action shall be conducted immediately.

3-3 Operation for control

The water flow rate is one of the most essential valuee for the operation of water treatment process.

The well water is oxidized by the aeration process in the first step and treated water is drawn into the sedimentation basin and stored for next filtration process.
The water from sedimentation basin is fed into the filter and filtered water is supplied to the network directly without the clear water tank.

Hence, control of the water level and working number of the well pump is important activity for operation of the plant.

The nominal treatment capacity of the plant is 6,000 m3/day or 250 m3/h and the two well pumps can cover the capacity. Therefore usually two well pumps are operated but the working number of the well pumps can be reduced when consumption volume of clear water in the network is low. Locally the control of the working number of the well pumps is conducted depends on the water level in the sedimentation basin which reflects the demand fluctuation in the network.
In normal operating condition, the working time of well pump shall be limited 3-4

hours for one continuous operation.

4. Operation under unusual condition

4-1 Prospected troubles and trouble shooting

-1. Discharge pressure is not enough
-2. Discharge pressure is too high
-3. Discharge quantity is not enough
-4. The water level in the sedimentation basin is not enough
-5. Mechanical or physical trouble of the pump
-6. Electrical power failure

Trouble shooting is shown as KFR-FMR02-OPTS-01.

5. Report and record

5-1.Record

The Record for operation of well pumps shall be as follows;
5-1-1.Record of working of the pump
-1.Time in operation of the each well pump
-2.Operation condition
- Discharge pressure, quantity, electrical current, and so on
-3.Water level in the well
-4.Unusual condition of the pump
5-1-2.Record of the water level in the sedimentation basin

5-2.Report

Reports for operation of well pumps shall be required as following;
5-2-1.Unusual condition in working
5-2-2.Monthly report
-1.Time in operation of each pump
-2.Recommendation on operation
5-2-3.Annual report
-1.Time in operation of each pump
-2.Recommendation on operation

Plant Name:	Title	SOP TAG No.
Kafr Farag FMRP	**Oxidation Tower**	**KFR-FMR03-OP**

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1. Description of the facility

1-1.Outline of process and facilities

The oxidation tower is provided to oxidize the iron contained in the well water and feed the oxidized water into the sedimentation basin. The oxidation process of contained iron in the well water is progressed in the 2 steps of the process.
The first step of the process: Aeration process by the sprinkling of the water through the oxidation tower
The second step: Chlorination process by chlorine dosing after aeration process.

In Kafr Farag Iron Manganese Removal Plant (KFR-FMRP), two oxidation towers with the sedimentation basins are available and these towers and basins are used in parallel usually. Two dosing stages with each two injection points are available for the chlorination. First dosing stage is located at inlet of the oxidation tower (dosing point-1 named “initial-chlorine”) and second stage is located at inlet of the sedimentation basin (dosing point-2 named “pre-chlorine”). Dosing stages can be changed by the change over valves.
Second dosing stage can be used under usual condition of the well water quality. First dosing stage can be used under the unusual condition of the well water quality when high ammonium contains is detected approx. 0.2 mg/l or more.
Approx. 40 minutes is needed for the oxidation reaction of ammonium in the process water. And detention time in the sedimentation basin is 30 min. or less and it is not sufficient by chlorination at second dosing stage for the well water containing high ammonium.

When first dosing stage is used, dosed chlorine in the sprinkled water is exhausted in the air in the oxidation tower. Hence, second dosing stage is recommended to be used in ordinary condition.

The well water is sprinkled through the oxidation tower and oxidation is performed by three steps of sprinkling. The well water is fed into the top floor of the oxidation tower and the water is sprinkled from many holes in the bottom of the floor to the second and third floors.
There is no device to control or operate the process in the oxidation tower.

1-2. Function of the oxidation tower

Functions of the oxidation tower are to receive the well water from the well pump, to oxidize iron in the well water and to feed the oxidized water into the sedimentation basins.

1-3.Impact of facility

The oxidation tower is the first step of oxidation of the iron contained in the well water by contact with the oxygen in the air. This contact is performed by sprinkling of the water.

1-4.Relation with other facilities

1-4-1.The well pump
Two well water pipes are provided for connecting well pumps to two oxidation towers individually.
The well water is distributed to two oxidation towers and outlet water from each oxidation tower is fed into the each of two sedimentation basin.
The equal distribution of the well water quantity shall be controlled by opening of the valves before the oxidation towers. The well water quantity to the each oxidation tower cannot be confirmed because there is no flow meter available in the line.

1-4-2.The sedimentation basin
The outlet water from the oxidation tower flows into the sedimentation basin by gravity. The sedimentation basins are existing one-to-one correspondence to the oxidation towers.

1-4-3.Pre-chlorine dosing for oxidation
Prior to flowing into the sedimentation basin, pre-chlorine is dosed into the oxidized water at the inlet.
Effectiveness of oxidation depends on pH condition of the process water and it is effective in high pH.
When pH is not high enough to oxidize iron contained in the water, aid by pre-chlorination is effective for oxidation.
Theoretically, 0.635 mg/l amount of chlorine is required to oxidize 1.0 mg/l amount of iron in the water. But this required amount varies depend on the existence of organics and ammonium contained in the water actually. 7.6 mg/l amount of chlorine is required to oxidize 1.0 mg/l amount of ammonium in the water. So this amount may increase and dosing rate of pre-chlorine shall be determined depend on the well water quality.

2. The criteria for operation

There is no device or equipment to be controlled in the oxidation tower and therefore the criteria for operation do not exist.

3. Operation under normal condition

Usually the well water passes through the oxidation tower and, when inlet valve is opened. Hence, any operation or control under normal condition is not needed for the oxidation tower but monitoring is needed to confirm that unusual condition does not exist. Check list for monitoring and visual check is provided in KFR-FRP03-OPCL-01.

When the sedimentation basin is cleaned, the inlet valve for the oxidation tower shall be closed.
When restart the oxidation tower operation, the inlet valve shall be opened and the initial outlet water from the oxidation tower shall be discharged from drain pipe in the sedimentation basin to clean the oxidation tower. Pre-chlorine shall be dosed at usual dosing rate during draining. After the initial cleaning of the oxidation tower is confirmed, drain valve shall be closed and outlet water from the oxidation tower shall be fed into the filter through the sedimentation basin. Free chlorine residual in the water shall be monitored periodically by sampling from the sedimentation basin and/or filter pump.

4. Operation under unusual condition

4-1.Typical unusual condition

Unusual condition of the oxidation tower is the case that the function is not secured sufficiently by unequal distribution and insufficient sprinkling of the well water.
Unequal distribution of well water quantity can be confirmed by observation of sprinkling condition in the oxidation tower.
Adjustment of distribution of the well water to the two oxidation towers can be done by control of valve opening in inlet pipes.
Insufficient sprinkling of the well water causes clogging of holes and irregular flow of the water. After confirming of the sprinkling condition of the well water, clogging holes shall be cleaned.

4-2.Troubuleshooting

Troubleshooting is provided in KFR-FMR03-OPTS-01.

5. Report and record

5-1.Record

Record of monitoring and visual check for the oxidation tower operation.

5-2.Report

5-2-1.Annual report
- Report of the well water quantity
- Report of the corrective action (as needed)
- Report of the preventive action (as needed)

5-2-2.Recommendation
- Rehabilitation and upgrading
- Review of SOPs
- Review of unified record sheet

Plant Name: **Kafr Farag FMRP**	Title **Oxidation tower**	SOP TAG No. **KFR-FMR03-QC**

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Introduction

Water quality control for the oxidation tower shall be conducted as follows;
- Monitoring and visual check
- Taking samples of the outlet water from the oxidation tower
  - to analyze oxidized water after aeration
  - to conduct chlorine demand test of the well water and outlet water from the oxidation tower

The sampling taps for the well water are available in discharge pipes of each well. The sampling tap is not available for oxidized water from the oxidation tower but the buffering room inside the sedimentation tank may be used for sampling point.

The oxidation process of contained iron in the well water is progressed in two steps.
The first step of the process is the aeration by the sprinkling of the water through the oxidation tower and the second step of the process is the pre-chlorination after aeration oxidation process.

Generally the turbidity of well water is low. Hence, KFR-FMRP is the facility to remove not turbidity but contained iron and manganese mainly. A key of iron and manganese removal process is to control oxidation reaction in the process.
Oxidation by aeration in the oxidation tower is done to a certain degree but cannot be controlled. Hence, oxidation process shall be controlled by dosing rate of pre-chlorine at sedimentation basin. For this control the process water shall be sampled, analyzed and tested.

1. Criteria for water quality control

1-1.Frequency of analysis:
Once a day or more
According to the requirements from Holding Company/SHAPWSCO (if any)

1-2.Time of taking of sample
Around 9 a.m. in the morning

1-3.Volume of sampling water
10 litters or more

1-4.Procedures for chlorine demand test
- According to the standard operation procedures of water quality control
- According to modified operation procedure

1-5.Items of water quality to be analyzed
- Iron, manganese, ammonia, organic substances and others
- According to the requirements from Holding Company/SHAPWASCO (if any additional items)

1-6.Chlorine demand of the outlet water from the oxidation tower
- 1.0-1.5 mg/l shall be used as tentative value and determined by the results of actual operation, considering free chlorine residual in the inlet water for the filter and preset value of free chlorine residual in the network water.
  - Free chlorine residual in the filtered water: 0.5-1.0 mg/l.
  - Free chlorine residual in the network water: 1.0-1.5 mg/l as tentative value
  - Free chlorine residual in the inlet water: 2.0-2.5 mg/l as tentative value

2. Water quality control under normal condition

The activity of the water quality control is required as follows;
- Monitoring and visual check
- Water quality analysis and the laboratory test for the treatment
  - Water treatment test such as chlorine demand test
- Determination of the dosing rate for the pre-chlorine
- Adjustment of the dosing rate for the pre-chlorine

2-1. Monitoring and visual check of process

Monitoring and visual check shall be conducted according to the unified list for the monitoring and check. Unified list is provided in KFR-FMRP03QC-CH01.

2-2. Water analysis and the laboratory tests for the treatment

Water analysis and laboratory test shall be conducted according to the standard operation procedures for water quality control prepared separately.

2-3. Determination of the dosing rate for the pre-chlorine

The dosing rate of pre-chlorine shall be determined by result of laboratory test of the

chlorine demand, taking into consideration of some additional margin onto the chlorine demand value. This margin shall be changed depend on experiments and data.

2-4.Adjustment of the dosing rate for the pre-chlorine

Dosing rate of pre-chlorine shall be adjusted by evaluation of free chlorine residual of the process water in actual facility because results of laboratory test are not always coincide with actual result and many factors is related to the result in the actual facility such as mixing condition, water temperature and pH of the well water, and so on.

3. Water quality control under unusual condition

Expected troubles and causes in the oxidation tower are as following;
- Uneven distribution of the well water to the two towers
  - Opening of the valves in inlet pipe line is improper
  - Clogging inside of the inlet valve
- The sprinkled water is fallen unevenly from distributed holes
  - Clogging of holes in the floors of the towers
- Chlorine demand is changed to high value compare with usual condition
  - Change of the well water quality
  - Insufficient aeration

Trouble shooting for the clear water reservoir is provided in KFR-FMR03-QCTS-01.

4. Report and record

4-1.Record

Records for water quality control of the oxidation tower are required as follows;

4-1-1.Record of monitoring and visual check
4-1-2.Record of water quality analysis and tests in the oxidation tower

4-2.Report

Reports for water quality control of the oxidation tower shall be required as follows;

4-2-1.Recomendation
- Upgrading or rehabilitation of facility

- Modification and arrangement
- Repairing and replace
- Addition of facility
- Review of criteria
  - Modifying
  - Addition or delete
- Review of procedures for operation and control
  - Modifying
  - Addition or delete

4-2-2.Annual report
Annual Report for water quality control of KFR-FMRP shall be prepared and it shall contain followings as part of Oxidization Tower.
- Change of water quality
- The well water
- The outlet water from the oxidation tower

Plant Name: Kafr Farag FMRP	Title: Sedimentation Basin	SOP TAG No. KFR-FMR04 –OP

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Introduction

There is no device or equipment thing to be handled in a sedimentation basin except sludge drainage, however, condition of the water in the sedimentation basin and quality of effluent water from the sedimentation basin, shall be checked and monitored. If quality of filtered water changes to poor, operation conditions of the process before sedimentation basin shall be checked and modified as needed.
Properness of oxidation process shall be evaluated by quality of clarified water.

1. Features of process

1-1.Function of facility

Function of the sedimentation basin is to settle and remove the oxidized iron particles which produced by the oxidization process.

1-2.Impacts of facility

-1.Result of oxidization process is evaluated by the water quality in a sedimentation basin.

-2.Water quality in a sedimentation basin is changed gradually.

- Detention time in sedimentation basin: Approx.2.5 hours
- Detention time in oxidation tower: Apprpx.0.5 hours
- Total detention time from start of coagulation to the end of sedimentation : Approx. three (3) hours

Though above, three (3) hours is not sufficient for the sedimentation and modification of the facility shall be considered.

-3. High turbidities in the water leaving from sedimentation causes poor performance of filtering.

1-3.Relations between other processes or other facility

-1. Quality of oxidized water affects to efficiency of filtering process.
In the present facility oxidized particles, which shall have been removed in the sedimentation basin, pass on to filters. This results in reduced filter run times and poorer filtered water quality.

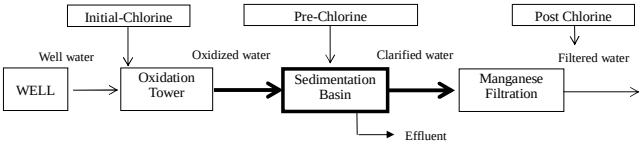
-2. The water treatment process is a chain of the several processes such as the well water transferring, oxidation, and the sedimentation process.
In the water treatment process, sedimentation process is affected directly and significantly by a result of previous oxidization processes.

-3. Water quality in the sedimentation basin is affected by operation condition of sludge drainage from the sedimentation basin. Insufficient of sludge drainage will cause of over flow of the oxidized particles to filter system.

-4. Oxidation of iron and manganese in the well water is the key factor for iron and manganese removal plant. Oxidation tower and pre-chlorination dosing are used to oxidize iron and manganese in the water.

-5. Clarified water is fed into to the filter tank by the filter pump.
Contact oxidization to the manganese sand process is applied for the filtration system in the Kafr Farag FMRP.
In manganese sand filtration system, basically the free chlorine residual of the filtered water shall be maintained in the value more than 0.5 mg/l as lower limit.
The free chlorine residual is consumed by the manganese sand to activate the oxidization effect.
Hence, the free chlorine residual in the clarified water shall be kept in the value more than above with a margin of consumption.
If the free chlorine residual in the oxidized water is not enough for the manganese sand filtration, it means not only drop in efficiency of manganese removal but damage of manganese coating layer around the manganese sand.

-6.The sedimentation basin is the connection process with the oxidation process and filtration process



Note: “Process water” is also used as general word for the water flowing in the Plant.

The quality control of the oxidized water is the most important activity and especially control of free chlorine residual is important.

2. Criteria for operation

There is no device or equipment to operate or control in the sedimentation basin itself, but attached facilities such as sludge drainage facility.
There are no criteria for operation or control of sedimentation basin.
Descriptions on water quality control refer to SOP KFR-FMR04QC.

3. Operation under normal condition

3-1.Start-up and shut-down procedures

From previous oxidization tower process the water flows into sedimentation basin through the pipe from the oxidation tower above of the sedimentation basin. There are no valve and no gate at the bottom of the tower.

3-1-1.Start up from a condition without water in sedimentation basin
(e. g. Restart after cleaning of basin)
In early stage of water filling into sedimentation basin, condition of the water from the oxidation tower is unstable by flow with oxidized particles, turbulent flow or short circuit flow.
Hence, oxidized water in early stage after restart shall be drain out and the water in the sedimentation basin shall not be fed to the filter. Leave the water in the sedimentation basin as it is drained for approx.2hours or more.

During the drainage, quality of oxidized water shall be monitored. Water quality shall be confirmed to reach to the criteria. Until condition of oxidized water became stable, monitoring and check of water quality of effluent shall be carried out periodically, i.e. intervals of approx. 30min – 60min usually.

In this stage, flow rate of the water from the oxidation tower shall be reduced and after water condition is stable, flow rate can be increased gradually. And dosing rate of pre-chlorine in this stage shall be increased compared with normal condition such as 2 times of normal dosage.

Procedures for restart after cleaning of sedimentation basin are shown by steps of work in KFR-FMRP04-OPFC-01.

3-1-2.Shut down of operation of a sedimentation basin

Shut down of sedimentation basin is carried out in case of activity of periodical maintenance.
Stop the water flow into the basin and drain out the water in the basin.

3-2. Sludge drainage operation

Oxidized particles precipitate in the sedimentation basin and shall be drained periodically by the sludge drainage facility. Interval of drainage operation shall be decided considering the actual situation to avoid the over flow of the particles to the filter.

3-3. Monitoring and visual check of facility

The jobs of monitoring and visual check shall be daily routine work in O&M activity. Unusual condition or trouble shall be picked up in early stage by these jobs.
Damage by unusual condition or trouble is minimized by early detection and rapid response of recovery. Daily check or monitoring jobs are insignificant work.
These jobs shall be carried out and ensured effectively, suitably by valuable check items, significant value will come out from these jobs.
Monitoring and check list is provided in APPENDIX. This list shall be reviewed periodically for maximize of value of jobs and improvement of works.

4. Operation under unusual condition

4-1 Prospect troubles and trouble shootings

4-1-1.During working

Water condition shall be monitored and operation condition of the facility in above shall be changed if necessary.

- Unusual condition of the water in sedimentation basin
  - Rising of the oxidized particles
  - Change of color of water
  - Unusual condition of the water level
- Causes of unusual condition
  - Raising of oxidized particles
  - Insufficient sludge drainage
  - Improper velocity of inlet
  - Excess of flow rate of inlet

- Change of color of water
- Change to brown or black
- Insufficient sludge drainage
- Insufficient chlorine dose
- Change of water quality
- Unusual of the water level
- Unusual of level sensor for the sedimentation basin
- Unusual of electrical switch board

- Actions shall be required to avoid above situation as follows;
  - Proper sludge drainage
  - Proper dosing rate of chlorine
  - Control and confirm the well water flow rate
  - Proper monitoring and analysis of process water quality

4-1-2. Restart after long term stopping

In case of stop for a long term, such as for 2 weeks or more, preparations before stop shall be required to enable the facility in a sedimentation basin to restart normally.
Prospects of trouble by a long term stop are as following;

- Cause of precipitation of sludge
  - Condensed and compressed of sludge on the bottom
  - Condensed and compressed of sludge in the pipe
  - Prospect of trouble of the facility
  - Unable to drain out the sludge by clogging of drainage pipe
- Actions before stop shall be required to prevent from above as follows;.
  - Carry out sludge drainage during above.
  - Drain out the effluent water until free chlorine residual is sufficient.
  - Sufficient free chlorine residual: 0.5 mg/l or more

5. Report and record

5-1.Record

The record for sedimentation basin shall be required to know operation condition and quality of oxidized water.
Quality of oxidized water shall be acceptable compared with criteria.
Operation condition shall be acceptable compared with design criteria.
Record is supplied to the activity of maintenance and water quality control.

5-2.Report

Generally almost of technical records shall be reported to people in technical sections in FMRP.
Any records have no value without utilizing them. Reports shall be useful tool for next improvement activities by utilizing of records.

Required reports for sedimentation basin are limited to the operation of sludge drainage and any recommendations for improvement.

Report for operation of sedimentation basin will include the following;
-1.Recommendation for operation according to records of operation
-2.Report for corrective and preventive action
-3.Result of recovery of trouble or unusual condition
-4.Recommendations for improvement

Plant Name: **Kafr Farag FMRP.**	Title **Sedimentation Basin**	SOP TAG No. **KFR-FMR04 -MT**

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Introduction

Generally, maintenance activity of the sedimentation basin is conducted not in a routine maintenance but along with the periodical maintenance of the plant.
Submerged part in the water is inspected, checked and cleaned up in the maintenance activity. There is no facility to be controlled in the sedimentation basin in FMRP except sludge drainage facility.
The basin structure and suction pipe of the filter pump and drainage pipe and valves are inspected, cleaned and maintained. Cleaning of the basin is the main activity. If cleaning is not sufficient, precipitated oxidized particles is sucked by the filter pump and fed into the filter.
Insufficient removal of oxidized particles in the sedimentation basin will cause of shortage of filter run time. Oxidized particles carried over to the filter are caught by the anthracite that is placed for the surface layer of the filter media in the filter tank

1. Criteria for maintenance

Main maintenance activity for the sedimentation basin is to clean inside of the basin.
This cleaning work is one of major events in FMRP.
We can check and confirm the inside condition of the basin and submerged parts of facilities. We shall check depth of precipitated sludge remaining in bottom of the basin.

- Frequency of cleaning and inspection of inside of the basin
  - Regular cleaning work: Once 3-6 months
  - Inspection and repairing: Once a year
- Acceptable stopping time of sedimentation basin
  - In winter season: 6 hours

2. Maintenance activity

Monitoring, check and inspection shall be carried out to judge necessity of recovering activity such as adjustment, repairing or replacing at the time of regular cleaning.
Unusual condition of the sludge drainage facility shall be confirmed by monitoring

results of the following;
- Condition of the water
- Quantity
- Turbidity
- Free chlorine residual

Maintenance activity consists of four (4) kinds of working as following;
-1.Monitoring and checking during daily operation
-2.Inspection
-3.Evaluate and analysis regarding result of inspection
-4.maintenance based on the inspection

2-1.Monitoring and visual check

Monitoring and visual check shall be carried out according to “O&M schedule” and unified check list, and it is conducted with the monitoring activities for the sedimentation basin.

2-2.Inspection

Inspection shall be carried out according to “O&M schedule” and unified check list and it is conducted with the inspection activities for the sedimentation basin.
Cause of troubles for the sludge drainage system shall be prevented as follows;

- External check of the basin
  - Appearance of crack on a basin
  - Leak of water from a basin
  - Foreign substances such as wooden blocks, waste of vinyl materials and so.
- Cleaning of inside of the basin and effluent channel
  - Flushing away remaining sludge by pressured water
  - Brushing away to remove adherent algae on the wall

2-2-1.Cleaning of a basin
- Make a plan and time schedule for cleaning
- Procedures for drainage of water in sedimentation basin
- Procedures for cleaning of a basin

2-2-2.Inspection procedure
Inspection check list shall be provided on the following items;
- Inspection of a basin
- Inspection of a pipe
- Inspection of a level sensor
- Inspection of sludge drainage pipe

2-3. Evaluate and analysis regarding inspection result

After inspection following items shall be evaluated;
- Precipitated condition of sludge
  - Frequency and operation time of the sludge drainage
- Necessity of recovery action
  - Corrosion
  - Crack in the wall or bottom of the basin
  - Water leakage

2-4. Maintenance after the inspection

Maintenance works shall be conducted based on the inspection results as follows;
- Repainting
- Cleaning of inside of the drainage pipe
- The drainage valve
  - Supplying the grease as needed
  - Change of parts as needed
  - Replace the valve as needed or periodically
- Repairing of leak part around the drainage pipe
- Repairing of leak part of the pipe connection

3. Procedures under unusual condition

3-1 Prospect troubles and trouble shootings
- Unusual condition of facilities and actions of remedy-

Refer to KFR-FMR04-MTTS-01.

4. Report and record

4-1.Record

Records for maintenance of the sedimentation basin are required as follows;
4-1-1.Record of monitoring and visual check
4-1-2.Record of inspection
4-1-3.Record of maintenance

4-2.Report

Following report for maintenance of the sedimentation basin is required and reports

shall include recommendations for improvement as follows:

4-2-1.Recommendations (as needed)
- Review of maintenance procedures
- Improvement of facility
- Upgrading or rehabilitation of facility
  - Replacement of facility
  - Repairing of facility
- Review of the criteria
- Review of SOP

Plant Name: **Kafr Farag FMRP**	Title **Sedimentation Basin**	SOP TAG No. **KFR-FMR04 –QC**

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Introduction

The water quality control of the oxidized water is the key point of the operation of the iron and manganese removal plant (abbreviate as FMRP).
The key process governing the removal efficiency in the FMRP is the process of manganese sand filtration.
The clarified water that is oxidized and precipitated in the basin is fed into the filter.
FMRP is the simple process and consists of three main processes such as oxidation, filtration and disinfection process. The disinfection is performed by post-chlorine dosing. The oxidation is performed oxidation of iron, manganese, ammonium in the water mainly by the aeration and pre-chlorine dosing, and oxidized particles of iron and manganese are precipitated in the sedimentation basin after aeration tower.

Generally, oxidation of manganese by aeration is not sufficient and precipitation in the sedimentation basin is not enough. Hence, filtration is needed to oxidize manganese and to catch and remove the carried over particles from the sedimentation basin as final process.
Manganese sand is put in the filter tank to oxidize manganese in the water by contact filtration. Anthracite is put on the manganese sand as the surface sand layer to catch and remove the carried over particles in the water.

Manganese sand oxidizes soluble manganese in the water by contact with the surface coating of manganese dioxide. The oxidation potential of manganese sand gets weaker by oxidation of manganese but free chlorine residual in the water activates again the manganese dioxide coating by contact with manganese sand surface. Hence, free chlorine residual is needed always in the water fed to the filter to keep the oxidation potential of the manganese sand.
If free chlorine residual in the water is insufficient removal of manganese shall be insufficient and it causes severe damage of manganese sand.

Condition of the water in the sedimentation basin and quality of effluent water shall be checked and monitored. When quality changes to poor, check the operation condition of the process before sedimentation basin and modify the operation condition as needed.
Properness of oxidation process shall be evaluated by quality of oxidized water.

Check the quality of water in the sedimentation basin and control the operation condition in the previous processes.

1. Criteria for water quality control

The sedimentation basin is the connection process with the oxidation process and filtration process. The free chlorine residual control in the oxidized water is the most important activity. Free chlorine residual in the oxidized water and filtered water shall be controlled in the process of the iron manganese removal plant.

1-1.Limit of free chlorine residual measurement
2-1-1.Filtered water: 0.5 mg/l or more and 1.5 mg/l or less
2-1-2.Oxidized water: Addition margin to above value
1-2.Limit of turbidity of the clarified water
2 NTU or less
1-3.Sampling frequency of the clarified water: for check free chlorine residual
6 times in a day or more
1-4.Frequency of the sludge drainage
Once a day

2. Water quality control under normal condition

2-1.Monitoring and visual check

Monitoring and check is to confirm change of water quality and change of operating condition in the process. We cannot control the process without monitoring and also cannot monitor without criteria to judge something in proper.

2-1-1.Monitoring of quality control for the oxidized water

Prior to the filtration process the well water is oxidized by aeration and pre-chlorination and oxidized iron and manganese is removed in the sedimentation basin but oxidization and removing are not done perfectly.
The limit quality of the clarified water for the filter shall be shown as the criteria.
Monitoring shall be conducted according to the planned monitoring frequency, monitoring method, monitoring items, and current condition shall be judged proper or not proper to the criteria by the monitored results.

-1.Sampling of the water in the sedimentation process
-Location of sampling point:
Sample-1: from opening of the sedimentation basin (surface water)
Sample-2: from suction pipe of the filter pump (bottom water)
-Sampling volume: 1 litter for each sampling
-Sampling frequency: 6 times in a day

-Time for sampling:
Sample-1: 30 min after start
Each 4 hours after above
Sample-2: 2 hours after start
Each 4 hours after above

-2.The water quality analysis
Analysis and report shall be required according to following frequency;
-Iron and manganese: Once a day
-Turbidity and chlorine residual: 6 times in a day

-3.Visual check
Visual check of the water shall be conducted by looking through the opening or by sampling of the water
- Condition of the water by visually
  - Color
  - Odor
  - Foreign substances
  - Other external unusual condition
- Covering of the opening
- Dosing condition of the pre-chlorine dosing (if possible)

Monitoring steps is shown by flow chart in KFR-FMR04-QCCHK-01

2-1-2.Shut down of operation of a sedimentation basin
Shut down of the sedimentation basin is carried out in case of activity of periodical maintenance,
The well pumps shall be stopped and the water shall be drained from the basin. The water in the sedimentation basin can be fed by the filter pump up to approx. 50 cm of the water level from the bottom and water below that level shall be drained by effluent line.

2-2.Water quality control of the sedimentation basin

2-2-1.Control of free chlorine residual in the sedimentation basin
Free chlorine residual shall be measured at 2 points as above mentions.
-Sampling point-1: a point of immediately after pre-chlorine dosing
-Sampling point-2: a point of after detention in the sedimentation basin
Measured free chlorine shall be evaluated and analyzed according to the criteria. Pre-chlorine dosing flow rate shall be adjusted as needed.
When the measurement of free chlorine is not sufficient compare with the criteria, the dosing flow rate of pre-chlorinator shall be checked and increase the dosing flow rate of the pre-chlorine as needed.
Simultaneously following items shall be confirmed;

- The flow rate of the well water
- The chlorine demand of the well water

2-2-2.Control of the turbidity in the sedimentation basin
When sludge drainage is not sufficient, the oxidized particles in the clarified water increase. If the turbidity exceeding the criteria is confirmed, drainage of the sludge shall be done immediately and the criteria of frequency of the sludge drainage shall be reviewed.
When high turbidity is caused by structure reason and cannot be avoided by drainage operation, modification of structure design of the basin is needed for instances;
- Installation of baffling plate to avoid sucking the precipitated sludge into the suction pipe of the filter pump
- Making slope on the bottom to be easy to drain out the sludge

When filtered water quality is improper severely, the well water quantity is reduced and quality improvement shall be examined. If insufficient, the plant is stopped. And cause of improper condition shall be found and corrective action shall be taken.

Daily check or monitoring jobs are insignificant work. So, unusual condition or trouble shall be picked up in early stage. Damage by unusual condition or trouble is minimized by early detection and rapid response of recovery.
These jobs shall be carried out and ensured effectively, suitably by valuable check items, significant value will come out from these jobs.
Monitoring and check list is provided in APPENDIX. This list shall be reviewed periodically for maximize of value of jobs and improvement of works.

2-2-3. Restart after long term stopping

When the restart of the sedimentation basin is conducted after a long term stop of the plant/oxidization tower, such as stopping for 2 weeks or more, the water in the sedimentation basin shall be drained before feeding the water to the filter.
And free residual chlorine and turbidity of the water shall be measured.
The water in the sedimentation basin shall not be fed to the filter until free chlorine and turbidity in the water is sufficient quality compared with the criteria.

3. Operation under unusual condition

3-1 Prospect troubles and trouble shootings

3-1-1.During working

Water quality shall be monitored and operation conditions of the facility mentioned above shall be changed if necessary.

- Unusual condition of the water in sedimentation basin
  - Rising of the oxidized particles
  - Change of color of water
- Cause of unusual condition for the water level
  - Rising of oxidized particles
    - Insufficient of sludge drainage
    - Improper velocity of inlet
    - Excess of flow rate of inlet
  - Change of color of water to brown or black
    - Insufficient sludge drainage
    - Insufficient chlorine dose
    - Change of the well water quality
  - Trouble of level sensor for the sedimentation basin
  - Trouble of electrical switch board

Actions shall be required to recover above as follows;
- Proper frequency of sludge drainage
- Proper time during sludge drainage
- Proper dosing rate of chlorine
- Control and confirm the well water flow rate
- Proper monitoring and analysis of well water quality

3-1-2. Restart after long term stopping

When the restart of the sedimentation basin is conducted after a long term stop, such as stopping for 2 weeks or more, the water in the sedimentation basin shall be drained before feeding the water to the filter.
And free residual chlorine and turbidity of the water shall be measured.
The water in the sedimentation basin shall not be fed to the filter until free chlorine and turbidity in the water is sufficient quality compare with the criteria and this may happen because of ;

- Cause of precipitation of sludge
  - Condensed and compressed of sludge on the bottom
  - Condensed and compressed of sludge in the pipe
- Unable to drain out the sludge by clogging of drainage pipe

Actions before stop shall be required to prevent from above as follows;.
- Carry out sludge drainage during above.

- Cause of reducing of free chlorine residual in water of sedimentation basin
  - Prospect of trouble of the process

- Insufficient of free chlorine residual in filtered water

Actions before restart shall be required to prevent from above as followings
- In restart operation, monitor free chlorine residual in the effluent water
- Drain out the effluent water until free chlorine residual iscome sufficient. Sufficient free chlorine residual shall be determined according to the criteria.

4. Report and record

4-1.Record

The record for sedimentation basin shall be required to know operation condition and quality of oxidized water.
Quality of oxidized water shall be acceptable compared with the criteria.
Operation condition shall be acceptable compared with the design criteria.
Record is supplied from activity of maintenance and water quality control.

For reference, records from water quality control of sedimentation basin is as follows;

- Result of monitoring and check
  - Quality of clarified water
    - Turbidity
    - Free chlorine residual
    - Containing of ammonium
    - Color of the water in the basin
  - Unusual condition
    - Excess of turbidity than the criterion
    - Excess of free chlorine residual as high or low than the criterion
    - Excess of containing of ammonium than the criterion
    - Unusual color of the water in the basin
    - Arising of flocks in the basin
  - Operation condition
    - Flow rate into a sedimentation basin
    - Dosing rate and flow rate of pre-chlorine
    - Frequency of sludge drainage

4-2.Report

Generally almost of technical records shall be reported to people in technical sections in FMRP.
Any records have no value without utilizing them. Reports shall be useful tool for

next improvement activities by utilizing of records.

Required reports for operation of sedimentation basin is limited area and it will need to make a recommendation regarding to operation of sludge drainage.

Report for operation of the sedimentation basin will include as follows;

-1.Recommendation for operation according to records of operation
-2.Report for corrective and preventive action
-3.Result of recovery of trouble or unusual condition
-4.Recommendations for improvement

Plant Name: **Kafr Farag FMRP**	Title **Filter**	SOP TAG No. **KFR-FMR05 –OP**

Issued		Developed by		Signature	
Revised		Approved by		Signature	

Introduction

Filtering process is the final removal process in the iron and manganese removal plant (abbreviate as FMRP). The filter in the FMRP is different from the filter in the conventional water treatment plant for the required function.
The source water for the Kafr Farag FMRP in SHARKIA is the groundwater from well and therefore it shows low turbidity and is steady through the year.

The main function of the filter in the FMRP is not removal of the turbidity by filtering, but removal of the iron and manganese by contact oxidization process in use of contact filter media.
The oxidation process is needed always prior to the filtering process in the FMRP and aeration and pre-chlorination are provided as the oxidation process.

Three filters are available in Kafr Farag FMRP and each filter is operated individually. Two of three filters can be used in maximum capacity and one of three filters is for stand by usually. Four wells and four well pumps, and four filter pumps are equipped and discharge capacity of one well and one well pump meets the capacity of one filter as capacity of 140 m3/hr. Number of the filter in operation is determined according to working number of the well pump. When one well pump is working, one filter pump will work and one filter work. When two well pumps are working, two filter pumps work and two filters work. Operations for this filtering system consist of three (3) kinds of operation modes as follows;

- Filtering
- Backwashing and drainage
- Pre-filtering and drainage after backwashing

1. Features of process

1-1.Function of facility

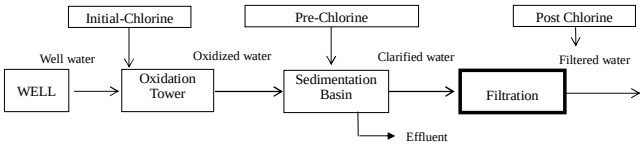
Function of the filter is to remove the oxidized iron and manganese particles which carried over, from the sedimentation basin and to remove manganese in the process water by contact oxidation.

1-2.Impacts of facility

-1.Filtering process is the final removal process in the FMRP.
-2.If manganese removal is insufficient, the filtered water is colored water by reaction with manganese and free chlorine residual. Degree of colored water is approx. 300 times of manganese contains in the water.
For example, in case of manganese contains are 0.1 mg/l in the filtered water the color of the filtered water is approx.30 mg/l after some reaction time.
-3.Free chlorine residual in the clarified water in to the filter shall be be kept in 0.5 mg/l or more. If above condition is not kept the oxidation filter media is damaged severely. And the effect of manganese removal is insufficient by this
-4.The clear water reservoir is not available in the FMRP. Filtered water is supplied directly to the network by discharge pressure of the filter pump. Stop of the filter pump means stop of the supplying of drinking water to the network.
-5.Free chlorine residual in the filtered water shall be adjusted by Post-chlorine to the regulation.

1-3.Relations between other processes or other facility

-1.Water quality of oxidized water affects to efficiency of filtering.
Oxidized particles, which should have been removed in the sedimentation basin, pass on to filters. This will result in reduced filter run times and poorer filtered water quality.
-2.The water treatment process is a chain of the several processes such as the well water transferring, oxidation and the sedimentation process.
In the water treatment process, the sedimentation process is affected directly and significantly by a result of the oxidation and sedimentation processes.
-3.Water quality of the filtered water is affected by operation condition of the oxidation and sedimentation process.
-4.Oxidation of iron and manganese of the well water is the key factor for iron and manganese removal plant. Initial-chlorine, oxidization tower and pre-chlorination are used to oxidize iron and manganese in process water.
-5.Clarified water is fed from the sedimentation basin into to the filter tank by the filter pump. The filter system in the Kafr Farag FMRP adopted the manganese sand filtration process.
In manganese filtration system, basically the free chlorine residual of the clarified water shall be maintained in the value more than 0.5 mg/l as lower limit. The free chlorine residual is consumed by the manganese sand.
Hence, the free chlorine residual in the clarified water shall be kept in the value more than above with a margin of consumption.
If the free chlorine residual in the clarified water is not enough for the manganese sand filtration, it means not only drop in efficiency of manganese removal but damage of manganese coating layer around the manganese sand.



Note: “Process water” is also used as general word for the water flowing in the Plant.

2. Criteria for operation

The criteria for operation or control of the filter shall be required as follows;

2-1.The criteria for operation
- 2-1-1.Timing of backwashing
- 2-1-2.Time in operation for pre-filtering after backwashing
- 2-1-3.Time in operation of backwashing
- 2-1-4.Flow rate for backwashing water
- 2-1-5.Number of working filter
  - Three filters shall be operated at the same time.
  - It is better that oxidation contact filter is operated continuously to keep an oxidation filter media in a satisfactory condition.
  - The process water contained free chlorine residual is supplied into the filter.

2-2.Judgement of Quality
- 2-2-1.Judgement of the completion of backwash in usual operation
  - Turbidity of backwash drain is less than 5 NTU
- 2-2-2.Judgement of the completion of pre-filtering
  - Turbidity of backwash drain is less than 1 NTU
  - Free chlorine residual is 1.0 mg/l or more

Descriptions on water quality control refer to SOP KFR-FMR05-QC.

3. Operation under normal condition

The operation for the oxidation filter consists of three (3) kinds of operation modes as follows;

-1.Filtering
-2.Backwashing and drain
-3.Pre-filtering and drain after backwashing (preparation step for the filtering)

3-1.Operation for the filtering

3-1-1.Start up for the operation of the filtering

Three filters are available in Kafr Farag FMRP and each filter is operated individually. Two filters can be used in maximum capacity of the plant and one filter is for stand by in design.

The procedures are shown in KFR-FMRP04-OPFC-01, for start up from condition of stand by.

The backwashing shall be needed for start up of a filter

The condition of the oxidation filter media in the stopped filter is lowered the oxidation potential and removal potential of manganese is insufficient.

Hence, backwashing shall be required prior to the filtering and the water use for backwash shall be contained free chlorine residual in concentration of approx.1.5 mg/l or more. The oxidation filter media is activated by backwashing by the water containing free chlorine residual. It means that backwash water shall contain required free chlorine residual to activate manganese sand.

3-1-2.Shut down of operation of the filter

Shut down of the filter is carried out when activity of periodical maintenance, scheduled change over or end of plant operation is conducted.

-1.Stopping for 2 days or less

The filter can be kept in condition of filling water.

Restart of the filter shall be conducted according to above procedures 3-1-1.

-2.Stopping for 7 days or less

Same as above, but if free chlorine residual is not sufficient (1.0 mg/l or less) in the clarified water by pre-filtering, dosing rate of per-chlorine shall be increased to the require free chlorine residual concentration.

-3.Stopping for 7 days or more

The water in the filter shall be drained out completely to avoid growth of organics such as algae or worm in the filter media.

All valves shall be closed except ventilation valve and drain valve.

Prior to restart, water shall be supplied through the backwash pipe gradually for backwashing of the filter. Free chlorine residual in the supplied water is needed 2.0 mg/l or more. By this activity the air in the filter media is discharged. Excess volume or pressure of water supplying from backwash pipe will cause damage of sand layer such as reversing of filter media.

If reversing of the filter media is happened, it will cause the short circuiting flow in the filter media or flowing out of the filter media into the network

Hence, backwash water valve shall be be opened slightly and this operation condition shall be kept for 3-4 hours. After that free chlorine residual of backwash drain water, that is slow speed backwashing, shall be checked as 1.0 mg/l or more. After the above check, ordinary backwash can be conducted prior to the pre-filtering.

The oxidation filter media is activated by contact to the water with sufficient free chlorine residual existence.

Detail procedures for the restart of the filter are provided in KFR-FMR05-OPFC-01.

3-1-2.Backwashing and drain for the filter

-1.Steps to the backwashing

Backwashing of the filter is conducted by changing the valves for the filter.

- 1st: Close the valve for clarified water
- 2nd: Open the valve for drain
- 3rd: Open the valve for backwashing

Time in backwashing is approx.10-20 min.

-2.The water use for backwashing

The water for backwashing shall contain of free chlorine residual as 1.0 mg/l or more.

The water for the backwashing is fed from the filer pump discharge

-3.Judgment of completion of backwashing

Turbidity of backwash drain shall be confirmed during backwashing.

Backwashing is completed when turbidity of backwashed drain water will reach to 5 NTU or less.

-4.Judgment of necessity of backwashing and completion of backwashing

The filter media in a filter is clogged by particles in the process water. And the oxidation ability is reduced by oxidation of manganese in the process water. These conditions is recovered by the backwashing.

. Necessity of backwashing shall be judged by reading of the indication of the pressure gauges for inlet and outlet of the filter.

The backwashing is needed when difference of the pressure indications of inlet and outlet is reached at 0.2 kg/cm2.

It is better that the backwashing is conducted once a day to ensure the oxidation ability of the filter media, even if the differential pressure will not reach to above value.

When backwashing is completed, difference of the pressure indications of inlet and outlet is confirmed that will return to the condition at starting of the filtering.

3-1-3.Pre-filtering and drain for the filter

Operation of pre-filtering and drain for the filter can be conducted as preparation prior to the filtering process.

The purposes of the pre-filtering are as following;

- To drain out the remaining water of backwashing in the filter
- To confirm free chlorine residual in the filtered water prior to the filter process

-1.Steps to the pre-filtering

The pre-filtering is conducted by change the valve around a filter.

- 1st: Close the valve for backwashing
- 2nd: Check close of the valve for the filtering outlet
- 3rd: Open the valve for drain
- 4th: Open the valve for the water inlet

Time in pre-filtering is approx.10-20 min.

After pre-filtering, the filtering process can be started.

-2.Judgment of completion of pre-filtering

Turbidity in drain water of pre-filtering shall be confirmed during pre-filtering.

Pre-filtering is completed when turbidity in drain water will reach to 2 NTU or less and free chlorine residual is 1.0 mg/l or more.

3-1-4.The filtering process

-1.Steps to the filtering

Filtering of the filter is conducted by change the valve around a filter.

- 1st: Close the valve for drain
- 2nd: Open the valve for the filtering outlet
- 3rd: Check open of the valve for water inlet
- 4th: Check close of the valve for backwashing

-2.Check in the start of the filtering

Following items shall be checked in the staring of the filtering;

- Pressure indication of the water inlet
- Pressure indication of the filtering outlet
- Differential pressure of inlet and outlet pressure
- Turbidity in the filtered water: 2 NTU or less
- Free chlorine residual in the filtered water: 0.5 mg/l or more
- Free chlorine residual in the inlet water: 0.5 mg/l or more
- Iron and manganese contains in the filter outlet water has to satisfy new Egyptian potable water standard for the groundwater source
  - Iron contains: 0.3 mg/l or less (old standard: 1.0 mg/l)
  - Manganese contains: 0.4 mg/l or less (old standard: 0.5 mg/l)
- Turbidity in the filtered water has to satisfy Egyptian standard of the potable water for the groundwater source

- 10 NTU or less

And more over SHAPWASCO's own allowable limit

- 5 NTU or less

- Color of the filtered water: 20-30 as a maximum limit using platinum cobalt

3-2.Monitoring and visual check

The jobs of monitoring and visual check shall be daily routine work in O&M activity. Unusual condition or trouble shall be picked up in early stage by these jobs.

Damage by unusual condition or trouble is minimized by early detection and rapid response of recovery. Daily check or monitoring jobs are insignificant work.

These jobs shall be carried out and ensured effectively, suitably by valuable check items, significant value will come out from these jobs.

4. Operation under unusual condition

4-1 Prospect troubles and trouble shootings

4-1-1.During working

Conditions of process water shall be monitored and operation condition of the facility in above shall be changed if necessary.

- Unusual condition of the water in the filter
  - Differential pressure rise up 0.2 kg/cm2 or more before 24 hours passing
  - Excess of iron and manganese concentrations in the filtered water
  - Insufficient free chlorine residual in the filtered water
  - Excess of turbidity in the filtered water
  - Excess of color of the filtered water
  - Change of color of water
  - Insufficient pressure to the network
- Cause of unusual condition
  - Differential pressure rise up 0.2 kg/cm2 or more before 24 hours passing
    - Poor quality of the inlet water to a filter
    - Excess of the flow rate of inlet water to a filter
    - Insufficient opening of the valve of inlet or outlet
    - Shortage of anthracite

- Excess of iron and manganese concentrations in the clarified water
  - Insufficient of free chlorine residual in the inlet water
  - Insufficient of oxidation process
  - Insufficient of oxidation of ammonium
  - Luck of dosing rate of pre-chlorine
  - Waste of the filter media
  - Shortage of volume of the filter media
  - Deterioration of the filter media
  - Excess of the flow rate of inlet water to a filter
  - Change of well water quality
- Insufficient free chlorine residual in the clarified water
  - Insufficient of free chlorine residual in the inlet water
  - Insufficient of oxidation of ammonium
  - Waste of the filter media
  - Shortage of volume of the filter media
  - Deterioration of the filter media
  - Excess of the flow rate of inlet water to a filter
  - Change of well water quality
- Excess of turbidity in the clarified water
  - Excess of differential pressure
  - Excess of the flow rate of inlet water to a filter
  - Poor quality of the inlet water to a filter
  - Unusual of arrangement of filter layer
- Excess of color of the filtered water
  - Excess of iron and manganese contains in the filtered water
- Change of color of water
  - Change to brown or black
  - Excess of iron and manganese contains in the filtered water
- Insufficient pressure to the network
  - Differential pressure rise up 0.2 kg/cm2 or more
  - Trouble of the filter pump
  - Trouble of the valves

Information for trouble history shall be collected and put into unified sheet, KFR-FMR05-OPTH-01.

5. Report and record

5-1.Record

Records of operation of the filter are required as follows;

5-1-1.Record of working
- -Time in working
- - Differential pressure at just before the backwash process
- - Differential pressure at initial state of the filtering process after backwash
- - Number of the well pump and the filter pump
  (Flow rate of well water and filter pump discharge)
- - Pressure of the transmission pipe
- - Turbidity in the backwashing drain water
- - Time of backwashing
  - Time of start
  - Time of finishing
  - During time of pre-filtering
  - Free chlorine residual at the end of pre-filtering

5-1-2.Record of free chlorine residual in the clarified water
- - Four (4) times in a day

5-1-3.Result of visual check
- - Unusual condition
  - Differential pressure
  - Transmission pressure
  - Free chlorine residual in the filtered water
  - Unusual color of the filtered water
  - Unusual odor of the filtered water
- - Operation condition
  - Visual check list
- - Record of recovery (Corrective action)

5-2.Report

Any records have no value without utilizing them. Reports shall be useful tool for next improvement activities by utilizing of records.

Report for operation of the filter will include the following;
- -1.Recommendation for operation according to records of operation
- -2.Report for corrective and preventive action
- -3.Result of recovery of trouble or unusual condition
- -4.Recommendations for improvement
- -5.Monthly and annual report of operation
  - - Filtered water volume of each filter
  - - Efficiency of iron and manganese removal
  - - Tendency of free chlorine residual in the filtered water

Plant Name: **Kafr Farag FMRP**	Title **Filter**	SOP TAG No. **KFR-FMR05 –MT**

Issued		Developed by		Signature	
Revised		Approved by		Signature	

Introduction

Maintenance activities for the filter shall be provided as follows;
- - The filter sand layer
- - The filter tank
- - Instrument such as the pressure gauge
- - Piping and valves

Maintenance of the filter sand is very important for FMRP.
The filter sand for iron and manganese removal filter consists of the oxidation sand and anthracite. The function of anthracite is removal of the particles such as oxidized iron, and the function of the oxidation sand is oxidation of iron and manganese in the process water.
The anthracite is put on the upper layer on the filter layer and is a light filter media.
The anthracite is easy to flown out of the filter when the backwashing is conducted with excess rate of backwashing.
The oxidation sand is coated on surface of sand grain by oxidized manganese layer.
The manganese and iron in the process water is reacted by the coated surface layer of the oxidation sand. The activation potential of the oxidation sand is kept in proper condition by contact with free chlorine residual in the process water.
If anthracite is lost by flown out, oxidized iron is removed insufficiently in the filter.
As a result of above, the surface on the oxidation sand is coated by oxidized iron layer. Consequently, the activation potential is weakened by interference of the oxidized layer on the oxidation sand. The oxidation sand is weakened by the lack of free chlorine in the inlet water to the filter.
The oxidation sands increase the size by coating of oxidized manganese.
Hence, periodical inspection and recovery is needed to keep the filter media in proper condition for oxidation reaction and filtration.

Pressure gauges for measuring of inlet and outlet pressure of the filter are use for check of clogging condition in the filter media. The poor filtered water is discharged from the filter by operation in high differential pressured condition between inlet and outlet pressure.
The differential pressure shall be less than 0.2 kg/cm2. The pressure gauge is important auxiliary instrument for operation of the filter and shall be confirmed usually.
The valves for the filter are provided to change the working of the filter such as a filtering, a backwashing and a pre-filtering. Trouble of the valves will reach to the stop of the filter directly.

1. Criteria for maintenance

The criteria for maintenance of the filter are as follows;
1-1.The criteria for the inspection work
- 1-1-1. Inspection of the filter media inside of the filter tank
  - - General inspection: Once in 3 months
  - - Detail inspection: Once in 3 years

1-2.The criteria for judgment
- 1-2-1.Limt of height for anthracite
  - Design height: 429 mm
  - Lower limit: 300 mm ?
- 1-2-2.Limit of height for oxidation sand
  - Design height: 273 mm
  - Lower limit: 250 mm ?
  - Upper limit: 400 mm ?
- 1-2-3.Surface condition of the oxidation sand (for reference)
  - Initial condition (normal condition): Blackly brown color
  - Peeled condition (unusual condition): Grey color
  - Coated by oxidized iron (unusual condition): Light brown color

2. Maintenance activity

Monitoring, check and inspection shall be carried out to judge necessity of recovering activity such as adjustment, repairing or replacing.

Maintenance activity consists of four (4) kinds of stages as follows;
- -1.Monitoring and checking during operation
- -2.Inspection
- -3.Evaluate and analysis regarding result of inspection
- -4.Reparing or replacing including check after the operation

2-1.Maintenance of the filter layer

Improper condition of filter layer may make filtered water quality worse and connect to acceleration of waste in filter layer further more. As a result, we will have to replace whole of filter sand in a short period.
To avoid above, conduct periodical monitoring and check about filter layer shall be required periodically.
When unusual condition is found about filter layer, rapid corrective action shall be carried out such as improvement of filter washing formation or supply of filter sand.
A plan for maintenance of filter layer shall be issued and maintenance activities for filter layer should include the followings;

-Distribution of degree of sand grain
- Waste degree of filter layer
- Existing of algae
- Existing of other waste such as adhesion substances
- Flatness of filter layer
- Existing of crack or crater
- Existing of clearance beside of wall

2-1-1.Usual monitoring and check

Description of inspection	Interval
1.Check of filtered water quantity, filtration rate, head loss of filter layer, filter run time	Daily
2.Check of filtered water quality (turbidity, free chlorine residual, pH, alkalinity, and so)	Daily

1. Periodical inspection

Description of inspection	Interval
1.Check waste adhesion on inside wall, drain trough in filter basin	Once 2-6 months
2.Check water leak, cracks, damage of filter basin inside	Once 2-3 years
3.Check of filter layer quality (waste, effective diameter and, uniformity, depth of filter sand layer)	Once 1-3 years
4.Check of moving of the gravel layer	Once 1-3 years
5.Check working condition of head loss pressure gauge	Once 1 year
6.Check of condition of under drain	Once 10-15 year
7.Check of flow rate and time formation for filter washing	Once 2-6 months
10.Monitoring of filter washing (e.g. flow out of filter media, malfunction of filter washing facility, improper condition of filter layer after washing such as crater, and so)	Once 3-4 days
11.Check turbidity of water of filter washing waste	As needed

2. Detail inspection and check (rehabilitation)

Description of inspection or rehabilitation	Interval
1.Additional supply of filter sand	As needed

3. Evaluate and analysis of result after inspection

Description of inspection	Criteria
1. Check of clarified water quality	
-1.Turbidity	5 NTU of less
-2.Free chlorine residual	1.5 mg/l or more
-3.Contaning of Ammonium	----------
2.Check of head loss of filter layer	0.2 kg.cm2 or less

3.Check of filter run time	24 hours or less

4. Check of filtered water quality (turbidity, free chlorine residual, pH, alkalinity, and so on)

-1.Turbidity	5 NTU of less
-2.Free chlorine residual	0.5 mg/l or more
-3.Contaning of Ammonium	Not detected
-4. pH, alkalinity, and so on	Not more than Egyptian standard of potable water quality

5. Monitoring of filter washing — No improper condition

6. Check of time formation for filter washing

7. Check turbidity of water of filter washing waste	Turbidity of washed drain is 5 NTU or less

8. Volume of sand layer

-1.Anthracite	Decrease of 10% or less of initial volume
-2.The oxidation sand	Increase of 10% or more, or decrease of 10% or less of initial volume

2-1-2.Filter tank

The filter tank shall be checked external condition such as physical damage of corrosion or sealing of connection parts.
Check list of the external check of the filter tank is provided.

2-1-3.Piping and the valve

Piping and valve shall be checked external condition such as physical damage of corrosion or sealing of connection parts and the valve shall be inspected inner part such as diaphragm seat of valve periodically by dismantling of the valve.
Check list of the external check and internal check of the pipe and valve is provided.

3. Procedures under unusual condition

Prospect troubles and trouble shootings

After change of supplying of the filter media, sometimes it is happened a trouble such as;

- Free chlorine residual in the filtered water will not be detected

- The filter media is flown out
- Turbidity in the filtered water is high
- Differential pressure between inlet and outlet is high in short period after filtering

Troubleshooting is provided as cause and remedy for above in KFR-FMR05-MTTS01.

4. Report and record

4-1.Record

Records for maintenance of the filter facility are required as follows;
4-1-1.Monitoing and visual check records according to;
Monitornig check list
4-1-2.Inspection records according to;
Inspection check list
4-1-3.Recovery, rehabilitation or upgrading
-1.Repair
-2.Replace or supplying
-3.Tightening
-4.Repainting
-5.Adjustment
-6.Additional facility or part

4-2.Report

O&M activities by utilizing of records, checking and analyzing the recorded data inside them and they are required as follows;.
4-2-1.Periodical maintenance report
4-2-2.Corrective maintenance report
4-2-3.Result of recovery of trouble or unusual condition
4-2-4.Recommendation to O&M and improvement of facility
- Preventive action
- Upgrading
- Review of SOP
- Review of record sheet

Plant Name: **Kafr Farag FMRP**	Title **Filter**	SOP TAG No. **KFR-FMR05 –QC**

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Revised		Approved by		Signature	

Introduction

Water quality control activities for the filter shall be provided as follows;
- The monitoring of quality of inlet water that is oxidized water
- The monitoring of quality of the filtered water
- The monitoring of a differential pressure
- The monitoring of quality of the backwash drain water
- Check of the filtering, the pre-filtering and the backwash operation
- Check of a condition of the filter media

Water quality monitoring and check of the operation condition of the filter shall be required mainly for water quality control in the FMRP.

Good performance of water quality control in FMRP shall be conducted by following;
- A control of clarified water quality
- Utilizing of feedback information from filtered water quality
- Daily monitoring of the filtered water and adjustment of chlorine dosage as needed
- Monitoring of operation condition
- Periodical inspection of the filter sand and early recovery action as needed

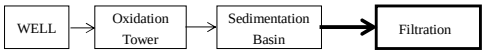
Water quality control shall be performed to optimum condition by not only water quality monitoring but check of operation and maintenance activity.
Almost of iron in the process water is removed by oxidation in aeration tower, oxidation by pre-chlorination and precipitation in the sedimentation basin.
But theoretically, manganese in the process water is not oxidized by chlorine.
Manganese in the process water with free chlorine residual is removed by a process of the oxidation sand filter in the condition around pH 7. In this process the oxidation sand works as a catalyst.

The filter sand for iron and manganese removal filter consists of the oxidation sand and anthracite. The function of anthracite is removal of the particles such as oxidized iron, and the function of the oxidation sand is oxidation of iron and manganese in the process water.
The anthracite is put on the upper layer on the filter layer and is a light filter media.
The anthracite is easy to flown out of the filter when the backwashing is conducted with excess rate of backwashing.

The oxidation sand is coated on surface of sand grain by oxidized manganese layer.
The manganese and iron in the process water is reacted by the coated surface layer of the oxidation sand. The activation potential of the oxidation sand is kept in proper condition by contact with free chlorine residual in the process water.

If anthracite is lost by flown out, oxidized iron is removed insufficiently in the filter.
As a result of above, the surface on the oxidation sand is coated by oxidized iron layer. Consequently, the activation potential is weakened by interference of the oxidized layer on the oxidation sand. The oxidation sand is weakened by the lack of free chlorine in the inlet water to the filter.

1. Criteria for water quality control



The criteria for water quality control of the filter shall be required as following;

1-1.The criteria for judgment
- The water quality of the filtered water
- The water quality of the oxidized water
- The water quality of the backwash water
- The water quality of the backwash drain water

1-2.The criteria for frequency of monitoring
Water quality analysis
- The filtered water
- The clarified water
- The backwash water
- The backwash drain water

1-3.The criteria for judgment
Limit of height for anthracite
Design height: 429 mm and Lower limit: 300 mm ?
Limit of height for oxidation sand
Design height: 273 mm and Lower limit: 250 mm ?
Upper limit: 400 mm ?
Surface condition of the oxidation sand
Initial condition (normal condition): Blackly brown color
Peeled condition (unusual condition): Grey color
Coated by oxidized iron (unusual condition): Light brown color

2. Report and record

2-1.Record

Record for maintenance of the filtering shall be required to recognize operation condition and water quality. For reference, water quality control records shall be as follows;
- Monitoring and visual check results
  - Filtered water quality
  - Turbidity
  - Free chlorine residual
  - Aluminum contains
- Operation condition
  - Flow rate inside sedimentation basin
  - Well water quality
  - Pre-chlorine dosing rate
  - Sludge drainage frequencies

2-2.Report

Generally almost of technical records shall be reported to people in technical sections in FMRP.
Any records have no value without utilizing them. Reports shall be useful tool for next improvement activities by utilizing of records.
Required Reports for filters is limited area, some recommendations will taken into consideration to operate the filter as follows;

2-2-1.Recommendations
- Rehabilitation
- Repairing or replacement of pumps and valves
- Filter media condition
- Replacing parts of facilities
- Required spare parts
- Review of SOP
- Procedures
- Criteria

Operation reports
- Produced water quantity
- Water used for backwashing
- Monthly and annually
- Free chlorine residual in discharge water

Plant Name: **Kafr Farag FMRP**	Title **Filter Pump**	SOP TAG No. **KFR-FMR06 –OP**

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Introduction

Filtration is the final treatment stage of the Iron/Manganese Removal Plant (KFR-FMRP) which physically removes suspended particles and oxidizes contained manganese in the water from the sedimentation tank.
The effectiveness of this stage is very important on water quality control for the water supply, because suspended particles in the water hinder germs from the disinfection and because the soluble manganese cannot be oxidized by chlorine and must be physically and chemically removed.
The filter pump assists strongly this function of filtering process to be operated efficiently. Three functions are given to the filter pumps of this plant and these functions are changed by change-over operation of the valves around the filter.
-1.To feed the water from the sedimentation basin: Function as filter pump
-2.To feed the filtered water to the network: Function as transmission pump
-3.To backwash the filter: Function as backwash pump

Filter backwashing affects to filtering efficiency and performance.

1. Features of process

1-1.Function of the facility

Three functions are required for the filter pump as mentioned above, although filtration coating builds and penetrates into the filter bed, and the head loss across the filter becomes greater until the flow rate is greatly reduced. At this time the filter must be backwashed to cleanse the media of the flock and particulate matter by filter pump.

1-2.Impacts of facility

The filter pump has a great effect on the filtration process, so the proper operation for these pumps affects the efficiency of filtration.

1-3.Relations between other processes

1-3-1.The oxidation tower and sedimentation basin
The water from the oxidation tower is fed into the sedimentation basin and pre-chlorine is dosed. Then clarified water from the sedimentation basin is fed into the filter by filter pump.

1-3-2.The filter
Contained iron in the well water is oxidized by aeration in the oxidation tower and chlorination. But soluble manganese in the water is hardly oxidized and precipitated because of the pH condition of the well water. Hence, manganese in the water shall be removed in the filtration process by oxidation contact reaction on the oxidation sand in the filter.
Discharge capacity of a filter pump is same as the treatment capacity of a filter unit.

2. Criteria for operation

Control of pump operation shall be as follows;
-1. Flow rate of the discharge water from the filter pump
- Control of flow rate of inlet water for the filter: 140 m3/hr or less
- Check of flow rate of filtered water
- Check of backwash water

- 2. The capabilities required to the filter backwashing are as follows;
- Suitable quantity for backwashing water
- Suitable operation time for filter backwashing
- Prevention of the filter sand flow-out

2-1. Procedures and specifications for filter backwashing

Water flow rate for backwashing: 0.6-0.8 (m3/m2/min)
Run time for backwashing: 15 (min)
Turbidity of drain water after filter washing: 5 NTU or less

2-2. Backwashing control

- Operation of the filter washing shall be evaluated by turbidity recovery of drain water of filter backwashing and by least loss of the filter sand by flown-out.
- Suspended particles are not removed by running of filter under the exceeding limit of pressure loss.
- Filter sand shall be checked periodically to confirm the proper filter backwashing

operation.
- Procedures and specifications for filter backwashing operation shall be modified by results of the above to be more effective and suitable.

3. Operation under normal condition

3-1.Start-up and shut-down procedures for filter washing

The filter pump is operated manually.

☆ Pre-operation check

-1.Select the filter pump to be operated.
-2.Select the function of the filter pump
(Filtering, backwashing or pre-filtering)
-3.Confirm the valve position of the filter according to the required function
-4.Check the valve in suction pipe and discharge pipe are opened fully.
-5.Check the valve for pressure gauge is closed.
-6.The water level in the sedimentation basin is enough for the pump operation.
-7.The power supply is coming and circuit breaker for the pump is "ON"

☆ Start-up procedure

-1.Turn the starting switch on the switch board to "ON"
-2.Check the pressure gauge indication
-3.Check the ampere meter indication

☆ Shut down procedures

-1.Turn a starting switch on the switch board to "OFF"

3-2.Monitoring and visual check of facility

Monitoring and visual check during working of the pump are shown in KFR-FMR06-OPFC-01.

3-3 Control of filter backwashing

The filter pump is controlled depend on required function of the filter.
Number of the working filter pumps shall be controlled by required flow rate of the water to the filter.
Controllable operations regarding the filter pumps are as follows;

-1.Flow rate for the filtration and backwashing by the number of working pumps
The filter pumps can feed the water quantity to use two filters and to backwash one filter at a time.
-2.Operation time of the filter pump
-3.Frequency of filter backwashing

Above items are mentioned in SOPs of the "Filter" KFR-FMR07-OP.

4. Operation under unusual condition

4-1.Unusual condition for pump
Trouble shooting is shown in KFR-FMR06-OPTS-02.
4-2. Unusual condition for piping and valve
Trouble shooting is shown in KFR-FMR06-OPTS-03.

5. Report and record

5-1.Record

Records for filter pump facility are required as follows;
5-1-1.Records of filter pump
- No. of working pumps
- Time of start and stop
- Pressure gauge indication during operation
- Records of backwashing
- Electrical current during operation
- Result of monitoring and check

5-2.Report

Reports are required as follows;
5-2-1.Recomendation
- Rehabilitation
  - Repair or remove
  - Repainting
  - Replacement of parts or facilities
  - Required spare parts
- Review of SOPs
  - Procedures
  - The criteria
  - Required record and report

5-2-2.Operation report
- Consumption of water volume use for backwashing
  - Monthly and annually

Plant Name: **Kafr Farag FMRP**	Title **Chlorination Facility**	SOP TAG No. **KFR-FMR07-OP**

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Revised		Approved by		Signature	

Introduction

There are three injection points of chlorine in the chlorination system of KFR-FMRP, i.e. initial chlorine, pre-chlorine and post chlorine dosing system. Three functions are provided to the chlorination facility, one is pre-chlorination (for initial chlorine and pre-chlorine dosing) and the other is post-chlorination. For this purpose two pre-chlorination dosing pipes are prepared in this plant. One is dosed in inlet water for initial chlorine and the other is dosed in outlet water for pre-chlorine in the oxidation tower.

1. Features of process

1-1.Function of process

Function of initial and pre-chlorination is to oxidize iron, manganese, ammonium and organic matter and so which are contained in the raw well water.
Function of post-chlorination is to destroy disease causing organics, also called pathogenic organics contained or contaminated in the water supply network.

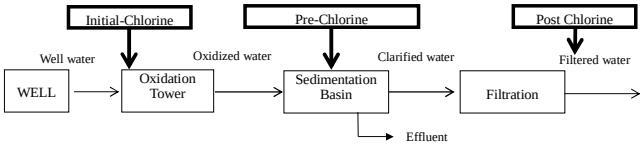
1-2.Impacts of process

Initial chlorination is dosed into the well water supply pipe to oxidation tower. Pre-chlorine is dosed into the outlet water prior to the sedimentation basin. Pre-chlorination aids oxidation reaction by free chlorine residual in the inlet water for filtering in the contact oxidization process.
Chlorination is an essential process in the iron and manganese removal plant with contact filtration process. Soluble iron and manganese in the water cannot be removed where chlorine is not dosed.

Post-chlorination performs disinfection of the filtered water and the free chlorine will continue to react with the impurities in the water, such as organic materials and organisms, until all the impurities and organisms are destroyed and there is an excess of free chlorine.
It is important to recognize that the combination of sufficient free chlorine residual and adequate contact time are essential for effective killing of the pathogenic organisms.

1-3.Relations between other processes

1-3-1.The well water
Pre-chlorine dosing rate is depend on the raw well water quality, especially iron, manganese, ammonia and organic matter concentration.
1-3-2.The oxidation tower
Iron in the raw well water is oxidized in the oxidation tower by initial chlorination and aeration. This process is the first step of the oxidation process in this plant.
The pre-chlorination is the second process of the oxidation of iron in the well water after aeration process in the oxidation tower.
1-3-3.The sedimentation basin
The oxidized iron particles in the process water are precipitated in the sedimentation basin. The water removed oxidized iron in the sedimentation basin is fed to the filter by the filter pump.
Contained ammonia in the well water is also oxidized by the aeration and the pre-chlorination. Duration time for the oxidation reaction of ammonia by pre-chlorination is needed for 40 minutes or more but actual detention time for the oxidation of ammonia in the sedimentation basin is approx. 30 minutes or less.
Ammonia shall be oxidized prior to the filtration process to maintain free chlorine residual of clarified water in the required value.
Hence, when ammonia is contained in the well water, the initial-chlorination shall be dosed in the well water prior to the oxidation tower to oxidize ammonia.
1-3-4.The filter
The post-chlorine is dosed into the filtered water prior to supply the clear water to the network as needed. Free chlorine residual in the transmission water shall be maintained in a range of preset target value.
In the iron manganese removal plant with contact filtration system, free chlorine residual in the outlet water from the filter shall be kept in the range of 0.5-1.0 mg/l.
Additional chlorine is dosed in the filtered water as post-chlorination depend on measured free chlorine residual in the filtered water and target free chlorine residual of the network water.
Post-chlorination dosing rate is varied by filtered water quality.



Note: "Process water" is also used as general word for the water flowing in the Plant.

2. Criteria for operation

2-1.For the pre-chlorination

Free chlorine residual for filtered water: 0.5 mg/l or more and less than 1.5 mg/l
Free chlorine residual for inlet water for the filter: 1.0 mg/l or more and less than 2.0 mg/l
Dosing flow rate for pre-chlorination shall be changed at the same time when the well water flow rate is changed

2-2.For the post-chlorination

Free chlorine residual for the filtered water for transmission: 1.5 mg/l or more and less than 2.0 mg/l
Free chlorine residual for distributed final tap: 0.5 mg/l or more and less than 1.5 mg/l
Dosing flow rate for post-chlorination shall be changed at the same time when the water flow rate of the filter pump is changed

3. Operation under normal condition

Basically, operation procedures for facility such as chlorinator shall be kept strictly according to manufacturers recommendations in instruction manuals.

3-1.Common notice for operation of chlorination facility

3-1-1. Early detection and rapid response to chlorine leak accidents is a corrective action of chlorine leak. It is a very important action for operation of chlorination facility.
And we shall be carry out check of chlorine leakage about all of chlorine piping and valves, cylinders also opening and close of valve in chlorine line piping.

3-1-2. Close all doors in chlorination house to avoid diffusing leaked chlorine to outside of chlorination house.

3-1-3. Knowledge and skills on handling of chlorine and chlorination facility are required for persons to handle chlorination facility.
Persons to operate chlorination facility shall be be trained on chlorine, chlorination facility and handling skills on them.

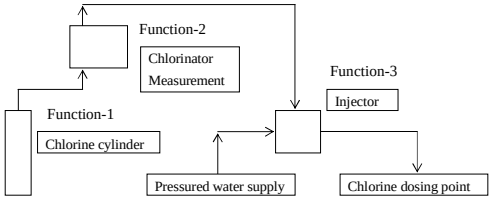
3-1-4. Periodical practice on activity in emergency situation

Emergency case means situation of accident with severe chlorine leak.
Under emergency situation, we shall be act immediately according to prepared action plan and program. Safety devices and tools shall be be provided and maintained and kept in proper condition to use any time. And they shall be stored in the room without chorine such as chlorine neutralization room.

3-1-5. No smoking in the room of chlorination house

3-2. Start-up and shut-down procedures

3-2-1.Facility component of the chlorination equipment
The chlorination equipment consists of 3 main component init as following;
-1.Chlorine cylinder
-2.Injector and chlorinator
-3.Pipes and valves
Chlorine gas is taken out from chlorine cylinder and the gas is sucked with negative pressure by the injector. The sucked chlorine gas can be measured and the chlorine dosing flow rate is controlled by the chlorinator. Controlled and measured chlorine gas is sucked by the injector and sucked chlorine gas is mixed with the water supplied into the injector and mixed chlorine water is dosed into the dosing point. Functions for the chlorination equipment are following;
Function-1: Supplying of chlorine gas with positive pressure
Function-2: Measuring and control of dosed chlorine
Function-3:.Making of chlorine water and feeding of chlorine water with pressurized water
Even if one of the above 3 shall not be functioned, function of the chlorination shall be stopped.



3-2-2.Start up procedures
Procedures for start up of chlorinator shall be according the instruction manual issued by a manufacturer of the chlorinator as follows.

-1. Connect a lead tube with chlorine cylinder and manifold inlet valve
-2. Feed the pressured water into the injector
-3. Confirm the arising of negative pressure in the chlorinator
-4. Flow rate of chlorine shall be set at zero in the chlorinator
-5. Open slightly outlet valve of chlorine in the chlorinator
-6. Check a close of inlet and outlet valves for chlorine gas manifold
-7. Check the connection parts of the lead tube and tighten a cover nut
-8. Open the master valve for cylinder and close it immediately.
-9. Check no leak around connection parts of lead tube from cylinder to manifold
-10. Leak check shall be conducted by use of ammonia solution water.
-11. After confirmation of above, open the outlet valve for manifold and check no leak of chlorine around connection part of the chlorinator.
-12. Confirm the flow rate of chlorine gas is zero in the chlorinator.
-13. Open the master valve for cylinder gradually and open it fully.
Master valve for cylinder shall be opened fully when it needs to be opened.
Check again the connection parts of chlorine gas line for leaks.
Sealing characteristic of master valve for cylinder shall be effective in a condition of opened fully.
-14. Adjust the flow rate of chlorine gas of the chlorinator to needed dosing flow rate. Flow rate of chlorine gas can be confirmed by flow meter in the chlorinator.
-15. After 30 minutes of above adjustment, confirm a condition of flow rate that it shall be kept in needed value.

Key points for start up procedures are as follows;
☆ Chlorine gas feeding into the tube or pipe from cylinder shall be conducted step by steps.
- Check for leaks of chlorine gas shall be done by as small amount chlorine gas as possible at the first step.
- Check for leaks from cylinder to connection part and to manifold one by one. Do not feed the gas at a time into whole pipe line and facilities.

☆ Negative pressure shall be arisen from injector prior to feed chlorine gas into the manifold and the chlorinator.
☆ Required chlorine dosing rate shall be grasped prior to start up the chlorinator. Chlorine dosing flow rate is calculated by following formula;
Chlorine dosing rate: R (mg/l)
Chlorine dosing flow rate: W (kg/h)
Flow rate of the process water: Q (m3/h)
W = Q * R * 1/1000 -------- (kg/h)

3-2-3.Shut down procedures
Cases of shut down
- Periodic shut down
- Long term shut down
-Changing cylinders

Procedures for shut down of chlorinator for above shall be according as the instruction manual issued by a manufacturer of the chlorinator.

Procedures are shown in the following for reference.
-1. Close the master valve for cylinder and keep this condition for several minutes. Confirm indication of a pressure in the manifold is zero.
Keep this condition for 10 minutes or more.
-2. Check for leaks of chlorine gas from cylinder and pipe connection parts.
-3. Close the inlet valve of chlorine gas to the injector.
-4. Stop the water supply to the injector. At first close a inlet valve for the injector and then close a outlet valve for the injector.
Regarding of actions for long term stopping of the facilities, refer to the instruction manual issued by a manufacturer of the chlorinator.

Key points for shut down procedures are following;
☆ To avoid water flowing into the chlorinator, be sure the procedures from-3 to -4 in above mentions.
☆ The often cause of trouble of the chlorinator is backward flow of the water into the chlorinator.

3-3.Monitoring and visual check of facility

Monitoring and visual check during operation shall be conducted according to the check list.

3-4 Operation procedures for control of facility

Dosing flow rate of chlorine shall be controlled by the chlorinator.
3-4-1.Pre-chlorination
Dosing flow rate of pre-chlorination shall be changed depend on the following;
- Quality of the well water
- Chlorine demand of the well water
- Quality of the outlet water from oxidation tower
- Chlorine demand of the outlet water from oxidation tower

Consumed quantity is varied in characteristics of contained substances.
Contained substance (as 1 mg/l) Consumed chlorine (mg/l)

Iron	0.635
Manganese	1.29
Ammonia	7.6

Required dosing rate of pre-chlorine shall be determined based on laboratory test of chlorine demand for the sampling water from a process. Determination procedures of dosing rate are shown in KFR-FMRP07-QC.

3-4-2.Post-chlorination

Dosing flow rate of post-chlorination shall be changed depend on following;

- Free chlorine residual of the filtered water
- Required free chlorine residual for the network water
- Flow rate of the filtered water

4. Operation under unusual condition

4-1 Prospect troubles and trouble shootings

4-1-1.Chlorinator

Troubleshooting chart of the chlorinator shall be according as the instruction manual issued by a manufacturer of the chlorinator.

Examples of prospect trouble for reference are as follows;

-1.Gas leak
-2.The required gas feed rate is not achieved at start-up
-3.Out-of-gas indications occurs during normal operation
-4.Insufficient ejector vacuum
-5.Loss of gas feed
-6.Flowmeter ball bounced and/or maximum gas feed rate cannot be achieved during normal operation
-7.Flooded metering tube
-8.Vacuum leaks

Probable causes and corrective actions for above are shown in troubleshooting chart KFR-FMR07-OPTS-01.

4-1-2.Piping and valves

-1.Gas leak from
-Lead tube
-Connection part
-Valves

4-1-3.The chlorination process

-1.Insufficient free chlorine residual in the filtered water
-2. Insufficient free chlorine residual in the inlet water for the filter

Probable causes and corrective actions for above are shown in troubleshooting chart KFR-FMR07-OPTS-02.

Important Note

Insufficient free chlorine residual in the filtered water is caused to severe damage of oxidation filter sand in the filter tank. When detected this condition, cause of this condition shall be found immediately and corrective action shall be done. Detail information for above is shown in KFR-FMRP07-QC.

5. Report and record

5-1.Resord

5-1-1.Records for operation condition

-1.Chlorine gas feed
- Pressure gauge indication of chlorine gas feed for the chlorine gas manifold
- Line-1 for pre-chlorination, Line-2 for post-chlorination

-2.Records for the chlorinator
- Pre-chlorine dosing flow rate
- Post-chlorinator dosing flow rate
- Water supply pressure fed to the chlorinator

-3.Indication of chlorine gas leak detector
-4.Visual check list in a routine work

5-2.Report

Reports are required as shown in the following;

5-2-1.Consumption tendency of the chlorine
- Weight of chlorine used each 24-hour period during a month
- Total weight of chlorine used for a month
- Average weight of chlorine dosed during a 24-hour period for a month
- Maximum weight of chlorine used during any 24-hour period during a month
- Minimum weight of chlorine used during any 24-hour period during a month

5-2-2. Recommendation on facility
- Rehabilitation and upgrading
- Repairing
- Replacement
- Repainting
- Additional parts or facilities

- Required spare parts
- Recommendation on modification of the criteria
- Recommendation on training for persons
- Recommendation on review of O&M plan

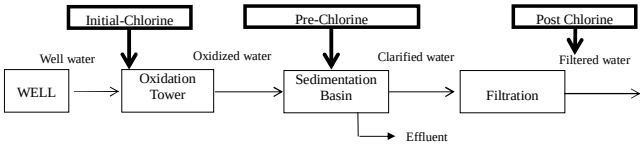
Rev.	Version	Revised Date	Description of revision
0	Original Version		

Plant Name:	Title	SOP TAG No.
Kafr Farag FMRP	**Chlorination Facility**	**KFR-FMR07-QC**

Issued	13/Nov./07	Developed by		Signature	
Revised		Approved by		Signature	

Introduction

In iron and manganese removal plant, iron and manganese in the well water is removed by an oxidation, sedimentation and filtration treatment process.
Process flow of the Kafr Farag iron and manganese removal plant is as shown below;



Note: “Process water” is also used as general word for the water flowing in the Plant.

1. Potable Water Standards

Maximum allowable limit value of iron and manganese contained in the potable water are limited by new and previous Egyptian standards as follows;

Iron: 0.3 mg/l (1.0 mg/l for ground water by the previous standard)
Manganese: 0.4 mg/l (0.5 mg/l for ground water by the previous standard)

Color of water is also limited by new and previous Egyptian standards as follows;

Color: Nil (20-30 as a maximum limit using platinum cobalt by the previous standard)

The water contained manganese is colored result of oxidation by chlorination and colored degree of above is approx. 300 times as much as manganese contained concentration. If concentration of 0.5 mg/l manganese is contained in the water, color of the water is 150 after oxidation by chlorination. Hence, manganese in the filtered water shall be controlled less than 0.1 mg/l actually.

The functions of the chlorination consist of 2 kinds as follows;

-1.Oxidation
-2.Disinfection

Both functions are essential for the plant. Especially function of the oxidation shall be controlled securely in a routine work of the water quality control activity.

The oxidation treatment is performed by 3 steps.
-1st step: Aeration in the oxidation tower for oxidation of iron
-2nd step: Pre-chlorination in the sedimentation basin for oxidation iron
-3rd step: Contact oxidation in the filter by oxidation filter media for oxidation of manganese

pH value of the well water is around 7.8 in this plant.
The 1st step oxidation process of iron by the aeration is insufficient to remove in condition of low pH as 8.5 or below.
Hence, pre-chlorination shall be needed as 2nd oxidation process in this plant.
The 3rd step of oxidation is performed by contact oxidation filtration in the filter for oxidation of manganese. Free chlorine residual in the inlet water for the filter shall be needed to keep an oxidation potential of filter media in activated condition.
Disinfection treatment is final treatment process before transmission of the potable water in this plant. Chlorine residual measurement shall be done on the distribution system at the area farthest from the source of the water treatment plant. This ensures that the entire distribution system is receiving enough chlorine.

2. Monitoring Frequencies

2.1 Frequency of water quality analysis
- -The well water: Once in 6 months
- The outlet water from oxidation tower: Once in 6 months
- The inlet water to the filter: Once in 6 months
- Measurement of free chlorine residual: Twice a day
- The filtered water: Once a day
- Measurement of free chlorine residual: Twice a day
- Measurement of iron and manganese: Once a day
- Distributed water at the farthest tap in the network: Once a day

2.2 Frequency of chlorine demand test
- For the well water: Once in 6 months
- For the outlet water from oxidation tower: Once in 6 months

3. Water quality control under normal condition

3-1.Monitoring of the well water

3-1-1.Laboratory test of chlorine demand

Chlorine demand test shall be conducted according to a standard procedure in SHAPWASCO including sampling procedures.

- Water quality analysis
  - Iron
  - Manganese
  - Ammonia
  - pH
  - Other items as needed

3-1-2. Determination of the dosing rate of the pre-chlorine

Dosing rate of the pre-chlorine shall be determined based on water quality of the well water and prospect free chlorine residual in the filtered water.

Dosed chlorine is consumed by consumed substances in the well water such as iron, manganese, ammonia and organics. And consumed amount is varied contained amount of above substances and water condition such as a water temperature, an air temperature and so.
Consumed amount is varied in characteristics of contained substances.
Typical examples of theoretical consumed amount of chlorine are following;

Contained substance (as 1 mg/l)	Consumed chlorine (mg/l)
Iron	0.635
Manganese	1.29
Ammonia	7.6

Required dosing rate of pre-chlorine shall be determined based on laboratory test of chlorine demand for the sampling water from a process.

Free chlorine residual in the filtered water shall be controlled in a range of 0.5-1.0 mg/l.
Activation potential of filter media for contact oxidation filtration is affected by concentration of free chlorine residual in the inlet water to the filter.
If free chlorine residual in the filtered water is less than 0.5 mg/l, coating layer of oxidation sand is damaged and removal potential of the contact filter is reduced.

Determination procedures of dosing rate are shown in flow chart KFR-FMR07-QCFC01.

3-2.Determination of the dosing point of the pre-chlorine

Two pre-chlorination dosing pipes are prepared in this plant. One is dosed in inlet water and another is dosed in outlet water in the oxidation tower.

Contained ammonia in the well water also oxidized by the aeration and the pre-chlorination. Duration time for the oxidation reaction of ammonia by pre-chlorination shall be needed for 40 minutes or more but detention time for the oxidation of ammonia in the sedimentation basin is approx. 30 minutes or less.

Ammonia shall be be oxidized prior to the filtration process to maintain free chlorine residual of filtered water in the required value.
Hence, when ammonia is contained in the well water, the pre-chlorination shall be dosed in the well water prior to the oxidation tower to oxidize ammonia.

Hence, proper dosing point shall be chosen depend on water analysis result of the well water on ammonia contained.

Dosing point	Contained ammonia (mg/l)
Outlet of the oxidation tower	0.1 or less
Inlet of the oxidation tower	More than above

3-3.Monitoring of the outlet water from the oxidation tower

- Laboratory test of chlorine demand

Iron removal amount is monitored in the first step of oxidation process as aeration. Dosing rate of pre-chlorine is expected by a result of chlorine demand for the outlet water from the oxidation tower.
Removal efficiency by the aeration treatment is changed slightly through a season. If quality of the well water is not changed, this chlorine demand value is changed slightly.
This value can be realized depend on the operation record in the past.
The operation record in the past shall be collected and kept, and utilized to determination of dosing rate of pre-chlorine.

3-4. Monitoring of the outlet water from the sedimentation basin

- Water quality analysis
  - Iron
  - Manganese
  - Ammonia
  - Free chlorine residual
  - Total chlorine residual
  - pH
  - Other items as needed

The outlet water from sedimentation basin is fed into the filter.
This water is inlet water for the filter and affects to the water quality of the filtered water directly.

Free chlorine residual in this water is a key factor of the filtering treatment by contact oxidation system. Insufficient concentration of residual chlorine causes to severe damage of oxidation filter media and poor quality of the filtered water.

3-5. Monitoring of the filtered water and pre-filtered drain water

- Iron
- Manganese
- Ammonia
- Color
- Turbidity
- Free chlorine residual
- Total chlorine residual
- pH
- Other items as needed

Pre-filter shall be done after backwashing and before filtering of the filter.
The functions of the pre-filtering are as follows;
-1.Initial drain of waste water after backwashing before filtering shall be confirmed by measurement result of turbidity of the pre-filtered drain water.
Turbidity of the pre-filtered drain water: 5 NTU or less
-2.Re-activation of filter media of oxidation sand in the filter tank shall be confirmed by measurement result of free chlorine residual in the pre-filtered drain water.
Free chlorine residual in the pre-filtered drain water: 0.5 mg/l or more

Monitoring of filtered water quality shall be conducted with standard frequency in a routine monitoring according to the criteria.
Free chlorine residual in the filtered water: 0.5 mg/l or more
Iron contained in the filtered water: 1.0 mg/l or less
Manganese contained in the filtered water: 0.1 mg/l or less
Other substances contained in the filtered water: Less than Egyptian standard

3-6. Monitoring of the distributed water at the farthest tap in the network

- Iron

- Manganese
- Ammonia
- Color
- Turbidity
- Free chlorine residual
- Total chlorine residual
- pH
- Bacteria and coliforms
- Other items as needed

Free chlorine residual in the distribution water is consumed during a distribution of the water in the network. Consumed amount of chlorine is varied a condition in the network such as contamination, water temperature, condition of network pipe lines and so.

And the outlet water from the plant is mixed with the water from the well stations in the network.

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Free chlorine residual in the distributed water shall be maintained at least 0.2 mg/l to 0.5 mg/l at a point of the farthest tap in the network.

If combined chlorine residual is being used for chlorination, the residual shall be 1 to 2 mg/l.

3-7.Control of the pre-chlorine dosing rate

As mentioned in 3-1-2, this is realized by applying the followings;

-1.Set a target for the filtered water
-2.Set a target for the inlet water of the filter
-3.Confirm a water quality of the well water
-4.Presume a consumed chlorine in the process
-5.Set a chlorine dosing rate of the pre-chlorine
-6.Confirm the flow rate of the well water
-7.Set a chlorine dosing flow rate of the pre-chlorine by the chlorinator
-8.Monitor a free chlorine residual in the water
- The inlet water of the filter
- The filtered water

-9.Compare a monitored date with the targets
-10.Determin that chlorine dosing rate shall be changed or not
-11.If a chlorine dosing rate shall be changed, change a dosing flow rate by operation of the pre-chlorinator to be increase or decrease
-12. Monitor a free chlorine residual in the water
- The inlet water of the filter
- The filtered water

-13.Compare a monitored date with the targets
-14.Determin that chlorine dosing rate shall be changed or not
-15.Repeat from control actions 11 to 14 in the routine work

3-8.Control of the post-chlorine dosing rate

Free chlorine residual in the filtered water shall be monitored and post-chlorine shall be dosed depend on a target of free chlorine residual in the outlet water from a treatment plant. A target of free chlorine residual in the outlet water from a treatment plant shall be presumed based on the measured records of the free chlorine residual in the distributed water at a point of the farthest tap in the network.

The free chlorine residual in the distributed water at a point of the farthest tap in the network shall be measured periodically according to the frequency of the criteria.

The control action of free chlorine residual shall be done by following activities;

-1.Set a target for the distributed water at a point of the farthest tap in the network
-2.Confirm the well water connected with the network
- Numbers of the well stations
- Free residual chlorine from each well station
- Flow rate of the distribution water from each well station

-3.Set a target for the filtered water
-4.Presume consumed chlorine in the process
-5.Set a chlorine dosing rate of the post-chlorine
-6.Confirm the flow rate of the filtered water (inlet water to the filter)
-7.Set a chlorine dosing flow rate of the post-chlorine by the chlorinator
-8.Monitor a free chlorine residual in the water
- The filtered water
- The distributed water at a point of the farthest tap in the network

-9.Compare a monitored date with the targets
-10.Determin that chlorine dosing rate shall be changed or not
-11.If a chlorine dosing rate shall be changed, change a dosing flow rate by operation of the post-chlorinator to be increase or decrease
-12. Monitor a free chlorine residual in the water
- The filtered water
- The distributed water at a point of the farthest tap in the network

-13.Compare a monitored date with the targets
-14.Determin that chlorine dosing rate shall be changed or not

-15.Repeat from control actions 11 to 14 in the routine work

3-9.Visual check of operation condition

Operation condition of the chlorination facilities and the treatment process shall be checked in the routine work to confirm proper operation of the facilities.

4. Operation under unusual condition

4-1 Prospect troubles and trouble shootings

4-1-1.The chlorination process
-1.Insufficient free chlorine residual in the filtered water
-2. Insufficient free chlorine residual in the inlet water for the filter
-3.Unusual colored water
- The water in the sedimentation water
- The filtered water
- The distribution water in the network

5. Report and record

5-1.Record

5-1-1.Records for water quality
-1.Water quality analysis result
- The well water
- Outlet water from the oxidation tower
- Inlet water to the filter
- The filtered water
- The distributed water (Outlet water from the plant)
- The distributed water at a point of the farthest tap in the network

-2.Records for the chlorinator
- Pre-chlorine dosing rate and dosing flow rate
- Post-chlorinator dosing rate and dosing flow rate

-3.Visual check list in a routine work

5-2.Report

Reports are required as shown in the following;

5-2-1.Consumption tendency of the chlorine
- In the sedimentation process
- In the filtering process
- In the network

5-2-2.Contamination of the wells
- Changing tendency of the well water

5-2-3. Recommendation on facility
- Rehabilitation
  - Repairing
  - Replacement
  - Additional facility
- Recommendation on modification of the criteria
- Recommendation on training for persons
- Recommendation on review of O&M plan

Rev.	Version	Revised Date	Description of revision
0	Original Version		

BIL-BPS00-OV	Revised version	Issued date	Page 1of 7

Plant Name: **Bilbeis BPS**	Title **Overview for Bilbeis Booster Pump Station**	SOP TAG No. **BIL-BPS00-OV**

Issued		Developed by		Signature	
Revised		Approved by		Signature	

SOP for Bilbeis BPS

1. General information of the plant

1-1.General information

1-1-1. Location

Bilbeis Booster Pump Station (BIL-BPS) is Located at 30°24' 27.6" North and 31°33'37.5" East. And 14m higher than Sea level

1-1-2. Construction Phases

Bilbeis Booster Pump Station constructed in 2004, with 300 l/s designed capacity, but it still operate lower than this capacity with 200l/s operation capacity.

1-1-3. Outline of the station

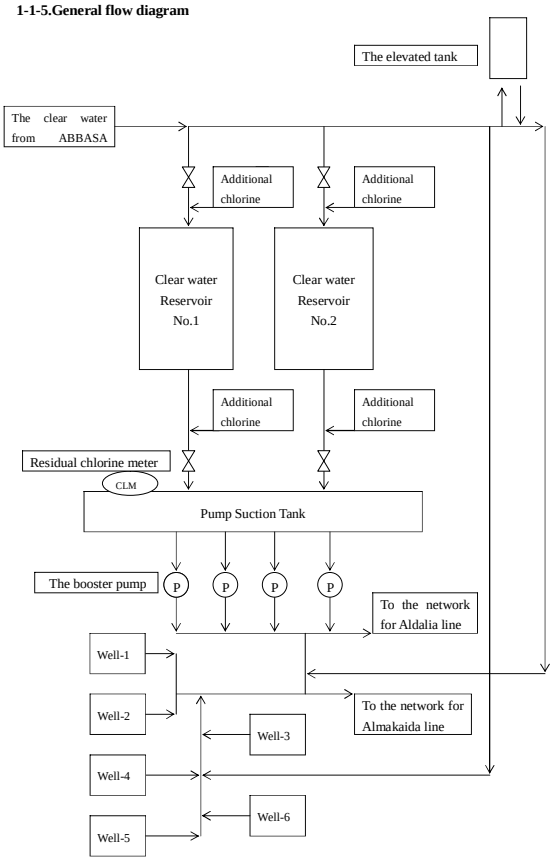
There are two trunk main pipes out of this plant with 300mm diameter, one of them in Bilbeis agriculture road (El Mekaida) and the other pipe in Soltani road –Adlia El Khalfi

- 1-1-4.General layout

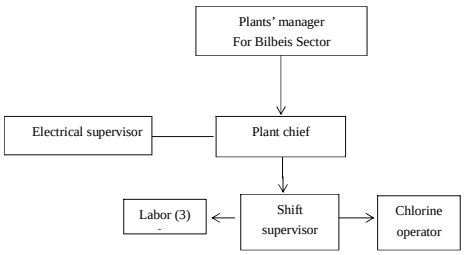
Satellite image

General layout

1-1-5.General flow diagram



1-1-6.Organization and staff formation



2. Components of process and facility with relation to water treatment plant

There are relations and connections between unit processes in booster pump station (abbreviate as BPS) process and facilities in each unit process, and further more water treatment plant (abbreviate as WTP) with respect to the quantity of water transmitted to the Booster from Abbasa WTP in addition to the local water out of the wells and also the quality of such water and how to keep it safe for users .

2-1 Components of unit process

Three unit processes are provided in Bilbeis BPS as following;

1-.The receiving and store process for the clear water from WTP

2-The additional chlorine dosing process

3-The water transmission process by the booster pump

2-2 Components of facility in each process

Components of facility in unit process are following;

1-2-2. The receiving and store process for the clear water from WTP

This process includes following;

- The clear water reservoir

2-2-2.Additionalchlorine dosing process

This process includes pre-chlorine and post-chlorine facility as following;

- Chlorine storage facility
- Chlorine gas piping and valve
- Chlorinator

- Chlorine leakage detector
- Chlorine gas neutralization system

3-2-2. The water transmission process by the booster pump

This process includes following;

- The booster pump suction tank
- The booster pump

3-2.Basic system on facility operating and process control

1-3-2.Basic system on unit process control

- Process control: All unit processes are controlled manually
- Water quality control

Water quality analyses should be carried out periodically by hand working by chemists. Free residual chlorine in the transmission water is monitoring continuously by monitoring instrument of free residual chlorine meter.

2-3-2.System description

1-.Basic system

Operation of facility

- Start and stop of the well pump will be operated manually
- Control of process: Manual control for all process
- Monitoring of water quality: Refer to above mentions

2-System of each process

- The receiving and store process for the clear water from ABBASA WTP
  - Receiving quantity of the water from WTP is not controlled.
  - Level meter for the reservoir is not available.
- The water transmission process by the booster pump
  - four pumps are available in the station. Two of four are small capacity pumps. 1 pump uses for duty another for stand-by. Another two pumps are large capacity pumps. 1 pump uses for duty another for stand-by.
  - Transmission quantity is controlled by change of working number of the pump.
  - Six wells are available near the BPS and discharge from wells is connected to discharge pipe from the booster pump.
  - Transmission water is distributed to two network lines.

3- Additional Chlorine dosage process

- Store of chlorine: 1 ton container
- The chlorinator :2 chlorinators are available one will be used for duty and another for stand by.
- Type of chlorinator: Injector vacuum type
- Type of operation: Manual operation
- Type of dosing flow rate control: Manual control. Dosing points for additional chlorine are available.

  -1st dosing point: Inlet pipe of the clear water reservoir

  -2nd dosing point: Outlet pipe of the clear water reservoir
- Chlorine will be dosed in case of insufficient of free residual chlorine in the outlet water from the clear water reservoir before transmission.

3. Overview of the SOPs of the Plant

1-3.Purpose of SOPs

Purpose of SOPs is to provide assistance to the water supplier in the operation & maintenance (O&M) and water quality control (WQC) procedures for each facility or process in water treatment plant.

2-3.Application of SOPs

SOPs should be applied to actual O&M and WQC, securely.

3-3.Component of SOPs

SOPs for BPS provides Nine SOPs component units and these components are shown in "SOPs Headline".
Each SOP consists of Three SOPs packages as following;

- SOPs for operation
- SOPs for maintenance
- SOPs for water quality control

3-3-1.SOPs for Operation

Documents on which required criteria and procedures for operation and control activities of facility, are provided in this SOPs and includes as following;

- Explanation of process and relation between other process
- Criteria for operation activity and design
- Operation and control procedures for facility in normal condition and unusual condition

- Monitoring and visual check items for facility
- Reporting and record system

3-3-2.SOPs for Maintenance

Documents on which required criteria and procedures for maintenance activities of facility, are provided in this SOPs and includes as following;

- Criteria for maintenance activity
- Maintenance procedures for facility in normal condition and unusual condition
- Monitoring and visual check items for facility
- Reporting and record system

3-3-3.SOPs for Water Quality Control

Documents on which required criteria and procedures for water quality control and process control, are provided in this SOPs and includes as following;

- Criteria for water quality control activity
- Water quality control and process control procedures in normal condition and unusual condition
- Monitoring and visual check items for water quality and process
- Reporting and record system

3-4.Review of SOPs and O&M plan

SOPs is one of tools to perform optimum O&M and WQC activities and results and as the result to improve management of water treatment plant operation.
We can realize and find in our O&M activities should be modified or arranged for improvement such as: to be more simple, effective or suitable method, by utilizing of SOPs.
When we find part to be modified or arranged for improvement in SOPs, we should approach to review SOPs to be proper according to prepared procedures, as soon as possible if necessary.

3-4-1 Review of O&M and WQC activities

Review of SOPs should be carried out periodically not less than once a year and properly if necessary. After review of SOPs, SOPs should be updated to revised version.

Records of SOPs review and histories of review must be required to issue and keep them. Records of review should includes following;

- Activities before review and after review and reviewed reasons
- Signatures of approved persons, date of review
- Results of review
- Marking of reviewed part and description of reviewed histories in revised SOPs documents

3-5.Preparation for making of O&M plan

O&M plan is developed to provide a material that can be easily referred to as guidance in the operating of the water system.

The O&M plan will also provide ready reference for following;

- All equipment data which is necessary for performing normal maintenance
- Ordering replacement parts and supplies
- Organized system for keeping records of O&M of the system
- Water sampling, analysis and testing which required for compliance with regulations
- Information regarding start-up and normal operating procedures and emergency operating procedures

O&M plan will become a training manual to provide personnel with handy source reference while they learn to operate the facilities.
The experienced operator will usually refer to the O&M plan for confirmation of normal operation and maintenance procedures and as a reference guide for unusual operating conditions. The entry level operator should frequently refer to the O&M plan for guidance and instruction.

Plant Name: BILBEIS BPS	Title: Clear water Reservoir	SOP TAG No. BIL-BPS01-OP

Issued		Developed by		Signature	
Revised		Approved by		Signature	

Introduction

Clear water reservoir (ground reservoir) in BPS is the basin to receive the clear water from WTP, to store the treated clear water and to keep it clean.
The water from Abbasa WTP is led into the clear water reservoir through the transmission water pipe after post-chlorine dose in WTP.

The water in the reservoir is final treated water in the plant. Hence, the water in the clear water reservoir must be kept it clean.

Activity of water quality control is the most important event in operation of the clear water reservoir, especially monitoring of free residual chlorine must be conducted by suitable frequency.

Operation about the clear water reservoir consists of valve operation and monitoring check.
And also cleaning of inside of reservoir
Main activity of operation for the reservoir will be monitoring and visual check.

1. Features of process

1-1.Function of process

- To receive the purified clear water
- To store the purified clear water
- To contact post-chlorine with filtered water
- To keep the purified clear water clean and safety

1-2.Impacts of process

In the clear water reservoir, the water should be finished for purification process to the potable water after dosing of post-chlorination and, mixing and contacting of post-chorine with filtered water.
The water in the clear water reservoir in BPS is real potable water. Hence, the water must be cleaned and safety condition. Any contamination is never accepted.

1-3.Relations between other processes

The water in the clear water reservoir in BPS is real potable water. Hence, the water must be cleaned and safety condition. Any contamination is never accepted.

1-3-1. Transmission process
Post-chlorine is dosed into the filtered water in previous step of the clear water reservoir in WTP and free chlorine residual is adjusted to the target of free chlorine residual of the end of transmission destination such as BPS, and that is final control of free chlorine residual.
1-3-2.Additional post chlorine dosage process
Free chlorine residual may be reduced in transmission pipe and it should be monitored and additional chlorine must be dosed when it will be insufficient to supply as drinking water.

2. Criteria for operation

2-1.Frequency of water analysis for turbidity, free chlorine residual and pH

: Frequency of each 2 hours in a day or more

2-2. Frequency of monitoring and visual check

- To prevent from contamination-
: Twice a day or more

2-3.Water level

: To keep water level in ----m and ----m

2-4.Quality of the water in the clear water reservoir

: To keep the quality of the water in the clear water reservoir good enough compared with Egyptian potable water standard, these values and limits have to be recognized.
- Free chlorine residual of inlet and outlet water of the clear water reservoir
  Inlet: 1.5 mg/l or more and less than 2.5 mg/l
  Outlet: 1.0 mg/l or more and less than 2.0 mg/l
- Turbidity of inlet water of the clear water reservoir
  Inlet and outlet: 0.5 NTU or less

2-5.Frequency of cleaning inside of the reservoir

: Once a years or as needed

3. Operation under normal condition

3-1.Start-up and shut-down procedures

Operations regarding the clear water reservoir will be as follows;

3-1-1.Operation of valves of inlet and outlet of the clear water reservoir
3-1-2.Drain out the water in the clear water reservoir
3-1-3.Cleaning inside of the clear water reservoir
3-1-4.Drain out the waste water by cleaning
3-1-5.Leading of the clear water into the clear water reservoir
3-1-6.Disinfection inside of the clear water reservoir

Procedures for above are shown in flow chart of BIL-BPS01-OPFC-01.

3-2.Monitoring and visual check

There are 2 kinds of monitoring and visual check of the clear water reservoir
3-2-1.Routine monitoring and check
3-2-2.Monitoring and check during operation

The monitoring and check list is provided in BIL-BPS01-OPSC-01.

3-3 Operation for control

No equipment exist for control of the clear water reservoir, quality, quantity or water level are the only items to be controlled
The water quality and water level of the clear water reservoir should be controlled by the operation of other facilities in the previous processes such as flow rate of receiving and booster pump facility.

The control of the water quality should be described in BIL-BPS01-OPFC-02.
Water level in the clear water reservoir will be changed by consumption in the network and inside of the station, and quantity of treated water.

4. Operation under unusual condition

4-1 Prospect troubles and trouble shootings

Trouble shooting for the clear water reservoir is provided in BIL-BPS-OPTS-01.

5. Report and record

5-1.Record

Records for operation of the clear water reservoir should be required as follows;

5-1-1.Record of monitoring and visual check
5-1-2.Record of water level in the clear water reservoir

5-2.Report

Reports for operation of the clear water reservoir should be required as follows;

5-2-1.Recomendation
- Upgrading or rehabilitation of facility
- Modification and arrangement
- Repairing and replace
- Additional of facility
- Review of criteria
- Review of procedures for operation and control

Plant Name: BILBEIS BPS	Title: Clear Water Reservoir	SOP TAG No. BIL-BPS01-MT

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Introduction

Maintenance of the clear water reservoir will be as the concrete basin of the clear water reservoir, attached valves with the clear water reservoir, water level indicators and inlet, outlet and overflow pipes.
These facilities are static and not confirmed by visual check in a routine work.
The clear water reservoir is important facilities to keep the water quality. Hence facilities must be maintained by periodical inspection. It will be found to need for recovery such as water leak or crack of basin, rapid action for recovery should be needed.

It had better that the activity of the inspection and cleaning of the clear water reservoir will be carried out in a season of small amount consumption in the network such as a winter season. In the activity of inspection and cleaning, the capacity for the clear water for storage should be reduced. So the activity should be conducted in a short period as possible according to the planed procedures.

The attached valves with the clear water reservoir will be not necessary to operate usually. Under this situation if these valves will not be operated for a long period, these valves will be damaged by corrosion of metal part. Hence periodical operation and supplying of grease should be needed for the valve.

1. Criteria for maintenance

1-1. Frequency of monitoring and visual check
- To prevent from contamination-
: Twice a day or more

1-2.Periodical operation of the valve
: Once a month

1-3.Frequency of cleaning and inspection inside of the reservoir
: Once a year or as needed

2. Maintenance activity

Monitoring, check and inspection should be carried out to judge necessity of recovering

activity such as adjustment, repairing or replacing.

Maintenance activity consists of 4 kinds of working as following;
-1.Monitoring and checking work during working
-2.Inspection
-3.Evaluate and analysis regarding result of inspection
-4.Recovery after the inspection

2-1.Monitoring and visual check

Monitoring and visual check should be carried out according to “O&M schedule” and unified check list

2-2.Inspection

Inspection should be carried out according to “O&M schedule” and unified check list.

2-3. Evaluate and analysis regarding inspection result

After inspection following items should be evaluated;
- Waste of the inside
- Operation of the valve
- Crack of the basin
- Leak of the water from outside

2-4. Recovery after the inspection

After the inspection recovery action should be conducted as following;
1- Waste of the inside
- Cleaning of inside of the basin
- Disinfection inside after cleaning

2- Operation of the valve
- Supplying the grease as needed
- Change of part as needed
- Replace the valve as needed or periodically

3- Crack of the basin
- Repairing

4- Leak of the water from outside
- Repairing

3. Report and record

3-1.Record

Record for maintenance of the clear water reservoir should be required as follows;
3-1-1.Record of monitoring and check
3-1-2.Record of inspection
3-1-3.Record of recovery
3-1-4.Record of disinfection

3-2.Report

Report for maintenance of the clear water reservoir should be required as follows;
3-2-1.Recommendation
- Review of the criteria
- Review of procedures
- Replace and rehabilitation

3-2-2. Annual report

Plant Name: BILBEIS BPS	Title: Clear Water Reservoir	SOP TAG No. BIL-BPS01-QC

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1. Criteria for water quality control

1-1.Frequency of water analysis
Frequency of water analysis should be based on standard of Holding Company.
- Turbidity, free chlorine residual and pH
: Frequency of each 2 hours in a day or more
- Other water quality
: Once a day

1-2. Frequency of monitoring and visual check
: Twice a day or more

1-3.Quality of the water in the clear water reservoir

To keep the quality of the water in the clear water reservoir in good enough compared with Egyptian potable water standard
Especially following water quality should be required SHAPWASCO’s own limit.
- Free chlorine residual of inlet and outlet water of the clear water reservoir
Inlet: 2.5 mg/l or more and less than 3.0 mg/l
Outlet: 1.5 mg/l or more and less than 2.5 mg/l
- Turbidity of inlet water of the clear water reservoir
Inlet and outlet: 0.2 NTU or less
- Aluminum content for the inlet water of the clear reservoir
Inlet and outlet water : 0.15mgm/l or less

1-4.Frequency of cleaning inside of the reservoir
: Once a years or as needed

2. Operation under normal condition

2-1.Start-up and shut-down procedures

Water quality control regarding the clear water reservoir will be as follows;

2-1-1.The water quality analysis of turbidity, chlorine residual, pH

2-1-2.Disinfection inside of the clear water reservoir

2-2.Monitoring and visual check

Monitoring and visual check of the clear water reservoir should be provided 2 kinds.
2-2-1.Routine monitoring and check
2-2-2.Monitorring and check in the operation

The monitoring and check list is provided in BIL-BPS01-QCSC-01.

2-3 Operation for water quality control

The water quality and water level of the clear water reservoir should be controlled by the operation of other facilities in the previous processes such as chlorination .

Control of free chlorine residual should be conducted by control of additional chlorination dosing if necessary. Control of additional chlorination is based on measurement result of free chlorine residual at inlet and outlet point of the clear water reservoir.

Consumption of free chlorine residual will be small amount that in the water through the transmission pipe from WTP to the clear water reservoir in BPS, and in the clear water reservoir.
Hence, almost of dosed additional chlorine will be added as free chlorine residual.
And difference of free chlorine residual at inlet and outlet in the clear water reservoir, that is full covered basin, will be small amount. If big difference of free chlorine residual from inlet and outlet such as reduction of 0.3-0.5mg/l will be appeared it should be result of unusual condition in the clear water reservoir. Situation like above will be out of control. Investigation should be needed and cause of reducing of free chlorine residual must be removed.

Procedures for control of chlorine residual are provided in flow chart of BIL-BPS01-QCFC-01.

3. Report and record

3-1.Record

Records for water quality control of the clear water reservoir should be required as followins;

3-1-1.Record of monitoring and visual check

3-1-2. Water level in the clear water reservoir

3-2.Report

Reports for water quality control of the clear water reservoir should be required as follows;

3-2-1.Recomendation
1- Upgrading or rehabilitation of facility
- Modification and arrangement
- Repairing and replace
- Additional of facility
2- Review of criteria
3- Review of procedures for operation and control

3-2-2.Annual report

Plant Name: **Bilbeis BPS**	Title **Booster Pump**	SOP TAG No. **BIL-BPS02-OP**

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1. Features of process

1-1. Function of process

The function of the booster pump is to feed the potable water to the network with adequate quantity, adequate pressure and reliable quality.

1-2. Impacts of process

Quantity and pressure of the distribution water should be controlled in this process. Insufficient control of quantity of the distribution water will cause reduced water quantity inside the network which lead to complains from consumers or increase of water quantity where network pressure increase causing increase of water leak from network pipes.

1-3. Relations between other processes

(1) The clear water reservoir
The clear water to distribute for the network is fed into the clear water basin from the clear water reservoir, and this is the suction tank for the transmission pump. The water in the clear water reservoir and the clear water basin must be kept clean and safety. These basin or reservoir must be covered to isolate from the air outside to avoid contamination by dust or sprayed agricultural chemical.

(2) Network
The operation of the booster pump relates to the function of the network. Hence, condition of the network such as pressure of pipe inside should be monitored usually during the operation of the booster pump.

2. Criteria for operation

2-1. Acceptable pressure inside of the network

The pressure in the main pipe: 5 Bar or less

2-2. Schedule for working of pump

The booster pump should be operated according to operation schedule. Usually a pump will

be operated for 24 hours and after that changed to stand by pump.

2-3. Indication of vacuum meter be possible for starting of pump

Prior to start a pump air in the casing of a pump should be sucked out by the vacuum pump. After pump casing will be in condition of filled water, a pump is possible to start. Vacuum indicator should be required -0.5 lb/in2 or more to start a pump.

3. Operation under normal condition

3-1. Startup and shutdown procedures

3-1-1. Pre-start check
- The pump will be operated should be selected.
- Water level should be sufficient for working of pump.
- Valves in suction line should be opened fully
- valves in discharge line should be closed in the beginning of the operation.
- Power should be supplied

3-1-2. Start
- Operate vacuum pump to start for approx.15 min
- Confirm vacuum indicator -0.5 lb/in^2.
- Close valve for air sucking and stop the vacuum pump
- Operate the start switch on switch board to start the pump
- Open the discharge valve gradually
- Confirm the indication of pressure gauge of discharge should be 5 bar or less.
- Check indicator of current meter on switch board
- Check unusual noise, vibration, temperature arise and leak of water
- Check dripping condition of water from part of grand packing in stuffing box (approx.20 points per minute).

3-1-2. Shutdown
- Close the pump discharge valve
- Operate the stop switch on switch board to stop the pump

3-2. Monitoring and visual check during operation

It should be conducted more than twice every day by prepared check list. If unusual condition will be found, corrective action should be conducted immediately.

3-3. Operation for control

The control of the booster pump should be conducted mainly by change of working number of the pumps and quantity and pressure in the network should be controlled. The water level in the clear water basin and the clear water reservoir should be monitored periodically.

4. Operation under unusual condition

4-1. Expected troubles and trouble shootings

- Clogging in the suction pipe or the discharge pipe
- Discharge pressure is not enough
- Discharge quantity is not enough
- The water level in the treated water basin is not enough
- Mechanical or physical trouble of the pump
- Unusual pressure in the network
- Elecrical power failure

5. Report and record

5-1. Record

Records for operation of the transmission pump should include the follows:

5-1-1. Record of working of the pump

- Time in operation of each pump
- Operation condition
- Discharge pressure, quantity, electrical current, and so
- Water level in the clear water reservoir
- Unusual condition of the pump

5-1-2. Record of working of the vacuum pump

- Time in operation of each pump
- Operation condition
- Vacuum pressure, electrical current, and so on.

5-2. Report

Reports for operation of the booster pump should include the follows:

5-2-1. Unusual condition during operation
Unusual condition, corrective action, time of occurrence and period of repairing have to be included in a report

5-2-2. Monthly report
(1) Time in operation of each pump
(2) Recommendation on operation

5-2-3. Annual report
(1) Time in operation of each pump
(2) Recommendation on operation

(2) Periodical inspection during working or after shut down
(3) Evaluate and analysis regarding result of monitoring and check, and inspection
(4) Recovery e.g., repairing, replace, supply or change of oil and so.

3-1. Monitoring and visual check

Daily	1. Visually check for leaks
	2, Adjust glands as necessary to maintain proper leakage
	3. Hand test bearing housing for any sign of temp. rise
Every week	1. Check coupling
	2. Check the bearing temperature using a thermometer
Every month	1. Check for lubrication
	2. Check the packing and replace it if necessary
	3. Check and re-grease the bearing
Every 6 months	1. Check alignment of the pump and motor
	2. Check holding down bolts for tightness
Every year	1. Check rotating element for wear
	2. Check wear ring clearance
	3. Vibration testing

3-2. Periodical inspection during working or after shut down

It includes monitoring of flow rate, pressure head for pumps and current consumption to recognize the pump operation efficiency. When the pump stopped, oiling/greasing of bearings have to be checked and cleaning the excesses.

3-3. Evaluate and analysis regarding result of monitoring and check, and inspection

Generally, we can recognize the efficiency of the pump or the corrective actions needed in case of not applying the flow rate or the pressure head or increase current consumption rater than the design rate for the pump from the results of monitoring.

3-4. Recovery e.g., repairing, replace, supply or change of oil, etc

This means keep the pump in its original condition or the nearest to this condition. This condition will happen by rapid repair or replacing damage parts and avoid the pump from not working.

Plant Name: **Bilbeis BPS**	Title **Booster Pump**	SOP TAG No. **BIL-BPS02-MT**

Issued		Developed by		Signature	
Revised		Approved by		Signature	

1. Introduction

A centrifugal pump consists of two (2) main components as a pump and a motor. The pump has two main components as follows:
(1) A rotating component comprised of impeller and shaft
(2) A stationary component comprised of a casing, casing cover, and bearing

Auxiliary components generally include the following systems for the following services:
-1. (Seal flushing, cooling, quenching system)
-2. Seal drains and vents
-3. Bearing lubrication, cooling system
-4. (Seal chamber) or stuffing box cooling, heating system

Auxiliary piping systems include tubing, piping, isolating valves, (control valves, relief valves, temperature gauges and thermocouples), pressure gauge, (sight flow indicator, orifices, seal flush coolers, dual seal barrier/buffer fluid reservoirs), and all related vents and drain.

Maintenance activity for the pump should be conducted to main components and auxiliary components.

2. Criteria for maintenance

It is represented in the pump maintenance activity in addition to the general cleanness, painting, confirm that internal parts work in proper condition and avoid the pump from not working so we can recover any simple phenomena like increase or decrease of cooling water, continuous lubrication, and inspecting pumps when much noise , rise in temperature or vibration occur.

3. Maintenance activity

Daily monitoring and check, and periodical inspection should be required to keep the pump in proper working. Maintenance activity shown herein means activity for the routine maintenance. Description regarding activity for the corrective maintenance is shown in trouble shooting.

Maintenance activity consists of four (4) kinds of working components as follows:
(1) Monitoring and checking during working of facility

4. Reports and records

4-1. Records

Records should include the following:

4-1-1. Records of the maintenance work for the facility

- ◆ Result of monitoring and check (check list)
- ◆ Result of periodical inspection
- ◆ Record during the maintenance work of facility
  - ➢ Indication of discharge pressure
  - ➢ Indication of current meter
  - ➢ Measurement of vibration by vibration meter
  - ➢ Measurement of noise by noise meter
  - ➢ Measurement of temperature of motor and bearing

4-2. Reports

Reports should include the following:

4-2-1. Report for recommendation
(1) Rehabilitation
- ◆ Repairing or replace
- ◆ List of spare parts that should be required to stock in the plant

(2) Upgrading of facility or system
- ◆ Change of capacity, material, and other specifications
- ◆ Addition of facility
- ◆ Modification of facility or system
- ◆ Proposal of preventive maintenance activity to be needed

4-2-2. Report of maintenance activity
(1) Annual report
- ◆ Repairing and replace for each facility
- ◆ Trouble and accident
- ◆ Result of corrective maintenance
- ◆ List of consumed spare parts in a year
- ◆

(2) Corrective action to prevent the trouble or accident

Plant Name: **Bilbeis BPS**	Title of SOP: **Booster Pumps - Trouble Shooting**	SOP TAG No. **BIL-BPS02-OPTS**

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PROBLEM	POSSIBLE CAUSE	RECOMMENDED REMEDY
No water delivered No flow No pressure	Delivery or suction valve closed	Open the closed valve
	The pump is not primed	Prime the pump
	Suction left is too high	Increase water level in suction sump
	Foot valve is partially closed	Clear the clog
	Air leak into suction line	Tight all flanges and packing
	Air buckets in suction line	Open air vent to release air
	Leaks in the shaft seal	Replace the seal or tighten gland
	Air leak through stuffing box	Seal the stuffing box properly
	Impeller damaged	Replace the impeller
	Rotation direction is incorrect	Reverse the phases
Low flow and low pressure	Gasket for casing is leaking	Replace the gaskets
	Suction pressure close to vapor	Close partially the discharge valve
	Excessive amount of air in liquid	Open air vent to release air
	Wearing ring worn	Replace new wearing ring
	Foreign maters in the impeller	Open pump and clean impeller
	Parallel operation effect the pump	Check the system design
	Glands is too tight	Loosen the gland nuts
	Packing improperly installed	Replace the backing
	Shaft or shaft sleeve worm	Replace with new shaft and sleeves
	Shaft running off-center	Rectify the shaft centering
	Pump start and stop frequently	Adjust the system control
	Water seal pipe clogged	Clear water seal pipe

PROBLEM	POSSIBLE CAUSE	RECOMMENDED REMEDY
Short life span of shaft seal and packing	Gland is too tight	Loosen gland nuts
	Seal cage improperly located	Check the location and correct
	Dirt or grit in sealing liquid	Use clean water for sealing
	Cooling liquid is not provided	Repair or install cooling liquid pipe
	Clearance between casing and shat is too excessive	Open the pump and adjust the clearance to the designed value
	Lack of lubricants	Add more grease or oil
Short life span for bearing, noisy operation	Misalignment between motor and pump shafts	Adjust the alignment of motor and pump shafts
	Dirt getting into bearing	Check the bearing seal and correct
	Lack of lubrication	Add more grease or oil
	Bearing rusted	Clean and cover protect hosing
	Bearing worn out	Replace the bearing
	Foundation not rigid enough	Repair and tighten foundation bolts
	Excessive grease in bearing housing	Remove some of the grease from bearing hosing
	Shaft is bent	Replace the shaft with new one
	Rotor of pump or motor out of balance	Change the motor and pump shaft with the impeller and check balance
	Rotating parts are rubbing	Check and replace necessary parts
Pump trip Stopped by itself	Electrical overload settings are incorrect	Check and correct setting
	Bearing jammed	Change the bearing
	Impeller obstructed	Clear obstruction from the impeller

aPlant Name: **Bilbeis BPS**	Title **Chlorination Facility**	SOP TAG No. **BIL-BPS03-OP**

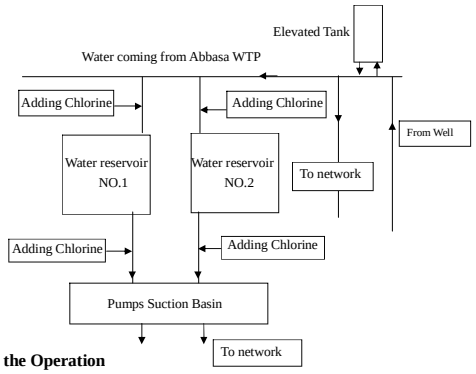
Issued		Developed by		Signature	
Revised		Approved by		Signature	

Introduction

The main purpose of the chlorination facility existing in Bilbeis booster pump station is to maintain the quality of the clear water coming from Abbasa WTP or water produced from the wells.

The chlorination facility consists of 2 injection points, the first one located on the inlet pipes to the clear water reservoir and the second point on the outlet pipes from the clear water reservoir and before the pumps suction basin .

The second dosage of chlorine is added in case of insufficient residual chlorine in the outlet water from the clear water reservoir.



1. Criteria of the Operation

1-1.Function and criteria of the operation

Function of chlorination is to inject the chlorine to the transmission pipeline and to maintain the free chloride residual concentration as designed. And it is protecting the supply water from the development of biological substances.

Designed chloride residual concentration at service area

- Cl: not less than 0.5 mg/l in summer
- Cl: not less than 0.3 mg/l in winter

1-2. Relations between other processes

Chlorine dosing rate shall be adjusted by the source water quality and network conditions at service areas.

2. Operation under normal condition

Beside this SOP, operation procedures for the chlorinator facility shall be conducted strictly according to the manufacturer's recommendations, instructions and manuals especially for the safety against chlorine handling, monitoring and so on.

2-1.Common notice for operation of chlorination facility

-1. Early detection and rapid response to chlorine leak accidents is the most important action for operation of chlorination facility. Continuous attention shall be paid to chlorine leakage around all chlorine piping, valves, and cylinders and when opening and close the valve in chlorine line piping.

-2. After the complete evacuation of operators/persons, all the doors shall be closed in chlorination house to avoid diffusing leaked chlorine to outside of chlorination house.

-3. Knowledge and skills on handling of chlorine and chlorination facility shall be required for persons to handle chlorination facility.
Persons to operate chlorination facility shall be trained for handling skills on chlorine, chlorination facility.

-4. Periodical practice on activity in emergency situation: Under emergency situation such as severe chlorine leakage, immediate actions are required according to prepared action plan and program. Safety devices and tools shall be provided and maintained and kept in proper condition to be used any time. Training for emergency situation shall be conducted periodically.

-5. No smoking in the room of chlorination house

3. Start-up and shut-down procedures

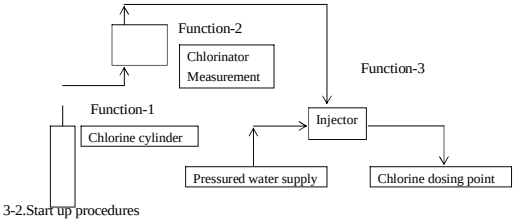
3-1.Facility component of the chlorination equipment

The chlorination equipment consists of the following three components;

-1.Chlorine cylinder
-2.Injector and chlorinator
-3.Pipes and valves

Chlorine gas is taken out from chlorine cylinder and the gas is sucked with negative pressure by the injector. The sucked chlorine gas can be measured and the chlorine dosing flow rate is controlled by the chlorinator. Chlorine gas sucked by the injector is mixed with the water supplied into the injector and injected at the dosing point. Functions for the chlorination equipment are following;

Function-1: Supplying of chlorine gas with positive pressure
Function-2: Measuring and control of dosed chlorine
Function-3: Making of chlorine water and feeding of chlorine water with pressurized water



3-2.Start up procedures

Procedures for start up of chlorinator shall be according the instruction manual issued by the chlorinator manufacturer but generally as follows.

-1. Connect a copper tube to chlorine cylinder and manifold inlet valve
-2. Feed the pressured water into the injector
-3. Confirm the arising of negative pressure in the chlorinator
-4. Flow rate of chlorine shall be set at zero in the chlorinator
-5. Open slightly outlet valve of chlorine in the chlorinator
-6. Check close of inlet and outlet valves for chlorine gas manifold
-7. Check the connection parts of the lead tube and tighten a cover nut
-8. Open the master valve for cylinder and close it immediately for leakage check.
-9. Check no leak around connection parts of copper tube from cylinder to manifold
-10. Leak check shall be conducted by use of ammonia solution water.
-11. After confirmation of above, open the outlet valve for manifold and check no leak of chlorine around connection part of the chlorinator.
-12. Confirm the flow rate of chlorine gas is zero in the chlorinator.

-13. Open the master valve for cylinder gradually until it will be fully open. Check again the connection parts of chlorine gas line for leaks. Sealing characteristic of master valve for cylinder shall be effective in a condition of opened fully.
-14. Adjust the flow rate of chlorine gas of the chlorinator to required dosing flow rate. Flow rate of chlorine gas can be confirmed by flow meter in the chlorinator.
-15. After 30 minutes of above adjustment, confirm the condition of the flow rate. It must be kept in the required value.

Key points for start up procedures are as follows;

☆ Chlorine gas feeding into the tube or pipe from cylinder shall be conducted step by steps.
☆ Check for leaks of chlorine gas shall be done by as small amount of chlorine gas as possible at the first step.
☆ Check for leaks from cylinder to connection part and to manifold one by one. Do not feed the gas at the same time into the whole pipe line and facilities.
☆ Negative pressure shall be arisen from injector prior to feed chlorine gas into the manifold and the chlorinator.
☆ Required chlorine dosing rate shall be grasped prior to start up the chlorinator. Chlorine dosing flow rate is calculated by following formula;

Chlorine dosing rate: R (mg/l)
Chlorine dosing flow rate: W (kg/h)
Flow rate of the process water: Q (m3/h)
W = Q * R * 1/1000 -------- (kg/h)

3-3.Shut down procedures

Cases of shut down
- Operational shut down
- Long term shut down
-Changing cylinders

Procedures for shut down of chlorinator shall be according as the instruction manual issued by the chlorinator manufacturer.

General procedures are shown hereunder for reference.

-1. Close the master valve for cylinder and keep this condition for several minutes. Confirm that indication of the pressure in the manifold will be zero. Keep this condition for 10 minutes or more.
-2. Check for leaks of chlorine gas from cylinder and pipe connection parts.
-3. Close the inlet valve of chlorine gas to the injector.
-4. Stop the water supply to the injector. Close the inlet valve for the injector first and then close a outlet valve for the injector.

Regarding of actions for long term stopping of the facilities, refer to them instruction manual issued by a manufacturer of the chlorinator.

General Notes:

☆ To avoid water flowing into the chlorinator, be sure the procedures from-3 to -4 in above mentions.
☆ The often cause of the troubles for the chlorinators are the backward flow of the water into the chlorinator.

3-4. Monitoring and visual check of facility

Monitoring and visual check during operation shall be conducted according to the check list.

3-5 Operation procedures for control of facility

Dosing flow rate of chlorination shall be changed depend on the following;
- Free residual chlorine of the filtered water
- Required free residual chlorine for the network water
- Flow rate of the filtered water

Determination procedures of dosing rate are shown in ASL-WPS06-QC.

4. Operation under unusual condition

4-1 Prospect troubles and trouble shootings

4-1-1.Chlorinator

Troubleshooting of the chlorinator shall be conducted according to the instruction manual issued by the chlorinator manufacturer.

Examples of prospect trouble for reference are as follows;

-1.Gas leak
-2.The required gas feed rate is not achieved at start-up
-3.Out-of-gas indications occurs during normal operation
-4.Insufficient ejector vacuum
-5.Loss of gas feed
-6.Flowmeter ball bounced and/or maximum gas feed rate cannot be achieved during normal operation
-7.Flooded metering tube
-8.Vacuum leaks

4-1-2. Piping and valves

-1.Gas leak from
-copper tube

-Connection part
-Valves

5. Records and Reports

5-1.Records

5-1-1.Records for operation condition

-1.Chlorine gas feed
- Pressure gauge indication of chlorine gas feed for the chlorine gas manifold

-2.Records for the chlorinator
- Chlorine dosing flow rate
- Water supply pressure fed to the chlorinator

-3.Indication of chlorine gas leak detector
-4.Visual check list in a routine work

5-2.Report

Reports are required as shown in the following;

5-2-1.Chlorine consumption records
- Weight of chlorine used each 24-hour period during a month
- Total weight of chlorine used for a month
- Average weight of chlorine dosed during a 24-hour period for a month
- Maximum weight of chlorine used during any 24-hour period during a month
- Minimum weight of chlorine used during any 24-hour period during a month

5-2-2. Recommendation on facility
- Rehabilitation and upgrading
  - Repairing
  - Replacement
  - Repainting
  - Additional parts or facilities
  - Required spare parts
- Recommendation on modification of the criteria
- Recommendation on training for persons
- Recommendation on review of O&M plan

Plant Name	Title	SOP TAG No.
Belbies BPS	**Chlorination Facility**	**BIL-BPS06-QC**

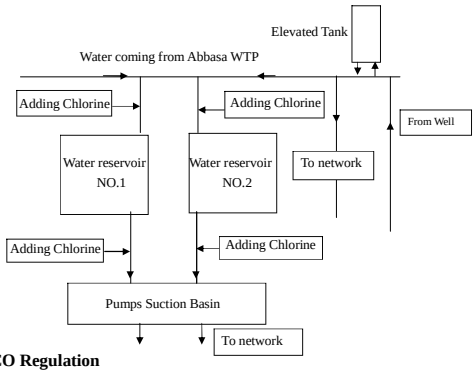
Issued		Developed by		Signature	
Revised		Approved by		Signature	

Introduction

The main purpose of the chlorination facility existing in Bilbeis booster pump station is to maintain the quality of the clear water coming from Abbasa WTP or water produced from the wells.

The chlorination facility consists of 2 injection points, the first one located on the inlet pipes to the clear water reservoir and the second point on the outlet pipes from the clear water reservoir and before the pumps suction basin .

The second dosage of chlorine is added in case of insufficient residual chlorine in the outlet water from the clear water reservoir.



1. SHAPWASCO Regulation

According to the water quality control regulation of SHAPWASCO, required residual chlorine concentration in the network is 0.5 mg/l in summer and 0.3 mg/l in winter for the water. Residual chlorine measurement shall be done on the distribution system at the area farthest from the source of the station. This ensures that the entire distribution system is receiving enough chlorine.

2. Monitoring Frequencies

2.1 Frequency of free residual chlorine measurement

- At the transmission pipe coming from Abbasa WTP: Once a day
- At the farthest tap on the network : once a day

2.2 Frequency of chlorine demand test

- For the well water: Once in six months and as the sample is taken for analysis

3. Water quality control under normal condition

3-1.Monitoring of the water coming from Abbasa WTP :

3-1-1.Laboratory test of chlorine demand

Chlorine demand test shall be conducted according to the standard procedure in SHAPWASCO for general water quality analysis including sampling procedures for the following items:

- Color
- Turbidity
- pH

3-1-2.Control of the chlorine dosing rate

Free residual chlorine in the distributed water shall be maintained at least 0.3 mg/l to 0.5 mg/l at any point of the farthest tap in the network. In the case that combined residual chlorine is used for chlorination, the total injected chlorine shall be 1 to 2 mg/l.

Free residual chlorine in the network is consumed during a distribution of the water. Consumed amount of chlorine is varied to the conditions in the network such as contamination, water temperature, condition of network pipe lines and so on.

The free residual chlorine in the distributed water at a point of the farthest tap in the network shall be measured periodically according to the frequency of the criteria.

The control action of free residual chlorine shall be done by following activities;

-1.Set a target for the distributed water at a point of the farthest tap in the network

-2.Confirm the water condition coming from Abbasa WTP .

- Water Quantity

- Residual chlorine at the beginning of the transmission line

-3.Set the target for the supply water

-4.Set the chlorine dosing rate

-5.Confirm the flow rate of the supply water

-6.Set the chlorine dosing flow rate by the chlorinator

-7.Monitor the free residual chlorine in the water

- The supply water
- The distributed water at any point of the farthest tap in the network

-8.Compare the monitored data with the targets

-9.Determin whether the chlorine dosing rate is to be changed or not?

-10.If a chlorine dosing rate shall be changed, change a dosing flow rate by operation of the chlorinator to be increase or decrease

-11. Monitor the free residual chlorine in the water

- The supply water
- The distributed water at a point of the farthest tap in the network

-12.Compare a monitored data with the targets

-13.Determin whether the chlorine dosing rate is to be changed or not?

-14.Repeat from control actions 11 to 13 in the routine work

3-3.Visual check of operation condition

Operation condition of the chlorination facilities shall be checked in the routine work to confirm proper operation of the facilities.

4. Operation under unusual condition

4-1 Prospect troubles and trouble shootings

Insufficient free residual chlorine in the supply water at the station and/or distribution water in the network

5. Record and report

5-1.Records

5-1-1.Records for water quality

- Free residual chlorine with general water quality analysis results of supply water and the distributed water at any point of the farthest tap in the network

5-1-2.Records for the chlorinator

- Chlorine dosing rate and dosing flow rate

5-1-3.Records for visual check

- Check list use in the routine work

5-2.Report

Reports are required as follows;

5-2-1. Consumption of chlorine

- Residual Chlorine measurement
- Chlorine consumption

5-2-2. Recommendation on facility

- Repairing
- Replacement
- Additional facility
- Recommendation on modification of the criteria and SOPs
- Recommendation on training for personnel
- Recommendation on review of O&M plan

Station Name: **Belbies BPS.**	Title **Elevated Tank**	SOP TAG No. **BIL-BPS08 -MT**

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Introduction

Generally, maintenance activity of the Elevated Tank is conducted not in a routine daily maintenance but along with the scheduled maintenance of the station.
Structure and devices to be maintained in Bilbeis booster Pump Station (BIL-BPS) are as follows;

- Upper storage tank structure with steel stairs
- Level guage
- Rising pipe with a pressure gauge
- Overflow pipe

The tank structure and suction pipe of the filter pump and drainage pipe is inspected and cleaned. Cleaning of the tank is the main activity.

1. Criteria for maintenance

Major maintenance activity for the Elevated Tank is to clean the upper storage tank. Inside and out side condition of the tank shall be checked and confirmed.

- Frequency of cleaning and inspection of the tank
  - Cleaning work: Once 3-6 months
  - Inspection and repairing: Once a year
- Acceptable time to stop the function of the Elevated Tank
  - In winter season: 6 hours

Criteria for maintenance activity of the other ordinary devices other than the tank shall be followed to the similar maintenance procedures.

2. Maintenance activity

In order to judge the necessity of maintenance activity such as adjustment, repairing or replacing, following steps shall be taken for the Elevated Tank;

-1. Monitoring and checking during operation

-2. Inspection
-3. Evaluation and analysis of inspection results
-4. Maintenance work

2-1.Monitoring and visual check

Monitoring and visual check shall be carried out according to “O&M schedule” and unified check list.

2-2.Inspection

Inspection shall be carried out according to “O&M schedule” and unified check list.
- External check of the tank
  - Appearance of crack on the tank
  - Leak of water from the tank
  - Foreign substances such as flying waste of vinyl materials, birds dropping and so.
- Cleaning of inside of the tank and overflow piping
  - Flushing away sludge by pressured water
  - Brushing away to remove adherent algae on the wall

2-2-1.Cleaning of the tank
- Make a plan and time schedule for cleaning
- Procedures for drainage of water in the tank
- Procedures for cleaning of the tank

2-2-2.Inspection procedure
Inspection check list shall be provided on the following items;
- Inspection of the tank
- Inspection of the rising pipe
- Inspection of the float and level indicator with wire
- Inspection of overflow pipe

2-3. Evaluate and analysis of the inspection result

After inspection following items shall be evaluated;
- Necessity of maintenance action
  - Corrosion
  - Crack in the wall or bottom of the tank
  - Water leakage

2-4. Maintenance after the inspection

Following shall be conducted for the maintenance work;
- Repairing cracks, leakage parts and broken parts
- Repainting
- Maintenance of the piping and valve
  - Supplying grease as needed
  - Change of parts as needed
  - Replace the valve as needed or periodically
  - Repairing of leak part pipe and connection

3. Procedures under unusual condition

3-1 Prospect troubles

As mentioned in operation procedures, unusual condition of the Elevated Tank is prospected simply to loose storage function as follows;

- Leakage by concrete structure problem
- Contamination by flown waste
- Trouble in the rising pipe and valve

3-2.Troubuleshooting

Once the above situation happens, shut down the elevated tank by closing the valve and remedial maintenance works shall be conducted as soon as possible.

4. Report and record

4-1.Record

Record for maintenance of the Elevated Tank shall be prepared as follows;
4-1-1.Record of monitoring and visual check
4-1-2.Record of inspection
4-1-3.Record of maintenance work

4-2.Report

Report for maintenance of the Elevated Tank shall be prepared as follows;

4-2-1. Summery of the Maintenance Records
4-2-2. Recommendations (as needed)
- Review of maintenance procedures
- Improvement of facility

- Upgrading or rehabilitation of facility
  - Replacement of facility
  - Repairing of facility
- Review of SOP

Plant Name: Bilbeis BPS	Title Elevated Tank	SOP TAG No. Bll-BPS09-OP

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1. Description of the facility

1-1.Outline of process and facilities

The Elevated Tank is provided to stabilize the flow and pressure in the network.

In Bilbies booster Pump Station (BIL-BPS), a reinforced concrete elevated tank is provided. Its upper tank has 500 m^3 storage capacity and 36 meter height.

There is only one device to control and operate the elevated tank, i.e. a valve in the rising pipe.

1-2. Function of the Elevated Tank

Functions of the Elevated Tank are to buffer the surplus water/pressure in the network and to cover the peak water consumption exceeding the pump supply capacity.

1-3.Impact of facility

The Elevated Tank is a large scale civil structure but a quite effective facility in the water supply network.

1-4.Relation with other facilities

1-4-1.The transmission pipe line from Abbasa WTP
The Elevated Tank is provided to stabilize the flow and pressure in the network. So functions of the Elevated Tank are to buffer the surplus water/pressure in the network and to cover the peak water consumption exceeding the pump supply capacity.

2. The criteria for operation

There is no operation required for the elevated tank and the criteria for operation do not exist.

3. Operation under normal condition

Usually the well water passes through the Elevated Tank and valve in the rising pipe is opened. Hence, any operation or control under normal condition is not required the Elevated Tank but monitoring is needed to confirm that unusual condition does not exist. Check list for monitoring and visual check is provided in BILL-BPS09-OPCL-01.

When the upper storage tank is cleaned, the valve in the rising pipe for the Elevated Tank shall be closed and emptied by drainage pipe.

4. Operation under unusual condition

4-1. Prospected unusual condition

Unusual condition of the Elevated Tank is prospected simply to loose storage function as follows;

- Leakage by concrete structure problem
- Contamination by flown waste
- Trouble in the rising pipe and valve

4-2.Troubuleshooting

Troubleshooting for the above situation shall be just closing the valve in the operation and remedial maintenance works shall be conducted as required.

5. Report and record

5-1.Record

Record of monitoring and visual check for the Elevated Tank.

5-2.Report

5-2-1.Annual report
- Report of the corrective action (as needed)
- Report of the preventive action (as needed)

5-2-2.Recommendation
- Rehabilitation and upgrading
- Review of SOPs

SOP for Aslougi WPS

Plant Name: Aslougi W.P.S.	Title General	SOP TAG No. ASL-WPS-G

Issued		Developed by		Signature	
Revised		Approved by		Signature	

1- Water Sources

Generally, water sources are classified as two sources; surface water source and underground water source. The surface water source includes rivers, water passes, lakes or water behind dams. The ground water source includes wells and springs.

Wells are the water source for ASLOUGI WPS

3- Operation steps

Operation steps is the sum of activities through the different operation process, this activities are divided to 12 as detailed starting from **ASL-WSP01-OP** up to **ASL-WSP08-OP,** this activities shall be explained in normal conditions or emergency cases

3-1- Operation in normal condition

Operation under normal conditions shall be explained in details for each activity in the standard operation procedures SOP

3-2- Operation in emergency cases

Operation under emergency cases includes up normal conditions such in case of sudden pollution of well water or power cut or work stop in major treatment facility …….etc

3-2-1- Expected problems and trouble shooting

The expected problems can be easily known from the past operating records and operators experiences analysis

3-2-2- Analysis of past problems, causes, and remedy actions

Study and analysis of some problems happened in past will help to solve existing problems and this will help to reach to the following occlusions ;

- ✓ Detect the weak points due to operation
- ✓ Detect the weak points due to design
- ✓ Detect the weak points in operation and maintenance
- ✓ Detect the weak points due to technical conditions for equipment
- ✓ Reference to problem analysis procedure

- ✓ Reference to what we need to reach to the cause of the problem
- ✓ Reference to what is not allowed to avoid the problem
- ✓ Etc.

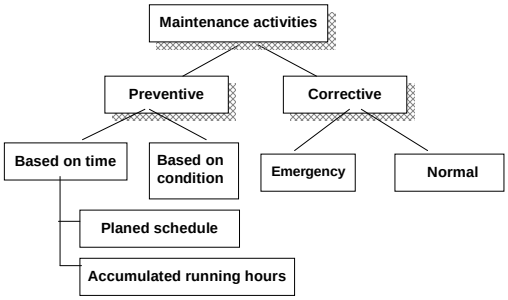
All data and actions related to the problem must be collected and recorded in one file as a reference to avoid repeating the problem

4- Maintenance activities

4-1 Maintenance activities references

4-1-1 General idea

Maintenance references are used to show the impotence of the activity including maintenance, replacement, check, for all or part of equipment. It is divided to preventive maintenance and corrective maintenance as shown in the following figure



The preventive maintenance is divided into two types, one of them based on time and the other is based on technical condition of equipment. There is a difficulty to evaluate the depreciation rate of the equipment

Time based maintenance either to be according the planned schedule or based on actual accumulated working hours for the equipment

The corrective maintenance is divided into two types; one of them is emergency corrective maintenance and normal corrective maintenance. In normal corrective maintenance good monitoring and periodic check for equipment should be applied to detect any up normal condition for the equipment

The classification of the maintenance and which type shall be applied should be based on activity and related equipment

Maintenance activities include monitoring, check and recommended action either by change, repair or improvement. The maintenance activities include four actions as following:

1. Mentoring of the equipment condition and performance
2. periodical check
3. analysis and evaluation
4. repair after check

4-1 mentoring of the equipment condition and performance

Mentoring and check shall be based on time schedule for operation and maintenance

4-2 periodical check

Periodical check shall be for all equipment in the external exposed parts as well as internal parts to be sure that the equipment is suitable and capable to perform well and the number of check and period shall be based on each equipment function and should be scheduled and documented

4-3 analysis and evaluation

The importance of repair is related to the importance of equipment and operation condition and the condition of parts and if it is subject to wear or rust.

The analysis of repair should include cost and risk and time required for maintenance and spare parts availability before the starting of maintenance activity

Discover the problems in early time and repair shall make long lifetime for equipment

4-4 repair after check

Replacement, repair or change the equipment depends on the spare parts availability. Sometimes only greasing and cleaning are only required

5- Quality control

Water quality control should be effectively applied and data analysis are required to forecast any future problem and review treatment process

It is important to monitor and check all water process steps for economic operation and prevent any of the process function from being overloaded due to improper operation for previous step

6- Records and Reports

Records and reports is one of the important activity which help in analysis and considered as on of the very important documents for personnel communications inside or outside the plant

These records will help in improvement of operation and maintenance and avoid repeating of problems

Plant Name: El Aslougi well plant station	Title **Overview El Aslougi Well Pump Station**	SOP TAG No. **ASL-WPS00-OV**

Issued		Developed by		Signature	
Revised		Approved by		Signature	

1. General information of the plant

1-1.General information

1-1-1. Location
El Aslougi Well Pump Station (ASL-WPS) exists in South East of Zagazig Markaz. It is Located at 30°33’ 22.4” North and 31°31’3.4” East.

1-1-2. Construction Phases
El Aslougi Old Well Plant Station constructed with an elevated tank in 1987, and rehabilitation with new one well drilling was done for El Aslougi area in 2000 and new one well drilling and pump installation was added for Kafr Al Ahrar in 2007.

1-1-3. Outline of the station
The source of water for this station is well water. Three wells of approximately 70 meter depth were drilled with the diameters of casing and screen of 10” and 12” in the station but two of them are currently used as production wells.

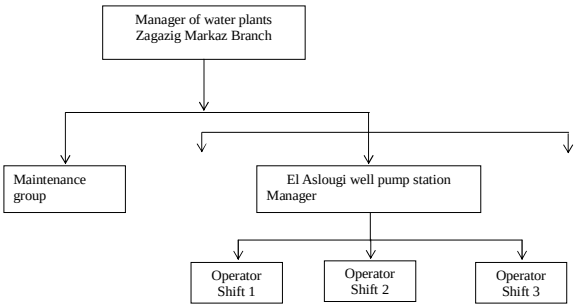
The old and new well stations both have same nominal capacity of 40 l/sec and are operated for twenty four hours with intermittent pump operation depend on the demand fluctuation in the network.

1-1-4. Service areas and connections to the distribution network

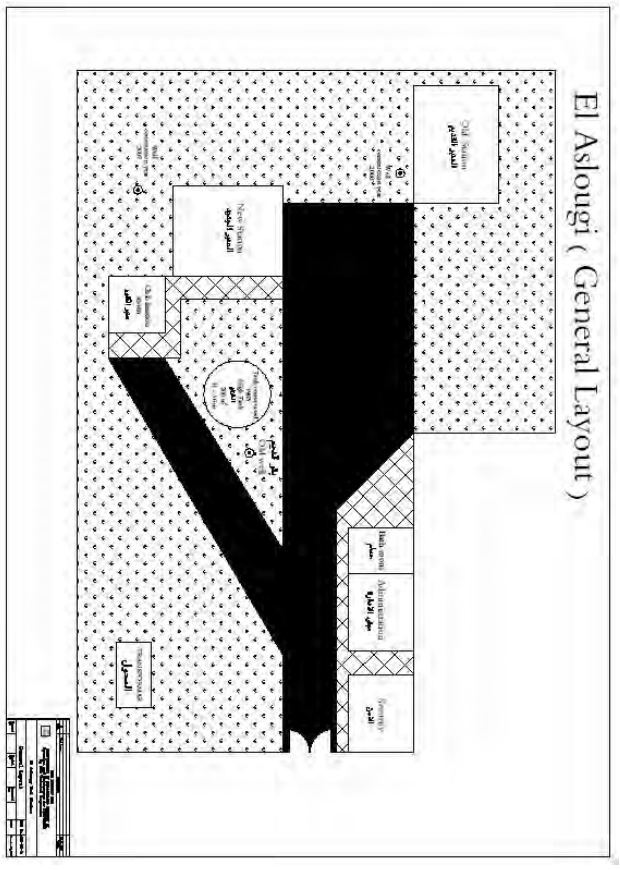
Well water is sent directly from pumping station to the network without treatment. Old well station transmits water to El Aslougi Area in Zagazig Markaz through trunk pipeline of 200mm diameter. Population of the supply area is estimated approximately 60,000. There is another water supply pipe connected to this Asluougi area from Zagazig.

The new well station transmits water to Al Ahrar area in Zagazig Markez through transmission pipe of 225mm diameter after chlorine injection. Population of the supply area is estimated approximately 20,000.
Distance from the well pump station to Al Ahrar area is approximately 2,000m. There is no elevated tank or reservoir available at Al Ahrar area.

1-1-5. Organization and stuff formation



1-1-6.General Layout



1-2. Components of process in the well pump station

1-2-1. Components

There are following five mechanical components and electric power supply facility in the well pump station (abbreviate as WPS) and they are related between each other component.

- Production wells
- Well pumps
- Chlorination facility
- Elevated tank
- Piping and valve
- Electric panels and cables

1-2-2. **Component equipment and devices**

Component equipment of the facility are as follows;

-1. Production wells
This component includes following;
- Wells with sufficient yield capacity

-2. The water transmission by well pump
This component includes following;
- The well pumps

-3. Chlorine dosing process
This component includes followings;
- Chlorine cylinder
- Feeding water piping and valve
- Chlorine gas piping and valve
- Chlorinator
- Feeding pump

-4. Elevated tank
This component includes following;
- Upper tank with level gauge
- Rising and over flow piping and valve

-5 Piping and Valves
This component includes following;
- Piping and valves between wells and pumps
- Piping and valves between pumps and Main delivery lines

-6 Electric panels and cables
This component includes following;
- Main switchboard and pumps operating panels
- Connecting cables

1-2-3.Specifications of all machines and devices in each facility

Refer to attached facility list in APPENDIX (to be prepared later in the course of SOP application).

1-3.Basic system on facility operating and process control

1-3-1.Basic system on unit process control

- Process control
  All unit processes of the station are controlled manually
- Water quality control
  Water quality analysis of raw well water is conducted for monitoring and free chlorine residual dosing rate to the transmission line is monitored continuously and controlled as required.

1-3-2. Basic system
- Start and stop of the well pumps are operated manually
- Monitoring of water quality

1-3-3. System of processes
-1. Production wells
- Two wells are available for two different service areas.

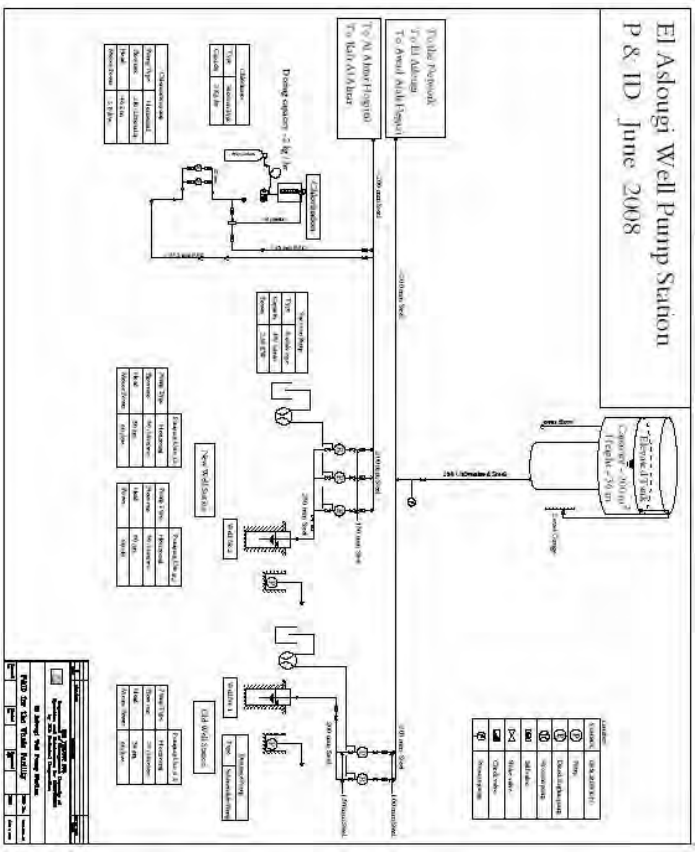
-2. The water transmission well pump
- Total five pumps are installed. Two pumps are used for old pump station and three are used for new pump station. One of the three pumps for new pump station is diesel engine drive pump for electrical blackout.

-3. Chlorine dosing process
- Chlorine cylinder: 50kg
- Chlorinator

One set of chlorinator is provided and consist of the following;
- Type of chlorinator: Injector vacuum type
- Type of operation: Manual operation
- Type of dosing flow rate control: Manual control
- Dosing point: Transmission pipe inside the station
- Capacity of chlorinator : 2kg/hr

-4. Elevated tank
Reinforced concrete elevated tank is available and used for the water supply line to El Aslougi area.
- Storage capacity: 200 m3
- Height: 36 meter
- Level gauge: Float and wire type

1-3-4. General P & ID Diagram



2. Overview of the SOPs of the ASL-WPS

2-1 Purpose of SOPs

Purpose of SOPs is to provide assistance to the water supplier in the operation & maintenance (O&M) and water quality control (WQC) procedures for the equipment, facility or process in the well plant station.

2-2. Priority Issues to be addressed in SOPs

According to the results of current field survey of the well pump station, priority issues for the O&M to be addressed in these SOPs are identified as follows (tentatively and to be finalized by SOP/Facility team);

2-2-1. Pump operation based on the water consumption in the network
Water supply to the service areas is controlled by ON-OFF of well pump. Generally in high water pressure in the network leakage water is likely to happen and causes water loss. Pump operation procedures considering the water consumption in the network, especially at night shall be prepared. For this purpose, data collection such as pump operation records and network characteristics shall be started.

2-2-2. Full-utilization of the elevated tank
There is an elevated tank existing in the well pump station. For the stable water supply it is quite useful. Therefore rehabilitation and full-utilization of the elevated tank shall be considered in SOP activity.
It is expected that service areas are expanding year by year and pressure at the end of network may be insufficient. These latest situation shall be grasped and taken into consideration.

2-2-3. Well monitoring
Water source is solely depending on the wells. Conditions of well shall be monitored continuously and recorded. Necessary maintenance shall be required in the monthly or annual report.
Items of the monitoring are as follows;
Groundwater level of two wells
Static water level
Dynamic water level
Groundwater quality analysis
Water quality items according to SHAPWASCO regulation

2-2-4. Supply control for Al Ahrar Area
New well station is supplying water to Al Ahrar area which is located 2 km away from the station. Pump operation procedures shall be established including communication method, valve operation and so on.

2-2-5. Operation of Chlorination Facility
Operation of the Chlorination facility seems confused in the field. Proper operation procedures shall be studied and established.

2-3. Application of SOPs

SOPs should be applied surely to actual O&M and WQC. However, SOPs are not necessarily constant and subject to change. SOPs should not only be kept as documents but

also be utilized as tools for O&M and WQC activities. Since SOPs must be utilized in actual activities, they should be reviewed and revised so that they can be suitable and useful anytime in any situation for water supplier according to evaluation of utilized results. We should find improved results of O&M and WQC activities whenever we review and revise SOPs.

2-4. Component of SOPs

SOPs for WPS consist of eight (8) SOPs component units and these components are shown in "SOPs Headline". Each SOP consists of three (3) SOPs packages as follows:
- SOPs for operation
- SOPs for maintenance
- SOPs for water quality control

2-4-1. SOPs for Operation

Documents which require criteria and procedures for operation and control activities of facility are provided in this SOPs and include the following:
- Explanation of process and relation between other process
- Criteria for operation activity and design
- Operation and control procedures for facility in normal condition and unusual condition
- Monitoring and visual check items for facility
- Reporting and recording system

2-4-2. SOPs for Maintenance

Documents which require criteria and procedures for maintenance activities of facility are provided in this SOPs and include the following:
- Criteria for maintenance activity
- Maintenance procedures for facility in normal condition and unusual condition
- Monitoring and visual check items for facility
- Reporting and record system

2-4-3. SOPs for Water Quality Control

Documents which require criteria and procedures for water quality control and process control are provided in this SOPs and include the following:
- Criteria for water quality control activity
- Water quality control and process control procedures in normal condition and unusual condition
- Monitoring and visual check items for water quality and process
- Reporting and record system

2-5. Review of SOPs and O&M plan

SOPs is one of tools to perform optimum O&M and WQC activities and results and as the result to improve well pump station operation. We can realize and find in our O&M activities should be modified or arranged for improvement such as more simple, effective or suitable method, by utilizing of SOPs. When we find part to be modified or arranged for improvement in SOPs, we should approach to review SOPs to be proper according to prepared procedures, as soon as possible if necessary.

2-5-1. Review of O&M and WQC activities

Review of SOPs should be carried out periodically not less than once a year and properly if necessary. After review of SOPs, SOPs should be updated to revised version. Records of SOPs review and histories of review must be required to issue and keep them. Records of view should include the following:

- Activities before review and after review and reviewed reasons
- Signatures of approved persons, date of review
- Results of review
- Marking of reviewed part and description of reviewed histories in revised SOPs documents

2-6. Preparation for making of O&M plan

O&M plan is developed to provide a material that can be easily referred to for guidance in operating a water system. The O&M plan will also provide ready reference for following;

- All equipment data which is necessary for performing normal maintenance
- Ordering replacement parts and supplies
- Organized system for keeping records of O&M of the system
- Water sampling, analysis and testing which required for compliance with regulations
- Monitoring of the treatment process for compliance with accepted waterworks procedures.
- Information regarding start-up and normal operating procedures and emergency operating procedures

O&M plan will become a training manual to provide personnel which handy source reference while they learn to operate the facilities. The experienced operator will usually refer to the O&M plan for confirmation of normal operation and maintenance procedures and as a reference guide for unusual operating conditions. The entry level operator should frequently refer to the O&M plan for guidance and instruction.

Station Name: El Aslougi WPS	Title: Water Well	SOP TAG No. ASL-WPS01-OP

Issued		Developed by		Signature	
Revised		Approved by		Signature	

Introduction

In El Aslougi Well Pump Station (ASL-WPS), the source of supplying water is well water and two wells with approximately 80 meter depth and 10" diameter steel casing and screen, are available. Water is distributed without treatment so that the quality of the well water must be within limits of Standard Potable Water Specifications.

Production capacity of the wells (safe yield capacity) must be higher than the design supply capacity of the station of 3,000 m3 per day for EL Aslougi area, having the serving population of approximately 10,000 and 3,000 m3 per day for Al Ahrar area, having the serving population of approximately 5,000 and Al Ahrar Hospital.

Draw-down of dynamic water level must be less than(6m) for the horizontal pump and in case of vertical pumps, it must be submerged by not less than (5m).

Current well water quality and static water level by Inventory Survey in 2007 are as follows;

- Turbidity: 1.4
- TDS: 453 mg/l
- Ca: 40 mg/l
- Iron: 0.2 mg/l
- Mn: 0.1 mg/l
- Total Hardness: 200 mg/l
- Total Alkalinity: 260 mg/l
- S.W.L: - 4.39 m from ground level

1. Features of process

1-1.Function of process

Function of the well is to produce water of design quantity and design quality within the design groundwater draw-down. The static water level in the well affects to the discharge pressure and quantity. If the water quality in the well is not within the limit of the standard, water can not be distributed to the network.

1-2.Impacts of process

Production capacity of the wells and water quality are essential value for the well pump

station deciding the operation procedures of the following processes.

1-3.Relations between other processes

The static water level in the well affects to the efficiency, pump flow rate and produced well water.

.

2. Criteria for operation

2-1. Water level

Static and dynamic water levels shall be not lower than the designed/planned figures for pumps. When the designed/planned water levels are not available at the initial stage of this SOP application, tentative static water levels are set up using current records of water levels and treatment operation and as follows :

1- Static water level should be recorded for each well
2- Dynamic water level should be recorded during operation for each well
3- Well Discharge flow rate should not exceed the design limits
4- The pump flow rate should not increase the safe yield capacity for the well
5- Check the well water level every 3 months to check the well efficiency and pump condition.

2-2. Well water quality

Water quality of raw well water shall not deviate the designed/planned figures. When the designed/planned water quality are not available at the initial stage of this SOP application, tentative water quality are set up using current records of water quality and transmission operation and reference figures will be finalized as soon as possible.

All the water quality items shall not be higher than the Egyptian potable standards. Sampling and analysis of raw well water quality should be conducted by daily routine work for main items and by monthly analysis for full standard items according to WQC procedures.

2-3. Clean well sites

Well sites shall be kept clean from any contamination derived from either surface water or ground water. Visual check of cleanness of the well sites should be conducted by daily routine work.

3. Operation under normal condition

3-1.Start-up and shut-down procedures

3-1-1. Visual check of well sites

Well sites shall be checked visually and confirmed that surface water drainage

and other well facilities are kept properly

3-1-2. Water level

Static water level in the observation well (an old well can be used) shall be measured and confirmed the value not lower than the designed/planned level.

3-1-3. Well water quality

Quality of raw well water shall be checked by the record of analysis of the previous day and confirmed satisfying the standards. Water sample shall be prepared for analysis for the day immediately after the pump operation.

3-2.Monitoring during operation

3-2-1. Water level

Static water level in the observation well (old well) shall be measured and confirmed that the value is not lower than the designed/planned level.

4. Operation under unusual condition

4-1 Prospect troubles and trouble shooting

4-1. Contamination

When any contamination such as surface rainwater flowing-in may be found, the station shall be stopped immediately and remedial measures such as sterilization at well site.

Discharge to the network shall be resumed only after the effect of the action would be confirmed.

4-2. Water level

There are two kinds of abnormal draw-down of groundwater level, i.e. extreme draw-down of dynamic water level and long term static water level decrease.

4-2-1. Clogging

Groundwater flow may be reduced by clogging of inlet screen and/or surrounding aquifer layer and extreme draw-down will occur by pumping.

In this case, 1) pump operation shall be restricted to the level of normal draw-down, or 2) pumping well shall be changed to sound one where backwashing the concerned well may be applicable to restore or new complete well drilling may be required.

4-2-2. Long term static water level decrease.

With many reasons considered, ground water level may be drawn down in long term and may exceed the design/planned level. In this case, 1) operation by a value less than the design flow rate and 2) increasing pump total head capacity or adding new well shall be considered to secure the discharge capacity of the wells.

4-3. Water Quality

When any water quality item in well water exceed the potable water standards,

the station shall be immediately stopped and the reason of worsened quality and remedial measure shall be clarified.

5. Report and record

5-1.Record

The Record for operation of the well sites should be required as follows;

5-1-1.Record of monitoring and visual check

Monitoring and visual check list should be prepared

Objects of monitoring and recoding are as follows:

-1.Visual check of the well sites

-2. The water levels

- Static water level
- Dynamic water level

-3. Raw well water quality

- Potable water quality standard items

When unusual condition will happen, it should be recorded with immediate actions, remedial measures taken.

5-2.Report

Reports for operation of wells should be required as follows;

- Monthly and annual ground water extraction volume in the station
- Monthly and annual ground water level fluctuation
- Monthly and annual ground water quality fluctuation
- Required maintenance of wells
  - Washing well and screen for clearing clogging
  - Painting or replacing well casing, piping, valves etc.
  - Maintenance of surface water drainage at well sites

Station Name: El Aslougi WPSP	Title: Water Well	SOP TAG No. ASL-WPS01-MT

Issued		Developed by		Signature	
Revised		Approved by		Signature	

Introduction

Generally, maintenance activity of the water wells will be conducted not in a routine maintenance but conducted along with the periodical maintenance of the station by cooperation with the responsible person from the branch and HQ Well department. HQ Well department will put maintenance schedule for wells and revising it with the branch team and station O&M members.

1. Criteria for maintenance

Major maintenance activity for the wells is to secure the safe yield capacity required to produce planned supply water volume.

Criteria

- Keeping the well yield capacity by periodical monitoring for static and dynamic well water levels.
  Timing: according to the maintenance schedule
- Maintaining outlet pipes and valves properly painting or replacing.
  Frequency: Every six months
- Keeping well sites clean avoiding contamination by surface water and others for a distance not less than 5 m from each side around the well and in the same time monitoring of the well site has to be achieved by the operation team.
  Frequency: Once a month

2. Maintenance activity

Based on the above criteria, the maintenance activity consists of following three categories;

- When an observable draw down for the dynamic water level occurs while operation of well pump
  The following procedures have to be achieved:
  a) Backwashing for the wells
  b) Damaged well shall be replaced by new well.
- Maintenance of the well casing, piping and valve, etc.
- Keeping well sites clean

2-1. Securing safe yield capacity

In order to secure the yield capacity, wells shall be backwashed regularly by the well section of the branch office. Frequency and timing shall be decided by examining the static and dynamic water level monitoring report prepared by station operation team. When backwashing interval will be shortened and yield capacity can not be recovered by backwashing, new well drilling shall be prepared for the replacement.

2-2. Maintaining well casing and piping

As a part of maintenance activity for the piping and valves inside the station, well casing and piping at well sites shall be maintained as below.

Inspection should be conducted regularly to ensure that facility should work on without accident during operation. Inspection list for well casing and piping shall be prepared as a part of station piping and valves.

- Repairing
- Painting
- Replacing

2-3. Well sites cleaning

Around the well there shall be kept clean from any contamination by others. Daily visual checking shall be conducted on the following points and necessary maintenance shall be made as required.

- Surface water drainage
- Protection from oil and grease
- Protection from animals

3. Report and record

Hence, the record and report are essential for O & M in WPS. All the maintenance activities done shall be recorded and summarized monthly and annually together with operation records of the whole station. These reports can be taken into consideration for the preparation of O&M plan for the next year.

Plant Name: El Aslougi WPSP	Title: Well Pump	SOP TAG No. ASL-WPS02-OP

Issued		Developed by		Signature	
Revised		Approved by		Signature	

Introduction

Total five well pumps are used in this well pump station to supply the groundwater to the network. Two horizontal pumps are installed in the old pump house for the well for El Aslougi and other areas and three horizontal pumps are installed in the new pump house for the well for Al Ahrar area. One of the three pumps in new pump house is diesel engine pump.

The ground water in the well is sucked by each well pump and discharged to the network through the elevated tank in case of the El Aslougi line.

The well pump facility is consists of following equipment;

-1.The well pump: Horizontal pump with one each stand-by

-2.Pipes and valves: Carbon steel, sluice valve and the swing type check valves

1. Features of process

1-1. Function of process

Function of the well pump is to transfer the ground water into the network with required quantity and water pressure.

1-2. Impacts of process

The well water flow rate and pressure are essential values for the water supply in the service areas.

For determination of capacities/diameters of network trunk pipeline are based on the well water flow rate based on the safe yield capacity of the wells.

1-3. Relations between other processes

In the well pump station, there are four mechanical processes, i.e. well, well pump, elevated tank and chlorination facility.

1-3-1.The well

The water level in the well affects to the discharge pressure and quantity. But water quality in the well may not affect to the operation because no treatment is expected in the station.

1-3-2. Elevated tank

Elevated tank in El Aslougi line is used as a buffer tank and therefore when the upper tank is filled up, well pump operation shall be stopped.

1-3-3. Chlorination facility

Well pump in Al Ahrar line can be operated only after the confirmation of proper operation of chlorination facility.

1-3-4.The network

The network is located after the well pump facility.
The well water is fed by the well pump to the network.

2. Criteria for operation

2-1.Schedule for working of pump

All the well pumps except diesel engine pump shall be operated according to the operation schedule. Usually one pump is operated for each service area. Working pump shall be changed periodically so that working cycle of pump is 24 hours

2-2.Indication of discharge pressure gauge of the pump/transmission line

Proper pressure gauge indication: Lower limit 3 bar
Upper limit 4 bar

3. Operation under normal condition

3-1.Start-up and shut-down procedures

3-1-1.Pre-start check

The well and well pump shall be selected before start-up operation.

-1.The Valve in discharge line

All valves in discharge line of the well pump shall be kept in working condition.

-2.Electrical switch board

Power shall be supplied.

3-1-2.Start-up

All the pumps are operated manually and the start switch on switch board is turned on to start the well pump and the common checking, unusual noise and vibration of the well pump and leak of water are followed after start.

Pressure of discharge line is confirmed by the pressure gauge;

Indication of pressure gauge shall be 3 bar or more.

3-1-2.Shut down

All the pumps shall be shout down manually and the stop switch on switch board is turned off to stop the well pump and common checking are followed after stop

Working time of the well pumps shall be checked from start to stop of each well pump.

3-2.Monitoring and visual check during operation

Monitoring and visual check of the well water pump is a very important activity. It shall be conducted not less than twice a day by prepared check list.

If any unusual condition is found, corrective action shall be conducted immediately.

3-3 Operation for control

The water flow rate and quantity are the most essential items for the operation of the well pump station.

The well water is transmitted by the well pumps to the networks with proper pressure. The nominal supply capacities of the station are 25 l/sec or 90 m3/hour for El Aslougi area, 40 l/sec or 144 m3/hour for Al Ahrar area and 65 l/sec or 234 m3/hour in total..

In normal operating condition, the working time of well pump shall be intermittently 24 hours a day.

4. Operation under unusual condition

4-1 Prospected troubles and trouble shooting

-1. Discharge pressure is not enough
-2. Discharge pressure is too high
-3. Discharge quantity is not enough
-4. Mechanical or physical trouble of the pump
-5. Electrical power failure

5. Report and record

5-1.Record

The Record for operation of well pumps shall be as follows;

5-1-1.Record of working of the pump

-1.Time in operation of the each well pump

-2.Operation condition

- Discharge pressure, quantity, electrical current, and so on

-3.Water level in the well

-4.Unusual condition of the pump

5-2.Report

Reports for operation of well pumps shall be required as following;

5-2-1.Unusual condition in working

5-2-2.Monthly report

-1.Time in operation of each pump

-2.Recommendation on operation

5-2-3.Annual report

-1.Time in operation of each pump

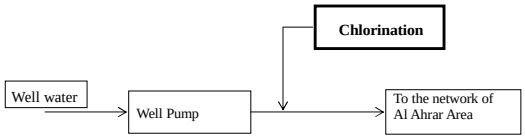
-2.Recommendation on operation

Plant Name: **Aslougi WPS**	Title **Chlorination Facility**	SOP TAG No. **ASL-WPS06-OP**

Issued		Developed by		Signature	
Revised		Approved by		Signature	

Introduction

The chlorination facility in Aslougi Well Pump Station (ASL-WPS) is chlorination dosing system to the transmission pipe for the purpose of maintaining the free chlorine residual in the network locating approximately 2,000 meter away from the station as shown on the drawing below.



1. Criteria of the Operation

1-1.Function and criteria of the operation

Function of chlorination is to inject the chlorine to the transmission pipeline and to maintain the free chloride residual concentration as designed. And it is protecting the supply water from the development of biological substances.

Designed chloride residual concentration at Al Ahrar service area

- Cl: not less than 0.5 mg/l in summer
- Cl: not less than 0.3 mg/l in winter

1-2. Relations between other processes

Chlorine dosing rate shall be adjusted by the well water quality and network conditions at service areas.

2. Operation under normal condition

Beside this SOP, operation procedures for the chlorinator facility shall be conducted strictly according to the manufacturer's recommendations, instructions and manuals especially for the safety against chlorine handling, monitoring and so on.

2-1.Common notice for operation of chlorination facility

-1. Early detection and rapid response to chlorine leak accidents is the most important action for operation of chlorination facility. Continuous attention shall be paid to chlorine leakage around all chlorine piping, valves, and cylinders and when opening and close the valve in chlorine line piping.

-2. After the complete evacuation of operators/persons, all the doors shall be closed in chlorination house to avoid diffusing leaked chlorine to outside of chlorination house.

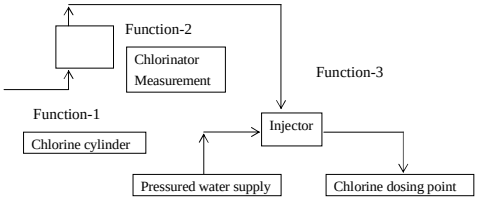
-3. Knowledge and skills on handling of chlorine and chlorination facility shall be required for persons to handle chlorination facility.
Persons to operate chlorination facility shall be trained for handling skills on chlorine, chlorination facility.

-4. Periodical practice on activity in emergency situation: Under emergency situation such as severe chlorine leakage, immediate actions are required according to prepared action plan and program. Safety devices and tools shall be provided and maintained and kept in proper condition to be used any time. Training for emergency situation shall be conducted periodically.

-5. No smoking in the room of chlorination house

3. Start-up and shut-down procedures

3-1.Facility component of the chlorination equipment
The chlorination equipment consists of the following three components;
-1.Chlorine cylinder
-2.Injector and chlorinator
-3.Pipes and valves
Chlorine gas is taken out from chlorine cylinder and the gas is sucked with negative pressure by the injector. The sucked chlorine gas can be measured and the chlorine dosing flow rate is controlled by the chlorinator. Chlorine gas sucked by the injector is mixed with the water supplied into the injector and injected at the dosing point. Functions for the chlorination equipment are following;
Function-1: Supplying of chlorine gas with positive pressure
Function-2: Measuring and control of dosed chlorine
Function-3: Making of chlorine water and feeding of chlorine water with pressurized water



3-2.Start up procedures
Procedures for start up of chlorinator shall be according the instruction manual issued by the chlorinator manufacturer but generally as follows.
-1. Connect a copper tube to chlorine cylinder and manifold inlet valve
-2. Feed the pressured water into the injector
-3. Confirm the arising of negative pressure in the chlorinator
-4. Flow rate of chlorine shall be set at zero in the chlorinator
-5. Open slightly outlet valve of chlorine in the chlorinator
-6. Check close of inlet and outlet valves for chlorine gas manifold
-7. Check the connection parts of the copper tube and tighten a cover nut
-8. Open the master valve for cylinder and close it immediately.
-9. Check no leak around connection parts of copper tube from cylinder to manifold
-10. Leak check shall be conducted by use of ammonia solution water.
-11. After confirmation of above, open the outlet valve for manifold and check no leak of chlorine around connection part of the chlorinator.
-12. Confirm the flow rate of chlorine gas is zero in the chlorinator.
-13. Open the master valve for cylinder gradually until it will be fully open. Check again the connection parts of chlorine gas line for leaks.
Sealing characteristic of master valve for cylinder shall be effective in a condition of opened fully.
-14. Adjust the flow rate of chlorine gas of the chlorinator to required dosing flow rate. Flow rate of chlorine gas can be confirmed by flow meter in the chlorinator.
-15. After 30 minutes of above adjustment, confirm the condition of the flow rate. It must be kept in the required value.

Key points for start up procedures are as follows;
☆ Chlorine gas feeding into the tube or pipe from cylinder shall be conducted step by steps.

☆ Check for leaks of chlorine gas shall be done by as small amount of chlorine gas as possible at the first step.
☆ Check for leaks from cylinder to connection part and to manifold one by one. Do not feed the gas at the same time into the whole pipe line and facilities.
☆ Negative pressure shall be arisen from injector prior to feed chlorine gas into the manifold and the chlorinator.
☆ Required chlorine dosing rate shall be grasped prior to start up the chlorinator. Chlorine dosing flow rate is calculated by following formula;
Chlorine dosing rate: R (mg/l)
Chlorine dosing flow rate: W (kg/h)
Flow rate of the process water: Q (m3/h)
W = Q * R * 1/1000 -------- (kg/h)

3-3.Shut down procedures
Cases of shut down
- Operational shut down
- Long term shut down
-Changing cylinders
Procedures for shut down of chlorinator shall be according as the instruction manual issued by the chlorinator manufacturer.

General procedures are shown hereunder for reference.
-1. Close the master valve for cylinder and keep this condition for several minutes. Confirm that indication of the pressure in the manifold will be zero. Keep this condition for 10 minutes or more.
-2. Check for leaks of chlorine gas from cylinder and pipe connection parts.
-3. Close the inlet valve of chlorine gas to the injector.
-4. Stop the water supply to the injector. Close the inlet valve for the injector first and then close a outlet valve for the injector.
Regarding of actions for long term stopping of the facilities, refer to them instruction manual issued by a manufacturer of the chlorinator.
General Notes:
☆ To avoid water flowing into the chlorinator, be sure the procedures from-3 to -4 in above mentions.
☆ The often cause of the troubles for the chlorinators are the backward flow of the water into the chlorinator.

3-4. Monitoring and visual check of facility

Monitoring and visual check during operation shall be conducted according to the check list.

3-5 Operation procedures for control of facility

Dosing flow rate of chlorination shall be changed depend on the following;
- Free residual chlorine of the filtered water
- Required free residual chlorine for the network water
- Flow rate of the filtered water
Determination procedures of dosing rate are shown in ASL-WPS06-QC.

4. Operation under unusual condition

4-1 Prospect troubles and trouble shootings

4-1-1.Chlorinator
Troubleshooting of the chlorinator shall be conducted according to the instruction manual issued by the chlorinator manufacturer.

Examples of prospect trouble for reference are as follows;
-1.Gas leak
-2.The required gas feed rate is not achieved at start-up
-3.Out-of-gas indications occurs during normal operation
-4.Insufficient ejector vacuum
-5.Loss of gas feed
-6.Flowmeter ball bounced and/or maximum gas feed rate cannot be achieved during normal operation
-7.Flooded metering tube
-8.Vacuum leaks

4-1-2. Piping and valves
-1.Gas leak from
- Copper tube
-Connection part
-Valves

5. Records and Reports

5-1.Records

5-1-1.Records for operation condition

-1.Chlorine gas feed
- Pressure gauge indication of chlorine gas feed for the chlorine gas manifold

-2.Records for the chlorinator
- Chlorine dosing flow rate
- Water supply pressure fed to the chlorinator

-3.Indication of chlorine gas leak detector
-4.Visual check list in a routine work

5-2.Report

Reports are required as shown in the following;

5-2-1.Chlorine consumption records
- Weight of chlorine used each 24-hour period during a month
- Total weight of chlorine used for a month
- Average weight of chlorine dosed during a 24-hour period for a month
- Maximum weight of chlorine used during any 24-hour period during a month
- Minimum weight of chlorine used during any 24-hour period during a month

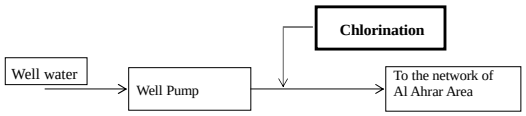
5-2-2. Recommendation on facility
- Rehabilitation and upgrading
  - Repairing
  - Replacement
  - Repainting
  - Additional parts or facilities
  - Required spare parts
- Recommendation on modification of the criteria
- Recommendation on training for persons
- Recommendation on review of O&M plan

Plant Name: **Aslougi WPS**	Title **Chlorination Facility**	SOP TAG No. **ASL-WPS06-QC**

Issued		Developed by		Signature	
Revised		Approved by		Signature	

Introduction

The chlorination facility in Aslougi Well Pump Station (ASL-WPS) is chlorination dosing system to the transmission pipeline for the purpose of maintaining the free residual chlorine in the network.



1. SHAPWASCO Regulation

According to the water quality control regulation of SHAPWASCO, required residual chlorine concentration in the network is 0.5 mg/l in summer and 0.3 mg/l in winter for the water which source is groundwater. Residual chlorine measurement shall be done on the distribution system at the area farthest from the source of the station. This ensures that the entire distribution system is receiving enough chlorine.

2. Monitoring Frequencies

2.1 Frequency of free residual chlorine measurement
- At the station: Once a day
- At Al Ahrar service area: once a day

2.2 Frequency of chlorine demand test
- For the well water: Once in six months and as the sample is taken for analysis

3. Water quality control under normal condition

3-1.Monitoring of the well water

3-1-1.Laboratory test of chlorine demand

Chlorine demand test shall be conducted according to the standard procedure in SHAPWASCO for general water quality analysis including sampling procedures for the following items:

- Turbidity
- Iron
- Manganese
- Ammonia
- pH
- Bacteria and coliforms
- Other items as require

3-2.Control of the chlorine dosing rate

Free residual chlorine in the distributed water shall be maintained at least 0.3 mg/l to 0.5 mg/l at any point of the farthest tap in the network. In the case that combined residual chlorine is used for chlorination, the total injected chlorine shall be 1 to 2 mg/l.

Free residual chlorine in the network is consumed during a distribution of the water. Consumed amount of chlorine is varied to the conditions in the network such as contamination, water temperature, condition of network pipe lines and so on.

The free residual chlorine in the distributed water at a point of the farthest tap in the network shall be measured periodically according to the frequency of the criteria.

The control action of free residual chlorine shall be done by following activities;

-1.Set a target for the distributed water at a point of the farthest tap in the network

-2.Confirm the well water connected with the network
- Numbers of the well stations
- Free residual chlorine from each well station
- Flow rate of the distribution water from each well station

-3.Set the target for the supply water

-4.Set the chlorine dosing rate

-5.Confirm the flow rate of the supply water

-6.Set the chlorine dosing flow rate by the chlorinator

-7.Monitor the free residual chlorine in the water
- The supply water
- The distributed water at any point of the farthest tap in the network

-8.Compare the monitored data with the targets

-9.Determin whether the chlorine dosing rate is to be changed or not?

-10.If a chlorine dosing rate shall be changed, change a dosing flow rate by

operation of the chlorinator to be increase or decrease

-11. Monitor the free residual chlorine in the water
- The supply water
- The distributed water at a point of the farthest tap in the network

-12.Compare a monitored data with the targets

-13.Determin whether the chlorine dosing rate is to be changed or not?

-14.Repeat from control actions 11 to 13 in the routine work

3-3.Visual check of operation condition

Operation condition of the chlorination facilities shall be checked in the routine work to confirm proper operation of the facilities.

4. Operation under unusual condition

4-1 Prospect troubles and trouble shootings

Insufficient free residual chlorine in the supply water at the station and/or distribution water in the network

5. Record and report

5-1.Records

5-1-1.Records for water quality
- Free residual chlorine with general water quality analysis results of supply water and the distributed water at any point of the farthest tap in the network

5-1-2.Records for the chlorinator
- Chlorine dosing rate and dosing flow rate

5-1-3.Records for visual check
- Check list use in the routine work

5-2.Report

Reports are required as follows;

-1. Free residual chlorine measurement

-2. Consumption of chlorine

5-2-2. Recommendation on facility
- Rehabilitation
  - Repairing
  - Replacement

- Additional facility

- Recommendation on modification of the criteria and SOPs
- Recommendation on training for personnel
- Recommendation on review of O&M plan

Plant Name: **Aslougi WPS**	Title **Elevated Tank**	SOP TAG No. **ASL-WPS08-OP**

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1. Description of the facility

1-1.Outline of process and facilities

The Elevated Tank is provided to stabilize the flow and pressure in the network.

In Aslougi Well Pump Station (ASL-WPS), a reinforced concrete elevated tank is provided for the water supply to AL Aslougi service area. Its upper tank has 200 m3 storage capacity and 36 meter height.

There is only one device to control and operate the elevated tank, i.e. a valve in the rising pipe.

1-2. Function of the Elevated Tank

Functions of the Elevated Tank are to buffer the surplus water/pressure in the network and to cover the peak water consumption exceeding the pump supply capacity.

1-3.Impact of facility

The Elevated Tank is a large scale civil structure but a quite effective facility in the water supply network.

1-4.Relation with other facilities

1-4-1.The well pump

It is rather special case but in ASL-WPS the elevated tank is by-passed from the transmission pipe to Al Aslougi area and is not connected directly from the well pump concerned.

2. The criteria for operation

There is no operation required for the elevated tank and the criteria for operation do not exist.

3. Operation under normal condition

Usually the well water passes through the Elevated Tank and valve in the rising pipe is opened. Hence, any operation or control under normal condition is not required for the Elevated Tank, but monitoring is needed to confirm that unusual condition does not exist. Check list for monitoring and visual check is provided in ASL-FRP03-OPCL-01.

When the upper storage tank is cleaned, the valve in the rising pipe for the Elevated Tank shall be closed and emptied by drainage pipe.

4. Operation under unusual condition

4-1. Prospected unusual condition

Unusual condition of the Elevated Tank is prospected simply to loose storage function as follows;

- Leakage by concrete structure problem
- Contamination by flown waste
- Trouble in the rising pipe and valve

4-2.Troubuleshooting

Troubleshooting for the above situation shall be just closing the valve in the operation and remedial maintenance works shall be conducted as required.

5. Records and reports

5-1.Records

Records of monitoring and visual check for the Elevated Tank.

5-2.Reports

5-2-1.Annual report
- Report of the corrective action (as needed)
- Report of the preventive action (as needed)

5-2-2.Recommendation
- Rehabilitation and upgrading
- Review of SOPs

Station Name: **Aslougi WPS.**	Title **Elevated Tank**	SOP TAG No. **ASL-WPS08 -MT**

Issued		Developed by		Signature	
Revised		Approved by		Signature	

Introduction

Generally, maintenance activity of the Elevated Tank is not conducted as a routine daily maintenance, but along with the scheduled maintenance of the station.
Structure and devices to be maintained in El Aslougi Well Pump Station (ALS-WPS) are as follows;

- Upper storage tank structure with steel stairs
- Level guage
- Rising pipe with a pressure gauge
- Overflow pipe

The tank structure, water supply pipe, and drainage pipe are inspected and cleaned. Cleaning of the tank is the main activity..

1. Criteria for maintenance

Major maintenance activity for the Elevated Tank is to clean the upper storage tank. Inside and out side. Condition of the tank shall be checked and confirmed.
- Frequency of cleaning and inspection of the tank
  - Cleaning work: Once 3-6 months
  - Inspection and repairing: Once a year
- Acceptable time to stop the function of the Elevated Tank
  - In winter season: 6 hours

Criteria for maintenance activity of the other ordinary devices other than the tank shall be followed to the similar maintenance procedures.

2. Maintenance activity

In order to judge the necessity of maintenance activity such as adjustment, repairing or replacing, following four steps shall be considered for the Elevated Tank;

-1. Monitoring and checking during operation
-2. Inspection
-3. Evaluation and analysis of inspection results

-4. Maintenance work

2-1.Monitoring and visual check

Monitoring and visual check shall be carried out according to “O&M schedule” and unified check list.

2-2.Inspection

Inspection shall be carried out according to “O&M schedule” and unified check list.

- External check of the tank
  - Appearance of crack on the tank
  - Leak of water from the tank
  - Foreign substances such as flying waste of vinyl materials, birds dropping and so.
- Cleaning of inside of the tank and overflow piping
  - Flushing away sludge by pressured water
  - Brushing away to remove adherent algae on the wall

2-2-1.Cleaning of the tank

- Make a plan and time schedule for cleaning
- Procedures for drainage of water in the tank
- Procedures for cleaning of the tank

2-2-2.Inspection procedure

Inspection check list shall be provided on the following items;

- Inspection of the tank
- Inspection of the rising pipe
- Inspection of the float and level indicator with wire
- Inspection of overflow pipe

2-3. Evaluate and analysis of the inspection result

After inspection following items shall be evaluated;

- Necessity of maintenance action
  - Corrosion
  - Crack in the wall or bottom of the tank
  - Water leakage

2-4. Maintenance after the inspection

Following shall be conducted for the maintenance work;

- Repairing cracks, leakage parts and broken parts
- Repainting
- Maintenance of the piping and valve
  - Supplying grease as needed
  - Change of parts as needed
  - Replace the valve as needed or periodically
  - Repairing of leak part pipe and connection

3. Procedures under unusual condition

3-1 Prospect troubles

As mentioned in operation procedures, unusual condition of the Elevated Tank is prospected simply to loose storage function as follows;

- Leakage by concrete structure problem
- Contamination by flown waste
- Trouble in the rising pipe and valve

3-2.Troubuleshooting

Once the above situation happens, shut down the elevated tank by closing the valve and remedial maintenance works shall be conducted as soon as possible.

4. Records and Reports

4-1.Records

Records for maintenance of the Elevated Tank shall be prepared as follows;

4-1-1.Record of monitoring and visual check
4-1-2.Record of inspection
4-1-3.Record of maintenance work

4-2.Reports

Reports for maintenance of the Elevated Tank shall be prepared as follows;

4-2-1. Summery of the Maintenance Records
4-2-2. Recommendations (as needed)

- Review of maintenance procedures
- Improvement of facility
- Upgrading or rehabilitation of facility
  - Replacement of facility

- Repairing of facility
- Review of SOP

SOP for Qenayate FMRP

Plant Name: QENAYATE FMRP	Title **General**	SOP TAG No. QEN-FMRP-G

Issued		Developed by		Signature	
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1- Water Sources

Generally, water sources are classified as two sources; surface water source and underground water source. The surface water source includes rivers, water passes, lakes or water behind dams. The ground water source includes wells and springs.

Wells are the water source for QENAYATE FMRP

3- Operation steps

Operation steps is the sum of activities through the different operation process, this activities are divided to 12 as detailed starting from **QEN-FMR01-OP** up to **QEN-FMR12-OP,** this activities shall be explained in normal conditions or emergency cases

3-1- Operation in normal condition

Operation under normal conditions shall be explained in details for each activity in the standard operation procedures SOP

3-2- Operation in emergency cases

Operation under emergency cases includes up normal conditions such in case of sudden pollution of well water or power cut or work stop in major treatment facility …….etc

3-2-1- Expected problems and trouble shooting

The expected problems can be easily known from the past operating records and operators experiences analysis

3-2-2- Analysis of past problems, causes, and remedy actions

Study and analysis of some problems happened in past will help to solve existing problems and this will help to reach to the following occlusions ;

- ✓ Detect the weak points due to operation
- ✓ Detect the weak points due to design
- ✓ Detect the weak points in operation and maintenance
- ✓ Detect the weak points due to technical conditions for equipment
- ✓ Reference to problem analysis procedure
- ✓ Reference to what we need to reach to the cause of the problem
- ✓ Reference to what is not allowed to avoid the problem
- ✓ Etc.

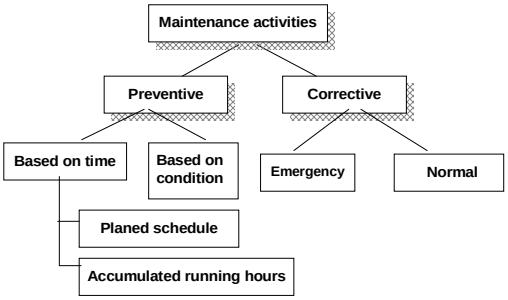
All data and actions related to the problem must be collected and recorded in one file as a reference to avoid repeating the problem

4- Maintenance activities

4-1 Maintenance activities references

4-1-1 General idea

Maintenance references are used to show the impotence of the activity including maintenance, replacement, check, for all or part of equipment. It is divided to preventive maintenance and corrective maintenance as shown in the following figure



The preventive maintenance is divided into two types, one of them based on time and the other is based on technical condition of equipment. There is a difficulty to evaluate the depreciation rate of the equipment

Time based maintenance either to be according the planned schedule or based on actual accumulated working hours for the equipment

The corrective maintenance is divided into two types; one of them is emergency corrective maintenance and normal corrective maintenance. In normal corrective maintenance good monitoring and periodic check for equipment should be applied to detect any up normal condition for the equipment

The classification of the maintenance and which type shall be applied should be based on activity and related equipment

Maintenance activities include monitoring, check and recommended action either by change, repair or improvement. The maintenance activities include four actions as following:

1. Mentoring of the equipment condition and performance
2. periodical check
3. analysis and evaluation
4. repair after check

4-1 mentoring of the equipment condition and performance

Mentoring and check shall be based on time schedule for operation and maintenance

4-2 periodical check

Periodical check shall be for all equipment in the external exposed parts as well as internal parts to be sure that the equipment is suitable and capable to perform well and the number of check and period shall be based on each equipment function and should be scheduled and documented

4-3 analysis and evaluation

The importance of repair is related to the importance of equipment and operation condition and the condition of parts and if it is subject to wear or rust.

The analysis of repair should include cost and risk and time required for maintenance and spare parts availability before the starting of maintenance activity

Discover the problems in early time and repair shall make long lifetime for equipment

4-4 repair after check

Replacement, repair or change the equipment depends on the spare parts availability. Sometimes only greasing and cleaning are only required

5- Quality control

Water quality control should be effectively applied and data analysis are required to forecast any future problem and review treatment process

It is important to monitor and check all water process steps for economic operation and prevent any of the process function from being overloaded due to improper operation for previous step

6- Records and Reports

Records and reports is one of the important activity which help in analysis and considered as on of the very important documents for personnel communications inside or outside the plant

These records will help in improvement of operation and maintenance and avoid repeating of problems

1. General information of the plant

1-1.General information

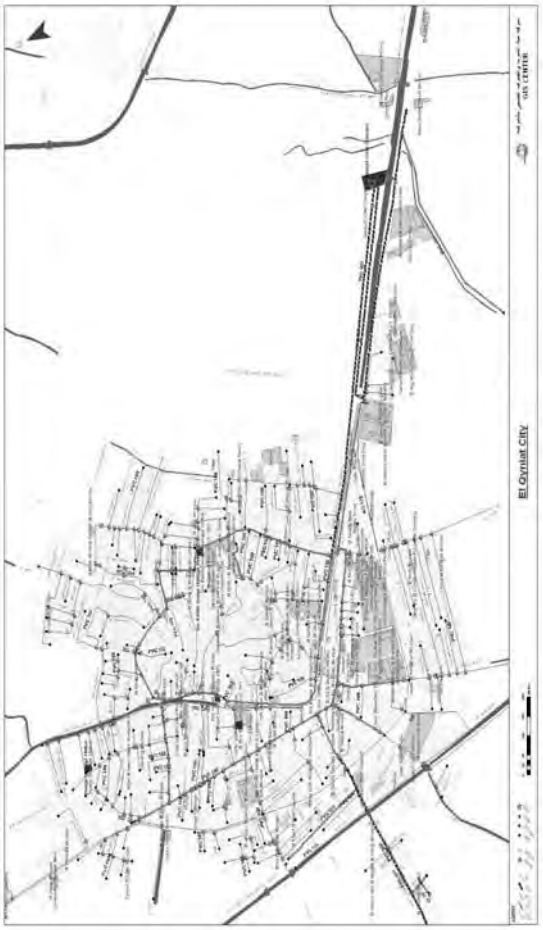
1-1-1. Location
Qenayate Iron/Manganese Removal Plant (QEN-FMRP) exists in Qenayate City It is Located at 30°36' 36.5" North and 31°26'18.3" East.

1-1-2. Construction Phases
Qenayate Iron/Manganese Removal Plant was constructed in 1996 as one of the standardized model plants in Egypt and rehabilitation in 2008.

1-1-3. Source of water
The source of raw water for this plant is well water. Four wells of approximately 70 meter depth and 25 cm diameter casing and screen, are available in this plant but. Two of them are used alternately on duty and another two well are stand-by

1-1-4. Type of treatment process
Iron/manganese removal plant is a treatment plant reducing the iron and manganese contents contained in the source ground water by applying the aeration and chlorine oxidization and contact oxidization filtering process.

1-1-5.Nominal treatment capacity
Nominal Capacity for the plant is 7000m^3 per day with one unit of oxidization tower and three units of filter tank.



1-1-6. Service areas and connections to the distribution network

1-1-7. Organization and stuff formation

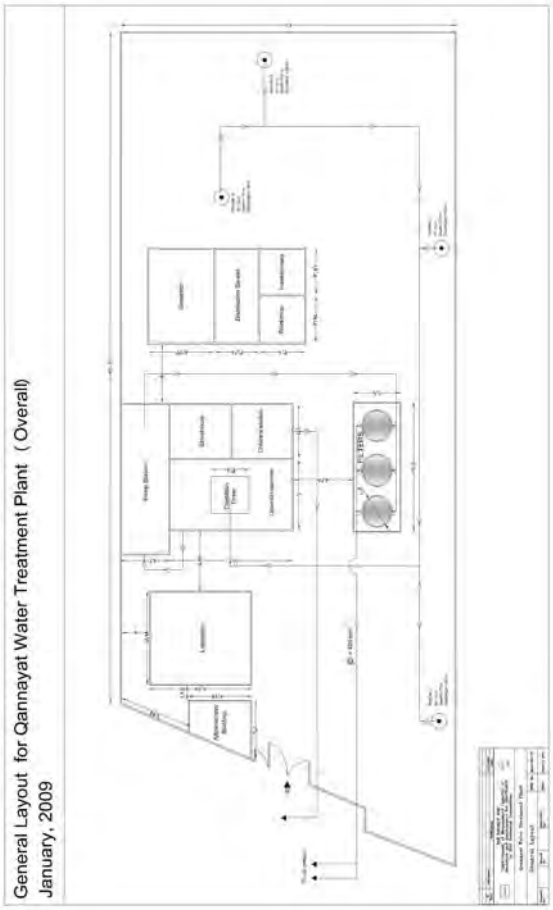
In the organization of SHAPWASCO, responsible person for the final water quality of the Plant to the network is

Operation/Maintenance Team in Qenayate Iron/Manganese Removal Plant

No.	Name	Position	Remarks
1	Mr. Adel Abu El yazied	Plant Manager	All of them Responsible for both Qenayate FMR
2	Mr. Seleem Abd Allah	Technical Supervisor	
3	Mr. El Said Ibrahim	Technical Supervisor	
4	Mr. Fatehey Hamad Bendary	Technical Supervisor	
5	Mr. Mohamed Gamal	Labor	
6	Mr. Mohamed Hussein	Labor	
7	Mr. Mahmoud Mahmoud Ali	Labor	
8	Mr. Aoni Abd El Mohsine	Labor	

Members of Laboratory and Maintenance of Chlorine Facility in the Branch

No.	Name	Position	Remarks
1	Mr. Attia Goda	Laboratory manager	Responsible for all of the branch
2	Ms. Naglaa Mohamed	Chemist	
3	Mr. Esam Saleman	Chemist	For Zagazig Markaz and Qenayate city
4	Mr. Said Syam	Cl. Maint. Supervisor	
5	Mr. Mohamed Mahmoud Hassan	Lab. Supervisor	



1-1-8.General Layout

1-2.Components of process and facility in iron manganese removal plant

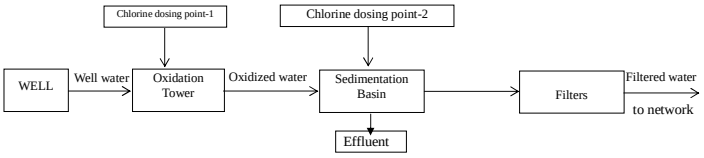
There are relations and connections between unit processes in iron manganese removal plant (abbreviate as FMRP) .

1-2-1 Components of unit process

Six (6) unit processes are provided in Qenayate FMRP as follows;

-1. Production wells
-2. The water feeding process by well pump
-3. Chlorine dosing process
-4. Oxidization Towers
-5. Sedimentation Tank
-6. Filter Process

1-2-2. Block flow diagram



1-2-3 Components of facility in each process

Components of facility in unit process are as follows;

1-. Production wells
This process includes following;
- Wells with sufficient yield capacity

2- The water feeding process by well pump
This process includes following;
- The well pump

3- Chlorine dosing process
This process includes chlorine facility as follows;
- Chlorine cylinder
- Chlorine gas piping and valve
- Chlorinator
- Feeding pump
- Chlorine leakage detector

4- Oxidization Towers
This process includes following;
- Upper tank to distribute water
- Aeration tower
- Chlorine dosing point-1

5- Sedimentation Tank
This process includes following;
- Detention tank

- Inlet piping for filter pump
- Chlorine dosing point-2
- Effluent drainage piping of oxidized iron particles

6-. Filter Process
This process includes following;
- Filter pump
- Contact oxidization filter tank
- Backwashing system
- Transmission piping to the network

1-2-4.Specifications of all machines and devices in each facility
Refer to attached facility list in APPENDIX.

1-3.Basic system on facility operating and process control

1-3-1.Basic system on unit process control
- Process control: All unit processes are controlled manually except filter washing process that controlled automatically
- Water quality control

Water quality analyses in the various processes should be carried out manually by chemists as scheduled. Free chlorine residual in the various process points are monitored continuously by the instrument of free chlorine residual meter.

1-3-2. Basic system
- Operation of facility
- Start and stop of the well pump will be operated manually
- Control of process: Manual control for all process except filter washing process
- Monitoring of water quality: Refer to above mentions

1-3-3. System of processes

1- Production wells
- Four wells are available and any two wells are able to yield water plant design capacity.

2- The water feeding process by well pump
- Total four pumps are available, one pump installed for each well with sufficient capacity and head.
- Feeding water to the Plant can be controlled by the number of operated pumps

3- Chlorine dosing process
- Chlorine cylinder: 50kg
- Chlorinator

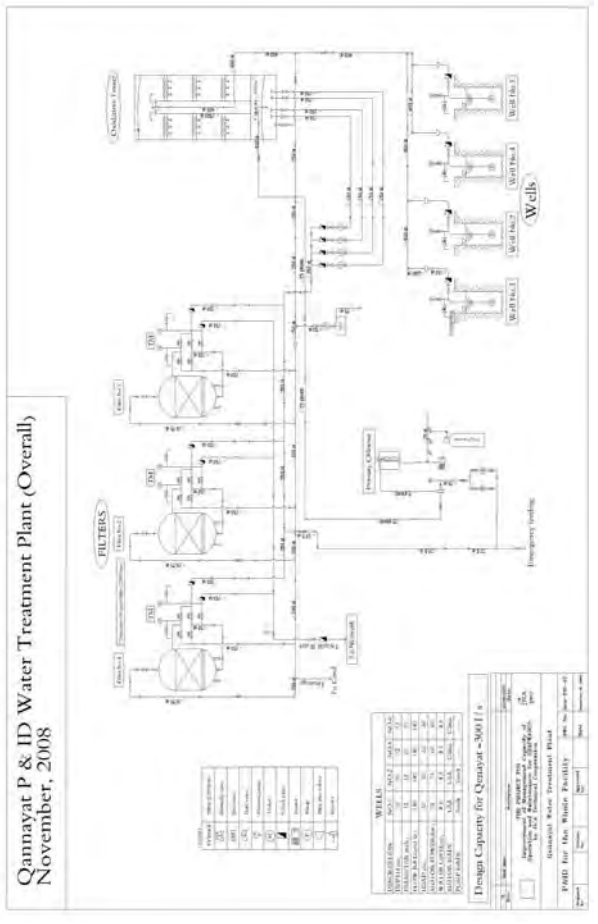
Two sets of chlorinators are available and one will be used for duty and the other for stand by.
- Type of chlorinator: Injector vacuum type
- Type of operation: Manual operation
- Type of dosing flow rate control: Manual control

Two dosing points are prepared.
- Injection point-1: Feeding pipe of the Oxidation Tower
- Injection point-2: Sedimentation tank

4- Oxidization Towers
One unit of reinforced concrete oxidization tower is available.
- Aeration tower: five stages with each height of seven (3) meters

-5. Sedimentation Tank
One unit of reinforced concrete sedimentation is equipped under the oxidization tower.
- Detention tank
  - Capacity: 300m3 with a baffling chamber
  - Detention time: 2 hours
- Chlorine dosing point-2

-6. Filter Process
Three units of sand filter and filter pump system are available for the design flow rate of the Plant.



1-3-4. General P&ID Diagram

2. Overview of the SOPs of the QEN-FMRP

2-1 Purpose of SOPs

Purpose of SOPs is to provide assistance to the water supplier in the operation & maintenance (O&M) and water quality control (WQC) procedures for the equipment, facility or process in the iron manganese removal plant.

2-2. Priority Issues to be addressed in SOPs

According to the results of current field survey of the plant, priority issues for the O&M to be addressed in these SOPs are identified as follows;

2-2-1. New Egyptian Potable Water Standards
According to the Decree 258 by Ministry of Health, new "Limits of the criteria and specifications of the potable and domestic water" (Egyptian Potable Water Standards hereinafter) were regulated dated October 21st, 2007 and new limits of Fe and Mn concentrations are as follows;

Maximum allowable limit
Fe: 0.3 mg/litter
Mn: 0.4 mg/litter

2-2-2. Function of Sedimentation Tank
There equipped a sedimentation tank under the oxidation tower with a chlorination injection point and effluent drainage piping but actual effect of this sedimentation in the process is not clear while effluent is drained every fifteen days in current operation and water qualities in this process were not analyzed in detail. Clarification of the function of the sedimentation tank and formulation of correct operation procedures for the Qenayate well water are important.

2-2-3. Full-utilization of Filter Equipment
As described in detail in the SOPs of the following chapter, the contact oxidization process applied for this filter system of the Plant requires strict free chlorine residual control for activating manganese sand to achieve effective manganese removal. Effort on full-utilization of the filter system shall be made by both operation (process water control) and maintenance (filter media conditioning).

2-3. Application of SOPs

SOPs should be applied surely to actual O&M and WQC. However, SOPs are not necessarily constant and subject to change. SOPs should not only be kept as documents but also be utilized as tools for O&M and WQC activities. Since SOPs must be utilized in actual activities, they should be reviewed and revised so that they can be suitable and useful anytime in any situation for water supplier according to evaluation of utilized results. We should find improved results of O&M and WQC activities whenever we review and revise SOPs.

2-4. Component of SOPs

SOPs for FMRP consist of eleven (12) SOPs component units and these components are shown in "SOPs Headline". Each SOP consists of three (3) SOPs packages as follows:

- SOPs for operation
- SOPs for maintenance

- SOPs for water quality control

2-4-1. SOPs for Operation

Documents which require criteria and procedures for operation and control activities of facility are provided in this SOPs and include the following:

- Explanation of process and relation between other process
- Criteria for operation activity and design
- Operation and control procedures for facility in normal condition and unusual condition
- Monitoring and visual check items for facility
- Reporting and recording system

2-4-2. SOPs for Maintenance

Documents which require criteria and procedures for maintenance activities of facility are provided in this SOPs and include the following:

- Criteria for maintenance activity
- Maintenance procedures for facility in normal condition and unusual condition
- Monitoring and visual check items for facility
- Reporting and record system

2-4-3. SOPs for Water Quality Control

Documents which require criteria and procedures for water quality control and process control are provided in this SOPs and include the following:

- Criteria for water quality control activity
- Water quality control and process control procedures in normal condition and unusual condition
- Monitoring and visual check items for water quality and process
- Reporting and record system

2-5. Review of SOPs and O&M plan

SOPs is one of tools to perform optimum O&M and WQC activities and results and as the result to improve management of iron manganese removal plant operation. We can realize and find in our O&M activities should be modified or arranged for improvement such as more simple, effective or suitable method, by utilizing of SOPs. When we find part to be modified or arranged for improvement in SOPs, we should approach to review SOPs to be proper according to prepared procedures, as soon as possible if necessary.

2-5-1. Review of O&M and WQC activities

Review of SOPs should be carried out periodically not less than once a year and properly if necessary. After review of SOPs, SOPs should be updated to revised version. Records of SOPs review and histories of review must be required to issue and keep them. Records of view should include the following:

- Activities before review and after review and reviewed reasons
- Signatures of approved persons, date of review
- Results of review
- Marking of reviewed part and description of reviewed histories in revised SOPs documents

2-6. Preparation for making of O&M plan

O&M plan is developed to provide a material that can be easily referred to for guidance in operating a water system. The O&M plan will also provide ready reference for following;

- All equipment data which is necessary for performing normal maintenance
- Ordering replacement parts and supplies
- Organized system for keeping records of O&M of the system
- Water sampling, analysis and testing which required for compliance with regulations
- Monitoring of the treatment process for compliance with accepted waterworks procedures.
- Information regarding start-up and normal operating procedures and emergency operating procedures

O&M plan will become a training manual to provide personnel which handy source reference while they learn to operate the facilities. The experienced operator will usually refer to the O&M plan for confirmation of normal operation and maintenance procedures and as a reference guide for unusual operating conditions. The entry level operator should frequently refer to the O&M plan for guidance and instruction.

Plant Name:	Title	SOP TAG No.
Qenayate FMRP	**Water Well**	**QEN-FMR01-OP**

Issued		Developed by		Signature	
Revised		Approved by		Signature	

Introduction

Iron and manganese removal plant is a treatment plant reducing the iron and manganese contents contained in the source ground water.
In Qenayate Iron and Manganese Removal Plant (QEN-FMRP), the source of supplying water is well water. Four wells with approximately 70 meter depth and 10" diameter iron screen, are available in this plant but three of them are currently used as production well. The fourth well is replaced by a new one with 100m depth and 12" plastic diameter with pump flow rate of 50 l/sec.
The quality of the well water must be within limits of Standard Potable Water Specifications except for iron and manganese as the removal process occurs by the oxidation tower and some additional chemicals (potassium permanganate – sodium hydroxide – chlorine)
Production capacity of the wells (safe yield capacity) must be higher than the design treatment capacity of the plant of 7000 m3 per day and draw-down of dynamic water level must be less than the design figure for the horizontal pump (6m).
Draw-down of dynamic water level must be more than the design figure for the submersible or with above motor pump (5m).

Current well water quality and static water level by Inventory Survey in 2007 are as follows;

- TDS: 365 - 560 mg/l
- Iron: 0.39 - 0.52 mg/l
- Mn: 0.35 - 0. 5mg/l
- S.W.L: - 3.4 m from ground level

1. Features of process

1-1.Function of process

Function of the well is to produce water of design quantity and design quality within the design groundwater draw-down. The static water level in the well affects to the discharge pressure and quantity and if the water quality in the well is not in a good condition, it affects to the removal efficiency, survival of filtering media inside filters and chemical consumption rate.

The well water is fed from the wells by well pumps to the oxidation tower to start the aeration, oxidation and removal process.

1-2.Impacts of process

Wells are the first stage process in Qenayate Iron and Manganese Removal plant (QEN-FMRP).

Production capacity of the wells and water quality are essential value for the iron and manganese removal plant deciding the treatment capacity and operation procedures of the following processes.
Dosing flow rate of chlorine is linked with the sedimentation basin in the oxidation tower, well water flow rate and quality.

1-3.Relations between other processes

The static water level in the well affects to the efficiency, pump flow rate and produced well water.

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2. Criteria for operation

2-1. Water level

Static and dynamic water levels shall be not lower than the designed/planned figures for pumps . When the designed/planned water levels are not available at the initial stage of this SOP application, tentative static water levels are set up using current records of water levels and treatment operation and as follows :

1- Static water level should be recorded for each well
2- Dynamic water level should be recorded during operation for each well
3- Well Discharge flow rate should not exceed the design limits
4- The pump flow rate should not increase the safe yield capacity for the well
5- Check the well water level every 3 months to check the well efficiency and pump condition.

2-2. Well water quality

Water quality of raw well water shall be not higher than the designed/planned figures . When the designed/planned water qualities are not available at the initial stage of this SOP application, tentative water quality are set up using current records of water quality and treatment operation and reference figures will be finalized as soon as possible.
Since this plant has limited functions to reduce Iron and Manganese concentrations, The maximum acceptable figures for well water are as follow :
other water quality items than these two items shall not be higher than the Egyptian

potable standards.
Iron: 0.6 mg/l
Manganese: 1.2 mg/l
Sampling and analysis of raw well water quality should be conducted by daily routine work for main items and by monthly analysis for full standard items according to QC procedures..

2-3. Clean well sites

Well sites shall be kept clean from any contamination derived from either surface water or ground water. Visual check of cleanness of the well sites should be conducted by daily routine work.

3. Operation under normal condition

3-1.Start-up and shut-down procedures

3-1-1. Visual check of well sites
Well sites shall be checked visually and confirmed that surface water drainage and other well facilities are kept properly
3-1-2. Water level
Static water level in the observation well (old well) shall be measured and confirmed the value not lower than the designed/planned level.
3-1-3. Well water quality
Quality of raw well water shall be checked by the record of analysis of the previous day and confirmed their values no more than the designed/planned ones. Water sample shall be prepared for analysis for the day immediately after the pump operation.
3-1-4. Well change-over program
Based on the production plan of the day, well change-over program shall be fixed considering the optimum effect to the aquifers and wells.

3-2.Monitoring during operation

3-2-1. Water level
Static water level in the observation well (old well) shall be measured and confirmed the value not lower than the designed/planned level.

4. Operation under unusual condition

4-1 Prospect troubles and trouble shooting

4-1. Contamination
When any contamination such as surface rainwater flowing-in may be found, the plant shall be stopped immediately and remedial measures such as sterilization at well site.
Discharge to the network shall be resumed only after the effect of the action would be confirmed.
4-2. Water level
There are two kinds of abnormal draw-down of groundwater level, i.e. extreme draw-down of dynamic water level and long term static water level draw-down.
4-2-1. Clogging
Ground water flow may be reduced by clogging of inlet screen and/or surrounding aquifer layer and extreme draw-down will occur by pumping.
In this case, 1) pump operation shall be restricted to the level of normal draw-down, or 2) pumping well shall be changed to sound one where backwashing the concerned well may be applicable to restore or new complete well drilling may be required.
4-2-2. Long term static water level draw-down
With many reasons considered, ground water level may be drawn down in long term and may exceed the design/planned level. In this case, 1) operation by a value less than the design flow rate and 2) increasing pump total head capacity or adding new well shall be considered to secure the discharge capacity of the wells.
4-3. Water Quality
4-3-1. Iron and Manganese concentrations
When iron and manganese concentrations in well water exceed the design/planned figures, the plant shall be stopped immediately and it shall be confirmed whether remedial measure can be taken within the modification of operation procedures such as increasing chlorine dosing rate and oxidization time or total shut-down and full scale upgrading of the plant may be required.
4-3-2. Other water quality items other than Fe and Mn
When other water quality items other than Fe and Mn in well water exceed potable water standards, the plant shall be immediately stopped and the reason of worsened quality and remedial measure shall be clarified.

5. Report and record

5-1.Record

The Record for operation of the well sites should be required as follows;
5-1-1.Record of monitoring and visual check
Monitoring and visual check list should be prepared
Objects of monitoring and recoding are as follows:
-1.Visual check of the well sites and the oxidation towers.
-2. The water levels
- Static water level
- Dynamic water level
-3. Raw well water quality
- Iron and Manganese concentration
- Other potable water standard items

When unusual condition will happen, it should be recorded with immediate actions, remedial measures taken.

5-2.Report

Reports for operation of wells should be required as follows;
- Monthly and annual ground water extraction volume in the plant
- Monthly and annual ground water level fluctuation
- Monthly and annual ground water quality fluctuation
  - Iron and Manganese
  - Other items
- Required maintenance of wells
  - Washing well and screen for clearing clogging
  - Painting or replacing well casing, piping, valves etc.
  - Maintenance of surface water drainage at well sites

Plant Name: Qenayate FMRP	Title: Water Well	SOP TAG No. QEN-FMR01-MT

Issued		Developed by		Signature	
Revised		Approved by		Signature	

Introduction

Generally, maintenance activity of the water wells will be conducted not in a routine maintenance but conducted along with the periodical maintenance of the plant by cooperation with the responsible person from the branch and HQ
HQ Well team will put maintenance schedule for wells and revising it with the branch team.

1. Criteria for maintenance

Major maintenance activity for the wells is to secure the safe yield capacity required to produce planned treated water volume without negative effect.

Criteria

- Keeping the well yield capacity by periodical monitoring for static and dynamic well water level.
  Timing: according to the maintenance schedule
- Maintaining outlet pipes and valves properly painting or replacing.
  Frequency: Every 6 months
- Keeping well sites clean avoiding contamination by surface water and others for a distance not less than 5 m from each side around the well and in the same time monitoring of the well site has to be achieved by the operation team.
  Frequency: Once a month

2. Maintenance activity

Based on the above criteria, the maintenance activity consists of following three categories;

- When an observable draw down for the dynamic water level occurs while operation of well pump

The following procedures have to be achieved:

a) backwashing for the wells
a-1) backwashing for wells of slotted bridge pipe
a-2) wounded wells have to be replaced by new wells.

- Maintenance of the well casing, piping and valve, etc.

- Keeping well sites clean

2-1. Securing safe yield capacity

In order to secure the yield capacity, wells shall be backwashed regularly by the well section of the branch office. Frequency and timing shall be decided by examining the static and dynamic water level monitoring report prepared by plant operation team. When backwashing interval will be shortened and yield capacity can not be recovered by backwashing, new well drilling shall be prepared for the replacement.

2-2. Maintaining well casing and piping

As a part of maintenance activity for the piping and valves inside the plant, well casing and piping at well sites shall be maintained as below.
Inspection should be conducted regularly to ensure that facility should go on without accident during operation. Inspection list for well casing and piping shall be prepared as a part of plant piping and valves.

- Repairing
- Painting
- Replacing

2-3. Well sites cleaning

Around the well there shall be kept clean from any contamination by others. Daily visual checking shall be conducted on the following points and necessary maintenance shall be made as required.

- Surface water drainage
- Protection from oil and grease
- Protection from animals

3. Report and record

Hence, the record and report are essential for O & M in FMRP. All the maintenance activities done shall be recorded and summarized monthly and annually together with operation records of the whole plant. These reports can be taken into consideration for the preparation of O&M plan for the next year.

Plant Name: Qenayate FMRP	Title: Well Pump	SOP TAG No. QEN-FMR02-OP

Issued		Developed by		Signature	
Revised		Approved by		Signature	

Introduction

The four wells (two wells of four are used interchangeably) are used as the water source and supply the ground water to this plant.
The ground water in the well is sucked by the well pumps installed beside or inside of the wells and discharged to the oxidation tower though the well water pipe.

The well pump facility is consists of following equipment;
-1.The well pump: Submersible pump and horizontal pump
-2.Pipes and valves: Carbon steel, sluice valve and the swing type check valves

Four discharge pipes from the four well pumps are connected each other, after that distributed to two lines for the two oxidation towers. Sampling tap for raw well water is provided on the discharge pipe of each well pump.

1. Features of process

1-1. Function of process

Function of the well pump is to transfer the ground water into the oxidation tower with required quantity and water pressure.

1-2. Impacts of process

The well water flow rate is essential value for iron and manganese removal process.
For determination of capacities of facility are based on the well water flow rate based on the safe yield capacity of the wells.

1-3. Relations between other processes

1-3-1.The well
The water level in the well affects to the discharge pressure and quantity and water quality in the well affects to the removal efficiency.
1-3-2.The oxidation tower
The oxidation tower is located after the well pump facility.
The well water is fed by the well pump to the oxidation tower.

2. Criteria for operation

2-1.Schedule for working of pump

The well pumps shall be operated according to the operation schedule.
Usually a pump will be operated automatically depends on the water level in the sedimentation basin. Four well pumps are available and one or two of them are operated depend on the demand in the network.
Working pump shall be changed periodically so that working cycle of pump is 24 hours

2-2.Indication of discharge pressure gauge of pump

Proper pressure gauge indication: Lower limit -----bar
Upper limit-----bar

3. Operation under normal condition

3-1.Start-up and shut-down procedures

3-1-1.Pre-start check
The well and well pump shall be selected before start-up operation.
-1.The Valve in discharge line
All valves in discharge line of the well pump shall be kept in working condition because that pump will start and stop automatically.
The sampling tap in discharge line shall be closed.
-2.Electrical switch board
Power shall be supplied.

3-1-2.Start-up
-1. Under automatic mode
Usually the well pumps shall be started and stopped by the level sensor automatically depends on the water level in the sedimentation basin.
The valves in the discharge pipes of the well pump are opened usually. The well water supplied to the oxidation tower will be sprinkled from holes of upper tank of the oxidation tower immediately after the start of the well pump.
-2. Under manual operation mode,
The start switch on switch board is turned on to start the well pump and the common checking, unusual noise and vibration of the well pump and leak of water are followed after start.
Pressure of discharge line is confirmed by the pressure gauge;
Indication of pressure gauge shall be ----bar or more.

3-1-2.Shut down

-1. Under automatic mode

The well pumps are usually stopped automatically depends on the water level in the sedimentation basin.

-2. Under manual operation mode

The stop switch on switch board is turned off to stop the well pump and common checking are followed after stop

Water level in the sedimentation basin is monitored and pumps shall be operated so that the water level is within proper range.

The water in the sedimentation basin shall be discharged through the effluent from the basin when the water level will not be detected by the level sensor correctly.

Working time of the well pumps shall be checked from start to stop of each well pump.

3-2.Monitoring and visual check during operation

Monitoring and visual check of the well water pump is a very important activity.
It shall be conducted not less than twice a day by prepared check list.
If unusual condition will be found, corrective action shall be conducted immediately.

3-3 Operation for control

The water flow rate is one of the most essential value for the operation of water treatment process.

The well water is oxidized by the aeration process in the first step and treated water is drawn into the sedimentation basin and stored for next filtration process.
The water from sedimentation basin is fed into the filter and filtered water is supplied to the network directly without the clear water tank.

Hence, control of the water level and working number of the well pump is important activity for operation of the plant.

The nominal treatment capacity of the plant is 7,000 m3/day and the two well pumps can cover the capacity. Therefore usually two well pumps are operated but the working number of the well pumps can be reduced when consumption volume of clear water in the network is low. Locally the control of the working number of the well pumps is conducted depends on the water level in the sedimentation basin which reflects the demand fluctuation in the network.
In normal operating condition, the working time of well pump shall be limited 3-4

hours for one continuous operation.

4. Operation under unusual condition

4-1 Prospected troubles and trouble shooting

-1. Discharge pressure is not enough
-2. Discharge pressure is too high
-3. Discharge quantity is not enough
-4. The water level in the sedimentation basin is not enough
-5. Mechanical or physical trouble of the pump
-6. Electrical power failure

Trouble shooting is shown as QEN-FMR02-OPTS-01.

5. Report and record

5-1.Record

The Record for operation of well pumps shall be as follows;

5-1-1.Record of working of the pump

-1.Time in operation of the each well pump

-2.Operation condition

- Discharge pressure, quantity, electrical current, and so on

-3.Water level in the well

-4.Unusual condition of the pump

5-1-2.Record of the water level in the sedimentation basin

5-2.Report

Reports for operation of well pumps shall be required as following;

5-2-1.Unusual condition in working

5-2-2.Monthly report

-1.Time in operation of each pump

-2.Recommendation on operation

5-2-3.Annual report

-1.Time in operation of each pump

-2.Recommendation on operation

Plant Name: **Qenayate FMRP**	Title **Oxidation Tower**	SOP TAG No. **QEN-FMR03-OP**

Issued	7/nov.	Developed by		Signature	
Revised		Approved by		Signature	

1. Description of the facility

1-1.Outline of process and facilities

The oxidation tower is provided to oxidize the iron contained in the well water and feed the oxidized water into the sedimentation basin.
The oxidation process of contained iron in the well water is progressed in the 2 steps of the process.
The first step of the process is the aeration by the sprinkling of the water through the oxidation tower and the second step of the process is the chlorination by chlorine dosing after oxidation process.

In Qenayate FMRP, one oxidation tower and one sedimentation basin are available. Two dosing points are available for the chlorination. one dosing point of two are located on inlet of the oxidation tower (dosing point-1) and another one is located on inlet of the sedimentation basin (dosing point-2). Dosing points can be changed by the change over valves
Dosing points-2 can be used under usual condition of the well water quality.
Dosing point -1 can be used under unusual condition of the well water quality when ammonium contains will be detected approx. 0.2 mg/l or more.
It should be needed approx. 40 minutes or more for the oxidation reaction of ammonium in the process water. And detention time in the sedimentation basin will be 2 hours. or less. Hence detention time of the ammonium in the sedimentation basin will be not sufficient by chlorination of dosing point-2 for the well water contained ammonium.
The well water is sprinkled through the oxidation tower and oxidation is performed by 5 steps of sprinkling. The well water is fed into the top floor of the oxidation tower and the water is sprinkled from many holes in the bottom of the floor to the next floor. 5 floors with holes are available in the oxidation tower.
There is no device to control or operate the process in the oxidation tower.

1-2.Function of the receiving well (Distribution shaft)

Functions of the oxidation tower are required to receive the well water from the well pump, to oxidize iron and manganese in the well water and to feed the oxidized water into the sedimentation basins.

1-3.Impact of facility

The oxidation tower is the first step of oxidation of the iron contained in the well water by contact with the well water and oxygen in the air. This contact will be performed by sprinkling of the water.

1-4.Relation with other facilities

1-4-1.The well pump

One well water pipe is available connected with one oxidation towers
the well water is distributed to the oxidation tower and outlet from oxidation tower is fed into the sedimentation basin.
The equal distribution of the well water quantity should be controlled by opening of the valve before the oxidation towers. The well water quantity to the each oxidation tower cannot be confirmed.

1-4-2.The sedimentation basin

The outlet water from the oxidation tower flows into the sedimentation basin by gravity.

1-4-3. Chlorine dosing for oxidation

Prior to flowing into the sedimentation basin of the oxidized water, chlorine is dosed into inlet of the sedimentation basin.
Chlorine oxidizes the iron in the process water mainly.
Effectiveness of oxidation depends of pH of the process water and it will be effective in high pH, it will be around.8.5, condition of the process water.
When pH is not high enough to oxidation of iron contained in the well water, aid by chlorination for oxidation is effective.
Theoretically, 0.635 mg/l amount of chlorine will be required to oxidize 1mg/l amount of iron in the process water. But organics and ammonium will be contained in the well water actually. Hence, dosing rate of chlorine should be determined depend on the well water quality.
For reference;
Theoretically, 7.6 mg/l amount of chlorine will be required to oxidize 1mg/l amount of ammonium in the process water.

2. The criteria for operation

The criteria for operation do not exist.

3. Operation under normal operation

Usually the raw water passes through the oxidation tower and, inlet valve will be opened. Hence, any operation or control does not need under normal condition for the oxidation tower but monitoring should be needed to confirm that unusual

condition does not exist. Check list for monitoring and visual check is provided in QEN-FRP03-OPCL-01.

When the sedimentation basin will be cleaned, the inlet valve for the oxidation tower to be cleaned will be closed.
When restart the oxidation tower, the inlet valve should be opened and drained out the outlet water from the oxidation tower from drain valve in the sedimentation basin to clean the oxidation tower initially. chlorine should be dosed usual dosing rate during draining. After cleaning of the oxidation tower should be confirmed, drain valve should be closed and the well water should be fed into the oxidation tower continuously and outlet water from the oxidation tower should be fed into the sedimentation basin. Free chlorine residual in the water should be monitored periodically by sampling from the sedimentation basin.

4. Operation under the unusual condition

4-1.Typical unusual condition

Unusual condition of the oxidation tower will be a case that function will be insufficient, that will be insufficient even distribution and insufficient sprinkling of the well water.
The insufficient even distribution of the raw water quantity can be confirmed by observation of sprinkling condition in the oxidation tower.
Even distribution of the well water to the oxidation towers can be done by control of valve opening in inlet pipes.
Insufficient sprinkling of the well water will be caused by clogging of holes for falling down of the water. After confirming of the sprinkling condition of the well water, clogging holes should be cleaned.

4-2.Troubuleshooting

Troubleshooting is provided in QEN-FMR03-OPTS-01.

4-3.Trouble in the past and cause, background and events for recovery

- Trouble history -

Examples of trouble in the past will be useful for applying to solve the trouble happen in the present. Trouble history, we will call the data of trouble in the past, should be applied to following job;

- Recognition of weak point of facility cause of use
- Recognition of weak point of facility cause of design
- Recognition of weak point of activity of operation and maintenance
- Recognition of wear of facility or part of facility

- Reference for approach way and procedures to the trouble
- Reference for “Need to know” to approach the trouble
- Reference for “Prohibit to do” to approach the trouble
- And so

Information for trouble history should be collected and put into unified sheet.
Trouble history should refer to QEN-FMR02-OPTH-01.

5. Report and record

To perform a rational O&M activity of FMRP, O&M activities should be carried out according to not only our experiences and hunches but also utilizing of statistical and mathematical approach by prediction, analysis and trial action to aim for the optimum result.

Hence, the record or report is one of essential and fundamental documents for O & M in FMRP. Reporting is activities of making documents and communication with persons inside and outside of FMRP according to utilizing of records, reports, data and other facts. Reports are including periodical reports such as monthly report or annual report and report of result on recovery activities of trouble or unusual condition.

5-1.Record

The Record for operation of the distribution shaft should be required as following;
5-1-1.Record of monitoring and visual check

5-2.Report

The Record for operation of the distribution shaft should be required as following;
5-2-1.Annual report
- Report of the well water quantity
- Report of the corrective action (as needed)
- Report of the preventive action (as needed)

5-2-2.Recommendation
- Rehabilitation and upgrading
- Review of SOPs
- Review of unified record sheet

Plant Name: **Qenayate FMRP**	Title **Oxidation tower**	SOP TAG No. **QEN-FMR03-QC**

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Introduction

Water quality control for the oxidation tower should be conducted as following;
- Monitoring and visual check
- Taking sample of the outlet water from the sedimentation basin
- The oxidized water by aeration and chlorination
- Chlorine demand test of the well water and outlet water from the oxidation tower

The sampling taps for the well water are available in discharge pipes of each well.
The sampling tap is not available for outlet water from the oxidation tower.

The oxidation process of contained iron in the well water is progressed in the 2 steps of the process.
The first step of the process is the aeration by the sprinkling of the water through the oxidation tower and the second step of the process is the chlorination by chlorine dose after oxidation process.

The sample water should be taken with following purpose;
-1.Oxidized result by aeration
This result should be needed to determine dosing rate of chlorination.
Required dosing rate of chlorination should be determined by chlorine demand test of this sample water.
-2.Oxidized result by chlorination
This result should be needed to prospect.
Required dosing rate of chlorine should be verified by monitoring of free chlorine residual of this sample water.
In addition to above, the sample of filtered water should be taken to confirm final oxidation of iron and manganese by oxidation sand in the filter.

Generally the quality of well water will be in condition of low turbidity. Hence, FMRP is the facility to remove not turbidity but contained iron and manganese mainly. A key of iron and manganese removal process is to control oxidation reaction in the process.
Oxidation by aeration in the oxidation tower cannot be controlled.
Hence, the process water should be sampled, analyzed and tested, and should be controlled the dosing rate of chlorine properly to control of the oxidation process.

1. Criteria for water quality control

1-1.Frequency of taking of sample:
Once a day or more
According to the requirements from the Holding company

1-2.Time of taking of sample
Around 9 a.m. in a morning

1-3.Volume of sampling water
10 litters or more

1-4.Procedures for chlorine demand test
- According to the standard operation procedures
- According to modified operation procedure

1-5.Items of water quality should be analyzed
- According to the requirements from the Holding company

1-6.Chlorine demand in the water of the outlet water from the oxidation tower
- 1.0-1.5 mg/l as tentative value

1-7.Free chlorine residual in the water of the sedimentation basin
- Free chlorine residual in the filtered water should be in range of 0.2-0.3 mg/l.
- Free chlorine residual in the inlet water for the filter should be prospected to perform above result and preset value of free chlorine residual in the network water.
- Free chlorine residual in the network water: more than 0.1 mg/l

2. Water quality control under normal condition

The activity of the water quality control should be required as following;
- Monitoring and visual check
- Water quality analysis and the laboratory test for the treatment
  - Sampling
  - Water quality analysis
  - Water treatment test such as chlorine demand test
- Determination of the dosing rate for the chlorine
- Adjustment of the dosing rate for the chlorine

2-1. Monitoring and visual check of process

Monitoring and visual check should be conducted according to the unified list for the monitoring and check. Unified list is provided in QEN-FMRP03QC-CH01.

2-2. Water analysis and the laboratory test for the treatment

Water analysis and laboratory test should be conducted according to the standard operation procedures. The standard operation procedures can be referred the documents of procedures for water quality control.

2-3. Determination of the dosing rate for the chlorine

The chlorine is dosed in the raw water discharged from the raw water pump.
The dosing rate of chlorine should be determined by result of laboratory test of the chlorine demand. The dosing rate of chlorine will be determined with some additional margin onto the chlorine demand value. This margin should be determined depend on experiments and data in the past.

2-4.Adjustment of the dosing rate for the chlorine

Dosing rate of chlorine should be adjusted by evaluation of free chlorine residual of the process water in actual facility.
Result of laboratory test will not always coincide with actual result.
Many factors will be related to the result in the actual facility such as mixing condition, water temperature and pH of the well water, and so.

3. Water quality control under unusual condition

4-1 Prospect troubles and trouble shootings

Typical trouble in the oxidation tower will be as following;
- Uneven distribution of the well water to the tower
  Cause of above
  - Opening of the valves in inlet pipe line will be improper
  - Clogging inside of the inlet valve
- The sprinkled water will be fallen unevenly from distributed holes
  Cause of above
  - Clogging of holes in the floors of the towers
- Chlorine demand will be changed to high value compare with usual condition
  Cause of above
  - Change of the well water quality
  - Insufficient aeration

Trouble shooting for the clear water reservoir is provided in QEN-FMR03-QCTS-01.

4-2 Trouble in the past and cause, background and events for recovery
- Trouble history -

Examples of trouble in the past will be useful for applying to solve the trouble happen in the present. Trouble history, we will call the data of trouble in the past, should be applied to following job;

- Recognition of weak point of facility cause of use
- Recognition of weak point of facility cause of design
- Recognition of weak point of activity of operation and maintenance
- Recognition of wear of facility or part of facility
- Reference for approach way and procedures to the trouble
- Reference for “Need to know” to approach the trouble
- Reference for “Prohibit to do” to approach the trouble
- And so

Information for trouble history should be collected and put into unified sheet
Trouble history should refer to QEN-FMR03-QCTH-01.

5. Report and record

To perform a rational O&M activity of FMRP, O&M activities should be carried out according to not only our experiences and hunches but also utilizing of statistical and mathematical approach by prediction, analysis and trial action to aim for the optimum result.

Hence, the record or report is one of essential and fundamental documents for O & M in FMRP. Reporting is activities of making documents and communication with persons inside and outside of FMRP according to utilizing of records, reports, data and other facts. Reports are including periodical reports such as monthly report or annual report and report of result on recovery activities of trouble or unusual condition.

5-1.Record

Records for water quality control of the oxidation tower should be required as following;

5-1-1.Record of monitoring and visual check
5-1-2.Record of water quality in the oxidation tower

5-2.Report

Reports for water quality control of the oxidation tower should be required as following;

5-2-1.Recomendation
- Upgrading or rehabilitation of facility
  - Modification and arrangement
  - Repairing and replace
  - Additional of facility
- Review of criteria
  - Modifying
  - Addition or delete
- Review of procedures for operation and control
  - Modifying
  - Addition or delete

5-2-2.Annual report
- Tendency of change of water quality
  -The well water
  -The outlet water from the oxidation tower
  -The inlet water for the filter and outlet water from the filter

Plant Name: **Qenayate FMRP**	Title **Sedimentation Basin**	SOP TAG No. **QEN-FMR04 –OP**

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Introduction

There is no device or equipment thing to be handled in a sedimentation basin except sludge drainage, however, condition of the water in the sedimentation basin and quality of effluent water from the sedimentation basin, shall be checked and monitored. If quality of filtered water changes to poor, operation conditions of the process before sedimentation basin shall be checked and modified as needed.
Properness of oxidation process shall be evaluated by quality of clarified water.

1. Features of process

1-1.Function of facility

Function of the sedimentation basin is to settle and remove the oxidized iron particles which produced by the oxidization process.

1-2.Impacts of facility

-1.Result of oxidization process is evaluated by the water quality in a sedimentation basin.
-2.Water quality in a sedimentation basin is changed gradually.

- Detention time in sedimentation basin: Approx.2.0 hours
- Detention time in oxidation tower: Approx.7 minutes
- Total detention time from start of coagulation to the end of sedimentation : Approx. two (2) hours

Though above, two (2) hours is not sufficient for the sedimentation and modification of the facility shall be considered.

-3. High turbidities in the water leaving from sedimentation causes poor performance of filtering.

1-3.Relations between other processes or other facility

-1. Quality of oxidized water affects to efficiency of filtering process.
In the present facility oxidized particles, which shall have been removed in the sedimentation basin, pass on to filters. This results in reduced filter run times and poorer filtered water quality.

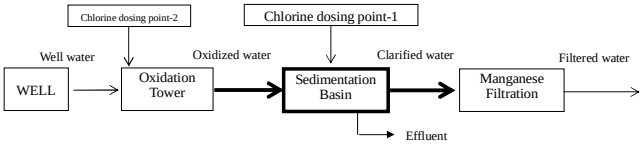
-2. The water treatment process is a chain of the several processes such as the well water transferring, oxidation, and the sedimentation process.
In the water treatment process, sedimentation process is affected directly and significantly by a result of previous oxidization processes.

-3. Water quality in the sedimentation basin is affected by operation condition of sludge drainage from the sedimentation basin. Insufficient of sludge drainage will cause of over flow of the oxidized particles to filter system.

-4. Oxidation of iron and manganese in the well water is the key factor for iron and manganese removal plant. Oxidation tower and chlorination dosing are used to oxidize iron and manganese in the water.

-5. Oxidized water is fed into to the filter tank by the filter pump.
Contact oxidization to the manganese sand process is applied for the filtration system in the Qenayate FMRP.
In manganese sand filtration system, basically the free chlorine residual of the filtered water shall be maintained in the value more than 0.5 mg/l as lower limit.
The free chlorine residual is consumed by the manganese sand to activate the oxidization effect.
Hence, the free chlorine residual in the oxidized water shall be kept in the value more than above with a margin of consumption.
If the free chlorine residual in the oxidized water is not enough for the manganese sand filtration, it means not only drop in efficiency of manganese removal but damage of manganese coating layer around the manganese sand.

-6.The sedimentation basin is the connection process with the oxidation process and filtration process



Note: “Process water” is also used as general word for the water flowing in the Plant.

The quality control of the oxidized water is the most important activity and especially control of free chlorine residual is important.

2. Criteria for operation

There is no device or equipment to operate or control in the sedimentation basin itself, but attached facilities such as sludge drainage facility.
There are no criteria for operation or control of sedimentation basin.
Descriptions on water quality control refer to SOP QEN-FMR04QC.

3. Operation under normal condition

3-1.Start-up and shut-down procedures

From previous oxidization tower process the water flows into sedimentation basin through the pipe from the oxidation tower above of the sedimentation basin. There are no valve and no gate at the bottom of the tower.

3-1-1.Start up from a condition without water in sedimentation basin
(e. g. Restart after cleaning of basin)
In early stage of water filling into sedimentation basin, condition of the water from the oxidation tower is unstable by flow with oxidized particles, turbulent flow or short circuit flow.
Hence, oxidized water in early stage after restart shall be drain out and the water in the sedimentation basin shall not be fed to the filter. Leave the water in the sedimentation basin as it is drained for approx.2hours or more.

During the drainage, quality of oxidized water shall be monitored. Water quality shall be confirmed to reach to the criteria. Until condition of oxidized water became stable, monitoring and check of water quality of effluent shall be carried out periodically, i.e. intervals of approx. 30min – 60min usually.

In this stage, flow rate of the water from the oxidation tower shall be reduced and after water condition is stable, flow rate can be increased gradually. And dosing rate of pre-chlorine in this stage shall be increased compared with normal condition such as 2 times of normal dosage.

Procedures for restart after cleaning of sedimentation basin are shown by steps of work in QEN-FMRP04-OPFC-01.

3-1-2.Shut down of operation of a sedimentation basin

Shut down of sedimentation basin is carried out in case of activity of periodical maintenance.
Stop the water flow into the basin and drain out the water in the basin.

3-2. Sludge drainage operation

Oxidized particles precipitate in the sedimentation basin and shall be drained periodically by the sludge drainage facility. Interval of drainage operation shall be decided considering the actual situation to avoid the over flow of the particles to the filter.

3-3. Monitoring and visual check of facility

The jobs of monitoring and visual check shall be daily routine work in O&M activity. Unusual condition or trouble shall be picked up in early stage by these jobs.
Damage by unusual condition or trouble is minimized by early detection and rapid response of recovery. Daily check or monitoring jobs are insignificant work.
These jobs shall be carried out and ensured effectively, suitably by valuable check items, significant value will come out from these jobs.
Monitoring and check list is provided in APPENDIX. This list shall be reviewed periodically for maximize of value of jobs and improvement of works.

4. Operation under unusual condition

4-1 Prospect troubles and trouble shootings

4-1-1.During working

Water condition shall be monitored and operation condition of the facility in above shall be changed if necessary.

- Unusual condition of the water in sedimentation basin
  - Rising of the oxidized particles
  - Change of color of water
  - Unusual condition of the water level
- Causes of unusual condition
  - Raising of oxidized particles
  - Insufficient sludge drainage
  - Improper velocity of inlet
  - Excess of flow rate of inlet

  - Change of color of water
  - Change to brown or black
  - Insufficient sludge drainage
  - Insufficient chlorine dose
  - Change of water quality
  - Unusual of the water level
  - Unusual of level sensor for the sedimentation basin
  - Unusual of electrical switch board

4-1-2. Restart after long term stopping

In case of stop for a long term, such as for 2 weeks or more, preparations before stop shall be required to enable the facility in a sedimentation basin to restart normally.
Prospects of trouble by a long term stop are as following;

- Cause of precipitation of sludge
  - Condensed and compressed of sludge on the bottom
  - Condensed and compressed of sludge in the pipe
  - Prospect of trouble of the facility
  - Unable to drain out the sludge by clogging of drainage pipe

-Actions before stop should be required to prevent from above as follows;.
  - Carry out sludge drainage during above.
  - Drain out the effluent water until free chlorine residual will be sufficient.
  - Sufficient free chlorine residual: 0.2 mg/l or more

5. Report and record

5-1.Record

The record for sedimentation basin shall be required to know operation condition and quality of oxidized water.
Quality of oxidized water shall be acceptable compared with criteria.
Operation condition shall be acceptable compared with design criteria.
Record is supplied to the activity of maintenance and water quality control.

5-2.Report

Generally almost of technical records shall be reported to people in technical sections in FMRP.

Any records have no value without utilizing them. Reports shall be useful tool for next improvement activities by utilizing of records.

Required reports for sedimentation basin are limited to the operation of sludge drainage and any recommendations for improvement.

Report for operation of sedimentation basin will include the following;

-1.Recommendation for operation according to records of operation
-2.Report for corrective and preventive action
-3.Result of recovery of trouble or unusual condition
-4.Recommendations for improvement

Plant Name: **Qenayate FMRP.**	Title **Sedimentation Basin**	SOP TAG No. **QEN-FMR04 -MT**

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Introduction

Generally, maintenance activity of the sedimentation basin is conducted not in a routine maintenance but along with the periodical maintenance of the plant.
Submerged part in the water is inspected, checked and cleaned up in the maintenance activity. There is no facility to be controlled in the sedimentation basin in FMRP except sludge drainage facility.
The basin structure and suction pipe of the filter pump and drainage pipe and valves are inspected, cleaned and maintained. Cleaning of the basin is the main activity. If cleaning is not sufficient, precipitated oxidized particles is sucked by the filter pump and fed into the filter.
Insufficient removal of oxidized particles in the sedimentation basin will cause of shortage of filter run time. Oxidized particles carried over to the filter are caught by the anthracite that is placed for the surface layer of the filter media in the filter tank

1. Criteria for maintenance

Main maintenance activity for the sedimentation basin is to clean inside of the basin. This cleaning work is one of major events in FMRP.
We can check and confirm the inside condition of the basin and submerged parts of facilities. We shall check depth of precipitated sludge remaining in bottom of the basin.

- Frequency of cleaning and inspection of inside of the basin
  - Regular cleaning work: Once 30-45 days
  - Inspection and repairing: Once a year
- Acceptable stopping time of sedimentation basin
  - In winter season: 6 hours

2. Maintenance activity

Monitoring, check and inspection shall be carried out to judge necessity of recovering activity such as adjustment, repairing or replacing at the time of regular cleaning.
Unusual condition of the sludge drainage facility shall be confirmed by monitoring

results of the following;

- Condition of the water
- Quantity
- Turbidity
- Free chlorine residual

Maintenance activity consists of four (4) kinds of working as following;

-1.Monitoring and checking during daily operation
-2.Inspection
-3.Evaluate and analysis regarding result of inspection
-4.maintenance based on the inspection

2-1.Monitoring and visual check

Monitoring and visual check shall be carried out according to “O&M schedule” and unified check list, and it is conducted with the monitoring activities for the sedimentation basin.

2-2.Inspection

Inspection shall be carried out according to “O&M schedule” and unified check list and it is conducted with the inspection activities for the sedimentation basin.
Cause of troubles for the sludge drainage system shall be prevented as follows;

- External check of the basin
  - Appearance of crack on a basin
  - Leak of water from a basin
  - Foreign substances such as wooden blocks, waste of vinyl materials and so.
- Cleaning of inside of the basin and effluent channel
  - Flushing away remaining sludge by pressured water
  - Brushing away to remove adherent algae on the wall

2-2-1.Cleaning of a basin

- Make a plan and time schedule for cleaning
- Procedures for drainage of water in sedimentation basin
- Procedures for cleaning of a basin

2-2-2.Inspection procedure

Inspection check list shall be provided on the following items;

- Inspection of a basin
- Inspection of a pipe
- Inspection of a level sensor
- Inspection of sludge drainage pipe

2-3. Evaluate and analysis regarding inspection result

After inspection following items shall be evaluated;

- Precipitated condition of sludge
  - Frequency and operation time of the sludge drainage
- Necessity of recovery action
  - Corrosion
  - Crack in the wall or bottom of the basin
  - Water leakage

2-4. Maintenance after the inspection

Maintenance works shall be conducted based on the inspection results as follows;

- Repainting
- Cleaning of inside of the drainage pipe
- The drainage valve
  - Supplying the grease as needed
  - Change of parts as needed
  - Replace the valve as needed or periodically
- Repairing of leak part around the drainage pipe
- Repairing of leak part of the pipe connection

3. Procedures under unusual condition

3-1 Prospect troubles and trouble shootings

- Unusual condition of facilities and actions of remedy-

Refer to QEN-FMR04-MTTS-01.

4. Report and record

4-1.Record

Records for maintenance of the sedimentation basin are required as follows;

4-1-1.Record of monitoring and visual check
4-1-2.Record of inspection
4-1-3.Record of maintenance

4-2.Report

Following report for maintenance of the sedimentation basin is required and reports

shall include recommendations for improvement as follows:

4-2-1.Recommendations (as needed)
- Review of maintenance procedures
- Improvement of facility
- Upgrading or rehabilitation of facility
  - Replacement of facility
  - Repairing of facility
- Review of the criteria
- Review of SOP

Plant Name: Qenayate FMRP	Title: Sedimentation Basin	SOP TAG No. QEN-FMR04 –QC

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Introduction

The water quality control of the clarified water is the key point of the operation of the iron and manganese removal plant (abbreviate as FMRP).
The key process in the FMRP is the process of manganese sand filtration.
The clarified water that is oxidized and sedimentation water, is fed into the filter.
FMRP is the simple process and consists of 3 main processes such as oxidation, filtration and disinfection process. The disinfection is performed disinfection of the drinking water by chlorine dosing. The oxidation is performed oxidation of iron, manganese, ammonium in the water mainly by the aeration and chlorine dosing, and oxidized particles of iron and manganese are precipitated in the sedimentation basin after aeration tower.

Generally, oxidation of manganese will be not sufficient by aeration and precipitation will be not sufficient in the sedimentation basin. Hence, filtration is needed to oxidize manganese and to catch and remove the escaped particles from the sedimentation basin as final process.
Manganese sand is put in the filter tank to oxidation of manganese in the water by contact filtration. Anthracite is put on the manganese sand as the surface sand layer to catch and remove the escaped particles in the water.

Manganese sand oxidizes manganese in the water by contact with the surface coating of manganese dioxide. The oxidation potential of manganese sand gets weaker by oxidation of manganese but free chlorine residual in the water activates again the manganese dioxide coating by contact with manganese sand surface. Hence, free chlorine residual is need always in the water fed to the filter to keep the oxidation potential of the manganese sand.
If free chlorine residual in the water is insufficient removal of manganese should be insufficient and it causes severe damage of manganese sand.

Condition of the water in a sedimentation basin and quality of effluent water from a sedimentation basin, should be checked and monitored.
If quality is change to poor, check the operation condition of the process before sedimentation basin and modify the operation condition as needed.
Properness of oxidation process should be evaluated by quality of clarified water.

Check the quality of water in the sedimentation basin and control the operation condition in the previous processes.

1. Features of process

1-1.Function of facility

Function of the sedimentation basin is to settle and remove the oxidized iron particles which produced by the oxidization process.

1-2.Impacts of facility

-1.Result of oxidization process is evaluated by the water quality in a sedimentation basin.
-2.Change of water quality in a sedimentation basin will progress gradually.

Detention time in sedimentation basin: Approx.2.0 hours
Detention time in oxidation tower: Apprpx.7 min
Total detention time from start of coagulation to the end of sedimentation
: Approx.2 hours

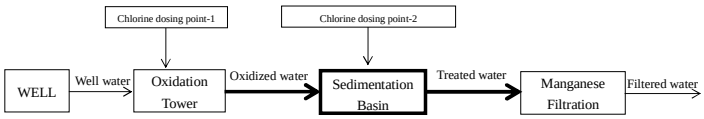
-3.High turbidities in the water leaving from sedimentation are lead to poor performance of filtering.

1-3.Relations between other processes or other facility

-1.Water quality of clarified water affects to efficiency of filtering work.
Oxidized particles, which should have been removed in the sedimentation basin, pass on to filters. This will result in reduced filter run times and poorer filtered water quality.
-2.The water treatment process is a chain of the several processes such as the well water transferring, oxidation, and the sedimentation process.
In the water treatment process, sedimentation process is affected directly and significantly by a result of previous processes.
-3.Water quality in the sedimentation basin will be affected by operation condition of sludge drainage from the sedimentation basin. Insufficient of sludge drainage will cause of suck of the oxidized particles.
-4.Oxidation of iron and manganese in the well water is the key factor for iron and manganese removal plant. Oxidation tower and pre-chlorination dosing are used to oxidize iron and manganese in the water.
-5. Oxidation water is fed into to the filter tank by the filter pump.
The filter in the Qenayate FMRP is applied the manganese sand filtration
In manganese filtration system, basically the free chlorine residual of the filtered water must be maintained in the value more than 0.5 mg/l as lower limit.
The free chlorine residual will be consumed by the manganese sand.

Hence, the free chlorine residual in the clarified water must be kept in the value more than above with a margin of consumption.
If the free chlorine residual in the clarified water is not enough for the manganese sand filtration, it means not only drop in efficiency of manganese removal but damage of manganese coating layer around the manganese sand.

The sedimentation basin is the connection process with the oxidation process and filtration process



The quality control of the clarified water is the most important activity especially free chlorine residual.

2. Criteria for water quality control

Free chlorine residual in the clarified water and filtered water must be controlled in the process of the iron manganese removal plant.

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2-1.Limit of free chlorine residual measurement
2-1-1.Filtered water: 0.2 mg/l or more and 0.3mg/l or less
2-1-2.oxidized water: Addition margin to above value
Experimental value based on the operated data
2-2.Limit of turbidity of the clarified water
1 NTU or less
2-3.Sanpling frequency of the clarified water: for check free chlorine residual
6 times in a day or more
2-4.Frequency of the sludge drainage
Once a day

3. Water quality control under normal condition

3-1.Monitoring and visual check

Monitoring and check is to confirm change of water quality and change of operating condition in the process. We cannot control the process without monitoring and also

cannot monitor without criteria to judge something in proper.

3-1-1.Monitoring of quality control for the clarified water

Filtration process is the final stage to remove turbidity and to oxidize iron and manganese in the process water.
Hence, we must deliver the filtered water with same or higher quality than Egyptian standard quality for potable water. After filtration post-chlorine should be dosed into the water to adjust final free chlorine residual in water of transmission and customer's tap.

Prior to the filtration process the well water is oxidized by aeration and pre-chlorination and oxidized iron and manganese is removed in the sedimentation basin but oxidization and removing will be not perfectly.
The limit of the water quality for the clarified water which will be filtered should be required shown as the criteria.
Monitoring should be conducted according to monitoring frequency, monitoring method, monitoring items, and current condition should be judged proper or not proper by the criteria.

-1.Sampling of the water
-Location of sampling point:
Sample-1: from opening of the sedimentation basin (surface water)
Sample-2: from suction pipe of the filter pump (bottom water)
-Sampling volume: 1 litter for each sampling
-Sampling frequency: 6 times in a day
-Time for sampling:
Sample-1: 30 min after start
Each 4 hours after above
Sample-2: 2 hours after start
Each 4 hours after above
-2.The water quality analysis
Analysis and report should be required according to following frequency;
-Iron and manganese: Once a day
-Turbidity and chlorine residual: 6 times in a day
-3.Visual check
Visual check of the water should be conducted by looking through the opening or by sampling of the water
- Condition of the water by visually
- Color
- Odor
- Foreign substances
- Other external unusual condition

- Covering of the opening
- Dosing condition of the pre-chlorine dosing (if possible)

Monitoring steps is shown by flow chart in QEN-FMR04-QCCHK-01

3-1-2.Shut down of operation of a sedimentation basin

Shut down of the sedimentation basin will be carried out in case of activity of periodical maintenance.
Stop the well pump and drain out the water in the basin.
The water in the sedimentation basin should be fed to the filter.
The water in the sedimentation basin can be sucked by the filter pump up to approx. 50 cm of the water level from the bottom.

3-2.Water quality control of the sedimentation basin

3-2-1.Control of free chlorine residual in the sedimentation basin

Free chlorine residual should be measured at 2 points as above mentions.
-Sampling point-1: a point of immediately after dosing point-1
-Sampling point-2: a point of after detention in the sedimentation basin
Measured free chlorine should be evaluated and analyzed according to the criteria. chlorine dosing flow rate should be adjusted as needed.
When the measurement of free chlorine is not sufficient compare with the criteria, the dosing flow rate of chlorinator should be checked and increase the dosing flow rate of the chlorine as needed.
Simultaneously following items should be confirmed;
- The flow rate of the well water
- The chlorine demand of the well water

3-2-2.Control of the turbidity in the sedimentation basin

When sludge drainage is not sufficient, the oxidized particles in the clarified water will be increase. If this condition is confirmed drainage of the sludge should be done immediately and the criteria of frequency of the sludge drainage should be reviewed.
When high turbidity is caused by design, modification of design will be needed such as following;
- Installation of baffling plate to avoid sucking the precipitated sludge into the suction pipe of the filter pump
- Making slope on the bottom to be easy to drain out the sludge

When water quality will be improper condition severely the well water quantity will be reduced and if possible the plant will be stopped. And cause of improper condition must be found and corrective action must be needed.

Unusual condition or trouble should be picked up in early stage by these jobs.

Damage by unusual condition or trouble will be minimized by early detection and rapid response of recovery. Daily check or monitoring jobs are insignificant work.
These jobs should be carried out and ensured effectively, suitably by valuable check items, significant value will come out from these jobs.
Monitoring and check list is provided in APPENDIX. This list should be reviewed periodically for maximize of value of jobs and improvement of works.

3-2-3. Restart after long term stopping

When the restart of the sedimentation basin will be conducted after a long term stop, such as stopping for 2 weeks or more, the water in the sedimentation basin should be drained before feeding the water to the filter.
And free residual chlorine and turbidity of the water should be measured.
The water in the sedimentation basin should not be fed to the filter until free chlorine and turbidity in the water will be sufficient quality compare with the criteria.

4. Operation under unusual condition

4-1 Prospect troubles and trouble shootings

4-1-1.During in working

Water condition should be monitored and operation condition of the facility in above should be changed if necessary.

- Unusual condition of the water in sedimentation basin
- Raising of the oxidized particles
- Change of color of water
- Unusual of the water level
- Cause of unusual condition
- Raising of oxidized particles
- Insufficient of sludge drainage
- Improper velocity of inlet
- Excess of flow rate of inlet
- Too much flow rate of inlet
- Change of color of water
- Change to brown or black
- Insufficient sludge drainage
- Insufficient chlorine dose
- Change of the well water quality

- Unusual of the water level
- Unusual of level sensor for the sedimentation basin
- Unusual of electrical switch board

Actions should be required to recover above as followings;

- Proper frequency of sludge drainage
- Proper time during sludge drainage
- Proper dosing rate of chlorine
- Control and confirm the well water flow rate
- Proper monitoring and analysis of well water quality

4-1-2. Restart after long term stopping

When the restart of the sedimentation basin will be conducted after a long term stop, such as stopping for 2 weeks or more, the water in the sedimentation basin should be drained before feeding the water to the filter.
And free residual chlorine and turbidity of the water should be measured.
The water in the sedimentation basin should not be fed to the filter until free chlorine and turbidity in the water will be sufficient quality compare with the criteria.

Prospects of trouble by a long term stop are as following;

- Cause of precipitation of sludge
- Prospect of condition
- Condensed and compressed of sludge on the bottom
- Condensed and compressed of sludge in the pipe
- Prospect of trouble of the facility
- Unable to drain out the sludge by clogging of drainage pipe

Actions before stop should be required to prevent from above as followings;.
- Carry out sludge drainage during above.

- Cause of reducing of free chlorine residual in water of sedimentation basin
- Prospect of trouble of the process
- Insufficient of free chlorine residual in filtered water

Actions before restart should be required to prevent from above as followings
- In restart operation, monitor free chlorine residual in the clarified water
- Drain out the effluent water until free chlorine residual will become sufficient. Sufficient free chlorine residual should be determined according to the criteria.

4-2.Trouble in the past and cause, background and recovering process

- Trouble history –

Examples of trouble in the past will be useful for applying to solve the trouble happen in the present. Trouble history, we will call the data of trouble in the past, should be applied to following job;

- Recognition of weak point of facility cause of use
- Recognition of weak point of facility cause of design
- Recognition of weak point of activity of operation and maintenance
- Recognition of wear of facility or part of facility
- Reference for approach way and procedures to the trouble
- Reference for “Need to know” to approach the trouble
- Reference for “Prohibit to do” to approach the trouble
- And so

Information for trouble history should be collected and put into unified sheet Trouble history

5. Report and record

To perform a rational O&M activity of WMRP, O&M activities should be carried out according to not only our experiences and hunches but also utilizing of statistical and mathematical approach by prediction, analysis and trial action to aim for the optimum result.

Hence, the record or report is one of essential and fundamental documents for O & M in FMRP. Reporting is activities of making documents and communication with persons inside and outside of FMRP according to utilizing of records, reports, data and other facts. Reports are including periodical reports such as monthly report or annual report and report of result on recovery activities of trouble or unusual condition.

5-1.Record

The record for sedimentation basin should be required to know operation condition and quality of clarified water.
Quality of clarified water should be acceptable compare with criteria.
Operation condition should be acceptable compare with design criteria.
Record will be supplied from activity of maintenance and water quality control.

Record of operation of sedimentation basin will be nothing.

For reference, records from water quality control of sedimentation basin will be as following;

- Result of monitoring and check
  - Quality of clarified water
    - Turbidity
    - Free chlorine residual
    - Containing of ammonium
    - Color and odor of the water in the basin
  - Unusual condition
    - Excess of criteria of turbidity
    - Excess of criteria of free chlorine residual as high or low
    - Excess of criteria of containing of ammonium
    - Unusual color and odor of the water in the basin
    - Arising of flocks in the basin
- Operation condition
  - Flow rate into a sedimentation basin
  - Quality of well water quality
  - Dosing rate and flow rate of pre-chlorine
  - Frequency of sludge drainage

5-2.Report

Generally almost of technical records should be reported to people in technical sections in FMRP.
Any records have no value without utilizing them. Reports should be useful tool for next improvement activities by utilizing of records.

Required reports for operation of sedimentation basin will be limited area and it will need to make a recommendation regarding to operation of sludge drainage and sludge collector.

Report for operation of the sedimentation basin will include as following;
-1.Recommendation for operation according to records of operation
-2.Report for corrective and preventive action
-3.Result of recovery of trouble or unusual condition
-4.Recommendations for improvement

Plant Name: **Qenayate FMRP**	Title **Filter**	SOP TAG No. **QEN-FMR05 –OP**

Issued		Developed by		Signature	
Revised		Approved by		Signature	

Introduction

Filtering process is the final removal process in the iron and manganese removal plant (abbreviate as FMRP). The filter in the FMRP is different from the filter in the conventional water treatment plant for the required function.
The source water for the Qenayate FMRP in SHARKIA is the groundwater from well and therefore it shows low turbidity and is steady through the year.

The main function of the filter in the FMRP is not removal of the turbidity by filtering, but removal of the iron and manganese by contact oxidization process in use of contact filter media.
The oxidation process is needed always prior to the filtering process in the FMRP and aeration and pre-chlorination are provided as the oxidation process.

Three filters are available in Qenayate FMRP and each filter is operated individually. three filters can be used in maximum capacity. Four wells and four well pumps, and four filter pumps are equipped and discharge capacity of one well and one well pump meets the capacity of one filter as capacity of 140 m3/hr. usually operate 3 filter . Operations for this filtering system consist of three (3) kinds of operation modes as follows;

- Filtering
- Backwashing and drainage
- Pre-filtering and drainage after backwashing

1. Features of process

1-1.Function of facility

Function of the filter is to remove the oxidized iron and manganese particles which carried over, from the sedimentation basin and to remove manganese in the process water by contact oxidation.

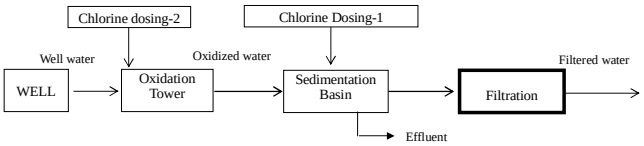
1-2.Impacts of facility

1-Filtering process is the final removal process in the FMRP.
2-If manganese removal is insufficient; the filtered water is colored water by reaction with manganese and free chlorine residual. Degree of colored water is approx. 300

times of manganese contains in the water.
For example, in case of manganese contains are 0.1 mg/l in the filtered water the color of the filtered water is approx.30 mg/l after some reaction time.
3-Free chlorine residual in the oxidized water in to the filter shall be be kept in 0.5 mg/l or more. If above condition is not kept the oxidation filter media is damaged severely. And the effect of manganese removal is insufficient by this
4-The clear water reservoir is not available in the FMRP. Filtered water is supplied directly to the network by discharge pressure of the filter pump. Stop of the filter pump means stop of the supplying of drinking water to the network.
5-Free chlorine residual in the filtered water shall be adjusted by Post-chlorine to the regulation.

1-3.Relations between other processes or other facility

1-Water quality of oxidized water affects to efficiency of filtering.
Oxidized particles, which should have been removed in the sedimentation basin, pass on to filters. This will result in reduced filter run times and poorer filtered water quality.
2-The water treatment process is a chain of the several processes such as the well water transferring, oxidation and the sedimentation process.
In the water treatment process, the sedimentation process is affected directly and significantly by a result of the oxidation and sedimentation processes.
3-Water quality of the filtered water is affected by operation condition of the oxidation and sedimentation process.
4- Oxidation of iron and manganese of the well water is the key factor for iron and manganese removal plant. Initial-chlorine, oxidization tower and pre-chlorination are used to oxidize iron and manganese in process water.
5- Clarified water is fed from the sedimentation basin into to the filter tank by the filter pump. The filter system in the Qenayate FMRP adopted the manganese sand filtration process.
In manganese filtration system, basically the free chlorine residual of the clarified water shall be maintained in the value more than 0.5 mg/l as lower limit. The free chlorine residual is consumed by the manganese sand.
Hence, the free chlorine residual in the oxidized water shall be kept in the value more than above with a margin of consumption.
If the free chlorine residual in the oxidized water is not enough for the manganese sand filtration, it means not only drop in efficiency of manganese removal but damage of manganese coating layer around the manganese sand.



Note: “Process water” is also used as general word for the water flowing in the Plant.

2. Criteria for operation

The criteria for operation or control of the filter shall be required as follows;

2-1.The criteria for operation

2-1-1.Timing of backwashing

2-1-2.Time in operation for pre-filtering after backwashing

2-1-3.Time in operation of backwashing

2-1-4.Flow rate for backwashing water

2-1-5.Number of working filter

Three filters shall be operated at the same time.

It is better that oxidation contact filter is operated continuously to keep an oxidation filter media in a satisfactory condition.

The process water contained free chlorine residual is supplied into the filter.

2-2.Judgement of Quality

2-2-1.Judgement of the completion of backwash in usual operation

- Turbidity of backwash drain is less than 1 NTU

2-2-2.Judgement of the completion of pre-filtering

- Turbidity of backwash drain is less than 1 NTU
- Free chlorine residual is 0.2-0.3mg/l or more

Descriptions on water quality control refer to SOP QEN-FMR05-QC.

3. Operation under normal condition

The operation for the oxidation filter consists of three (3) kinds of operation modes as follows;

-1.Filtering

-2.Backwashing and drain

-3.Pre-filtering and drain after backwashing (preparation step for the filtering)

3-1.Operation for the filtering

3-1-1.Start up for the operation of the filtering

Three filters are available in Qenayate FMRP and each filter is operated individually. Two filters can be used in maximum capacity of the plant and one filter is for stand by in design.

The procedures are shown in QEN-FMRP04-OPFC-01, for start up from condition of stand by.

The backwashing shall be needed for start up of a filter

The condition of the oxidation filter media in the stopped filter is lowered the oxidation potential and removal potential of manganese is insufficient.

Hence, backwashing shall be required prior to the filtering and the water use for backwash shall be contained free chlorine residual in concentration of approx.1.5 mg/l or more. The oxidation filter media is activated by backwashing by the water containing free chlorine residual. It means that backwash water shall contain required free chlorine residual to activate manganese sand.

3-1-2.Shut down of operation of the filter

Shut down of the filter is carried out when activity of periodical maintenance, scheduled change over or end of plant operation is conducted.

-1.Stopping for 2 days or less

The filter can be kept in condition of filling water.

Restart of the filter shall be conducted according to above procedures 3-1-1.

-2.Stopping for 7 days or less

Same as above, but if free chlorine residual is not sufficient (1.0 mg/l or less) in the clarified water by pre-filtering, dosing rate of per-chlorine shall be increased to the require free chlorine residual concentration.

-3.Stopping for 7 days or more

The water in the filter shall be drained out completely to avoid growth of organics such as algae or worm in the filter media.

All valves shall be closed except ventilation valve and drain valve.

Prior to restart, water shall be supplied through the backwash pipe gradually for backwashing of the filter. Free chlorine residual in the supplied water is needed 2.0 mg/l or more. By this activity the air in the filter media is discharged. Excess volume or pressure of water supplying from backwash pipe will cause damage of sand layer such as reversing of filter media.

If reversing of the filter media is happened, it will cause the short circuiting flow in the filter media or flowing out of the filter media into the network

Hence, backwash water valve shall be be opened slightly and this operation condition shall be kept for 3-4 hours. After that free chlorine residual of backwash drain water, that is slow speed backwashing, shall be checked as 1.0 mg/l or more. After the above check, ordinary backwash can be conducted prior to the pre-filtering.

The oxidation filter media is activated by contact to the water with sufficient free chlorine residual existence.

Detail procedures for the restart of the filter are provided in QEN-FMR05-OPFC-01.

3-1-2.Backwashing and drain for the filter

-1.Steps to the backwashing

Backwashing of the filter is conducted by changing the valves for the filter.

- 1st: Close the valve for oxidized water
- 2nd: Open the valve for drain
- 3rd: Open the valve for backwashing

Time in backwashing is approx.10-20 min.

-2.The water use for backwashing

The water for backwashing shall contain of free chlorine residual as 1.0 mg/l or more.

The water for the backwashing is fed from the filer pump discharge

-3.Judgment of completion of backwashing

Turbidity of backwash drain shall be confirmed during backwashing.

Backwashing is completed when turbidity of backwashed drain water will reach to 1 NTU or less.

-4.Judgment of necessity of backwashing and completion of backwashing

The filter media in a filter is clogged by particles in the process water. And the oxidation ability is reduced by oxidation of manganese in the process water. These conditions is recovered by the backwashing.

. Necessity of backwashing shall be judged by reading of the indication of the pressure gauges for inlet and outlet of the filter.

The backwashing is needed when difference of the pressure indications of inlet and outlet is reached at 0.2 kg/cm2.

It is better that the backwashing is conducted once a day to ensure the oxidation ability of the filter media, even if the differential pressure will not reach to above value.

When backwashing is completed, difference of the pressure indications of inlet and outlet is confirmed that will return to the condition at starting of the filtering.

3-1-3.Pre-filtering and drain for the filter

Operation of pre-filtering and drain for the filter can be conducted as preparation prior to the filtering process.

The purposes of the pre-filtering are as following;

- To drain out the remaining water of backwashing in the filter
- To confirm free chlorine residual in the filtered water prior to the filter process

-1.Steps to the Rinsing

The Rinsing is conducted by change the valve around a filter.

- 1st: Close the valve for backwashing
- 2nd: Check close of the valve for the filtering outlet
- 3rd: Open the valve for drain
- 4th: Open the valve for the water inlet

Time in pre-filtering is approx.10-20 min.

After pre-filtering, the filtering process can be started.

-2.Judgment of completion of pre-filtering

Turbidity in drain water of pre-filtering shall be confirmed during pre-filtering.

Pre-filtering is completed when turbidity in drain water will reach to 1 NTU or less and free chlorine residual is 0.2mg/l or more.

3-1-4.The filtering process

-1.Steps to the filtering

Filtering of the filter is conducted by change the valve around a filter.

- 1st: Close the valve for drain
- 2nd: Open the valve for the filtering outlet
- 3rd: Check open of the valve for water inlet
- 4th: Check close of the valve for backwashing

-2.Check in the start of the filtering

Following items shall be checked in the staring of the filtering;

- Pressure indication of the water inlet
- Pressure indication of the filtering outlet
- Differential pressure of inlet and outlet pressure
- Turbidity in the filtered water: 1 NTU or less
- Free chlorine residual in the filtered water: 0.2-0.3 mg/l or more
- Iron and manganese contains in the filter outlet water has to satisfy new Egyptian potable water standard for the groundwater source
  - Iron contains: 0.3 mg/l or less (old standard: 1.0 mg/l)
  - Manganese contains: 0.4 mg/l or less (old standard: 0.5 mg/l)
- Turbidity in the filtered water has to satisfy Egyptian standard of the potable water for the groundwater source

3-2.Monitoring and visual check

The jobs of monitoring and visual check shall be daily routine work in O&M activity. Unusual condition or trouble shall be picked up in early stage by these jobs.
Damage by unusual condition or trouble is minimized by early detection and rapid response of recovery. Daily check or monitoring jobs are insignificant work.
These jobs shall be carried out and ensured effectively, suitably by valuable check items, significant value will come out from these jobs.

4. Operation under unusual condition

4-1 Prospect troubles and trouble shootings

4-1-1.During working

Conditions of process water shall be monitored and operation condition of the facility in above shall be changed if necessary.

- Unusual condition of the water in the filter
  - Differential pressure rise up 0.2 kg/cm2 or more before 24 hours passing
  - Excess of iron and manganese concentrations in the filtered water
  - Insufficient free chlorine residual in the filtered water
  - Excess of turbidity in the filtered water
  - Excess of color of the filtered water
  - Change of color of water
  - Insufficient pressure to the network
- Cause of unusual condition
  - Differential pressure rise up 0.2 kg/cm2 or more before 24 hours passing
    - Poor quality of the inlet water to a filter
    - Excess of the flow rate of inlet water to a filter
    - Insufficient opening of the valve of inlet or outlet
    - Shortage of anthracite
  - Excess of iron and manganese concentrations in the clarified water
    - Insufficient of free chlorine residual in the inlet water
    - Insufficient of oxidation process
    - Insufficient of oxidation of ammonium
    - Luck of dosing rate of chlorine

    - Waste of the filter media
    - Shortage of volume of the filter media
    - Deterioration of the filter media
    - Excess of the flow rate of inlet water to a filter
    - Change of well water quality
  - Insufficient free chlorine residual in the clarified water
    - Insufficient of free chlorine residual in the inlet water
    - Insufficient of oxidation of ammonium
    - Waste of the filter media
    - Shortage of volume of the filter media
    - Deterioration of the filter media
    - Excess of the flow rate of inlet water to a filter
    - Change of well water quality
  - Excess of turbidity in the oxidized water
    - Excess of differential pressure
    - Excess of the flow rate of inlet water to a filter
    - Poor quality of the inlet water to a filter
    - Unusual of arrangement of filter layer
  - Excess of color of the filtered water
    - Excess of iron and manganese contains in the filtered water
  - Change of color of water
    - Change to brown or black
    - Excess of iron and manganese contains in the filtered water
  - Insufficient pressure to the network
    - Differential pressure rise up 0.2 kg/cm2 or more
    - Trouble of the filter pump
    - Trouble of the valves

Information for trouble history shall be collected and put into unified sheet, QEN-FMR05-OPTH-01.

5. Report and record

5-1.Record

Records of operation of the filter are required as follows;

5-1-1.Record of working
- -Time in working
- Differential pressure at just before the backwash process
- Differential pressure at initial state of the filtering process after backwash
- Number of the well pump and the filter pump
  (Flow rate of well water and filter pump discharge)

- Pressure of the transmission pipe
- Turbidity in the backwashing drain water
- Time of backwashing
  - Time of start
  - Time of finishing
  - During time of pre-filtering
  - Free chlorine residual at the end of pre-filtering

5-1-2.Record of free chlorine residual in the clarified water
- Four (4) times in a day

5-1-3.Result of visual check
- Unusual condition
  - Differential pressure
  - Transmission pressure
  - Free chlorine residual in the filtered water
  - Unusual color of the filtered water
  - Unusual odor of the filtered water
- Operation condition
  - Visual check list
- Record of recovery (Corrective action)

5-2.Report

Any records have no value without utilizing them. Reports shall be useful tool for next improvement activities by utilizing of records.

Report for operation of the filter will include the following;
-1.Recommendation for operation according to records of operation
-2.Report for corrective and preventive action
-3.Result of recovery of trouble or unusual condition
-4.Recommendations for improvement
-5.Monthly and annual report of operation
- Filtered water volume of each filter
- Efficiency of iron and manganese removal
- Tendency of free chlorine residual in the filtered water

Plant Name: **Qenayate FMRP**	Title **Filter**	SOP TAG No. **QEN-FMR05 –MT**

Issued		Developed by		Signature	
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Introduction

Maintenance activities for the filter shall be provided as follows;
- The filter sand layer
- The filter tank
- Instrument such as the pressure gauge
- Piping and valves

Maintenance of the filter sand is very important for FMRP.
The filter sand for iron and manganese removal filter consists of the oxidation sand and anthracite. The function of anthracite is removal of the particles such as oxidized iron, and the function of the oxidation sand is oxidation of iron and manganese in the process water.
The anthracite is put on the upper layer on the filter layer and is a light filter media.
The anthracite is easy to flown out of the filter when the backwashing is conducted with excess rate of backwashing.
The oxidation sand is coated on surface of sand grain by oxidized manganese layer.
The manganese and iron in the process water is reacted by the coated surface layer of the oxidation sand. The activation potential of the oxidation sand is kept in proper condition by contact with free chlorine residual in the process water.
If anthracite is lost by flown out, oxidized iron is removed insufficiently in the filter.
As a result of above, the surface on the oxidation sand is coated by oxidized iron layer. Consequently, the activation potential is weakened by interference of the oxidized layer on the oxidation sand. The oxidation sand is weakened by the lack of free chlorine in the inlet water to the filter.
The oxidation sands increase the size by coating of oxidized manganese.
Hence, periodical inspection and recovery is needed to keep the filter media in proper condition for oxidation reaction and filtration.

Pressure gauges for measuring of inlet and outlet pressure of the filter are use for check of clogging condition in the filter media. The poor filtered water is discharged from the filter by operation in high differential pressured condition between inlet and outlet pressure.
The differential pressure shall be less than 0.2 kg/cm2. The pressure gauge is important auxiliary instrument for operation of the filter and shall be confirmed usually.
The valves for the filter are provided to change the working of the filter such as a filtering, a backwashing and a pre-filtering. Trouble of the valves will reach to the stop of the filter directly.

1. Criteria for maintenance

The criteria for maintenance of the filter are as follows;

1-1.The criteria for the inspection work

1-1-1. Inspection of the filter media inside of the filter tank

- General inspection: Once in 3 months
- Detail inspection: Once in 3 years

1-2.The criteria for judgment

1-2-1.Limt of height for anthracite

Design height: 429 mm

Lower limit: 300 mm ?

1-2-2.Limit of height for oxidation sand

Design height: 273 mm

Lower limit: 250 mm ?

Upper limit: 400 mm ?

1-2-3.Surface condition of the oxidation sand (for reference)

Initial condition (normal condition): Blackly brown color

Peeled condition (unusual condition): Grey color

Coated by oxidized iron (unusual condition): Light brown color

2. Maintenance activity

Monitoring, check and inspection shall be carried out to judge necessity of recovering activity such as adjustment, repairing or replacing.

Maintenance activity consists of four (4) kinds of stages as follows;

-1.Monitoring and checking during operation

-2.Inspection

-3.Evaluate and analysis regarding result of inspection

-4.Reparing or replacing including check after the operation

2-1.Maintenance of the filter layer

Improper condition of filter layer may make filtered water quality worse and connect to acceleration of waste in filter layer further more. As a result, we will have to replace whole of filter sand in a short period.

To avoid above, conduct periodical monitoring and check about filter layer shall be required periodically.

When unusual condition is found about filter layer, rapid corrective action shall be carried out such as improvement of filter washing formation or supply of filter sand.

A plan for maintenance of filter layer shall be issued and maintenance activities for filter layer should include the followings;

-Distribution of degree of sand grain

- Waste degree of filter layer
- Existing of algae
- Existing of other waste such as adhesion substances
- Flatness of filter layer
- Existing of crack or crater
- Existing of clearance beside of wall

2-1-1.Usual monitoring and check

Description of inspection	Interval
1.Check of filtered water quantity, filtration rate, head loss of filter layer, filter run time	Daily
2.Check of filtered water quality (turbidity, free chlorine residual, pH, alkalinity, and so)	Daily

1. Periodical inspection

Description of inspection	Interval
1.Check waste adhesion on inside wall, drain trough in filter basin	Once 2-6 months
2.Check water leak, cracks, damage of filter basin inside	Once 2-3 years
3.Check of filter layer quality (waste, effective diameter and, uniformity, depth of filter sand layer)	Once 1-3 years
4.Check of moving of the gravel layer	Once 1-3 years
5.Check working condition of head loss pressure gauge	Once 1 year
6.Check of condition of under drain	Once 10-15 year
7.Check of flow rate and time formation for filter washing	Once 2-6 months
10.Monitoring of filter washing (e.g. flow out of filter media, malfunction of filter washing facility, improper condition of filter layer after washing such as crater, and so)	Once 3-4 days
11.Check turbidity of water of filter washing waste	As needed

2. Detail inspection and check (rehabilitation)

Description of inspection or rehabilitation	Interval
1.Additional supply of filter sand	As needed

3. Evaluate and analysis of result after inspection

Description of inspection	Criteria
1. Check of oxidized water quality	
-1.Turbidity	1 NTU of less
-2.Free chlorine residual	0.3 mg/l or more
-3.Contaning of Ammonium	----------
2.Check of head loss of filter layer	0.2 kg.cm2 or less

3.Check of filter run time	24 hours or less
4. Check of filtered water quality (turbidity, free chlorine residual, pH, alkalinity, and so on)	
-1.Turbidity	1 NTU of less
-2.Free chlorine residual	0.1mg/l or more
-3.Contaning of Ammonium	Not detected
-4. pH, alkalinity, and so on	Not more than Egyptian standard of potable water quality
5. Monitoring of filter washing	No improper condition
6. Check of time formation for filter washing	
7. Check turbidity of water of filter washing waste	Turbidity of washed drain is 5 NTU or less
8. Volume of sand layer	
-1.Anthracite	Decrease of 10% or less of initial volume
-2.The oxidation sand	Increase of 10% or more, or decrease of 10% or less of initial volume

2-1-2.Filter tank

The filter tank shall be checked external condition such as physical damage of corrosion or sealing of connection parts.

Check list of the external check of the filter tank is provided.

2-1-3.Piping and the valve

Piping and valve shall be checked external condition such as physical damage of corrosion or sealing of connection parts and the valve shall be inspected inner part such as diaphragm seat of valve periodically by dismantling of the valve.

Check list of the external check and internal check of the pipe and valve is provided.

3. Procedures under unusual condition

Prospect troubles and trouble shootings

After change of supplying of the filter media, sometimes it is happened a trouble such as;

- Free chlorine residual in the filtered water will not be detected

- The filter media is flown out
- Turbidity in the filtered water is high
- Differential pressure between inlet and outlet is high in short period after filtering

Troubleshooting is provided as cause and remedy for above in KFR-FMR05-MTTS01.

4. Report and record

4-1.Record

Records for maintenance of the filter facility are required as follows;

4-1-1.Monitoing and visual check records according to;

Monitornig check list

4-1-2.Inspection records according to;

Inspection check list

4-1-3.Recovery, rehabilitation or upgrading

-1.Repair

-2.Replace or supplying

-3.Tightening

-4.Repainting

-5.Adjustment

-6.Additional facility or part

4-2.Report

O&M activities by utilizing of records, checking and analyzing the recorded data inside them and they are required as follows;.

4-2-1.Periodical maintenance report

4-2-2.Corrective maintenance report

4-2-3.Result of recovery of trouble or unusual condition

4-2-4.Recommendation to O&M and improvement of facility

- Preventive action
- Upgrading
- Review of SOP
- Review of record sheet

Plant Name: **Qenayate FMRP**	Title **Filter**	SOP TAG No. **QEN-FMR05 –QC**

Issued		Developed by		Signature	
Revised		Approved by		Signature	

Introduction

Water quality control activities for the filter shall be provided as follows;
- The monitoring of quality of inlet water that is oxidized water
- The monitoring of quality of the filtered water
- The monitoring of a differential pressure
- The monitoring of quality of the backwash drain water
- Check of the filtering, the pre-filtering and the backwash operation
- Check of a condition of the filter media

Water quality monitoring and check of the operation condition of the filter shall be required mainly for water quality control in the FMRP.

Good performance of water quality control in FMRP shall be conducted by following;
- A control of clarified water quality
- Utilizing of feedback information from filtered water quality
- Daily monitoring of the filtered water and adjustment of chlorine dosage as needed
- Monitoring of operation condition
- Periodical inspection of the filter sand and early recovery action as needed

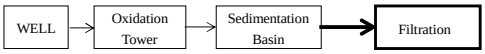
Water quality control shall be performed to optimum condition by not only water quality monitoring but check of operation and maintenance activity.
Almost of iron in the process water is removed by oxidation in aeration tower, oxidation by pre-chlorination and precipitation in the sedimentation basin.
But theoretically, manganese in the process water is not oxidized by chlorine.
Manganese in the process water with free chlorine residual is removed by a process of the oxidation sand filter in the condition around pH 7. In this process the oxidation sand works as a catalyst.

The filter sand for iron and manganese removal filter consists of the oxidation sand and anthracite. The function of anthracite is removal of the particles such as oxidized iron, and the function of the oxidation sand is oxidation of iron and manganese in the process water.
The anthracite is put on the upper layer on the filter layer and is a light filter media.
The anthracite is easy to flown out of the filter when the backwashing is conducted with excess rate of backwashing.

The oxidation sand is coated on surface of sand grain by oxidized manganese layer.
The manganese and iron in the process water is reacted by the coated surface layer of the oxidation sand. The activation potential of the oxidation sand is kept in proper condition by contact with free chlorine residual in the process water.

If anthracite is lost by flown out, oxidized iron is removed insufficiently in the filter.
As a result of above, the surface on the oxidation sand is coated by oxidized iron layer. Consequently, the activation potential is weakened by interference of the oxidized layer on the oxidation sand. The oxidation sand is weakened by the lack of free chlorine in the inlet water to the filter.

1. Criteria for water quality control



The criteria for water quality control of the filter shall be required as following;

1-1.The criteria for judgment
- The water quality of the filtered water
- The water quality of the oxidized water
- The water quality of the backwash water
- The water quality of the backwash drain water

1-2.The criteria for frequency of monitoring

Water quality analysis
- The filtered water
- The clarified water
- The backwash water
- The backwash drain water

1-3.The criteria for judgment

Limit of height for anthracite
Design height: 429 mm and Lower limit: 300 mm ?

Limit of height for oxidation sand
Design height: 273 mm and Lower limit: 250 mm ?
Upper limit: 400 mm ?

Surface condition of the oxidation sand
Initial condition (normal condition): Blackly brown color
Peeled condition (unusual condition): Grey color
Coated by oxidized iron (unusual condition): Light brown color

2. Report and record

2-1.Record

Record for maintenance of the filtering shall be required to recognize operation condition and water quality. For reference, water quality control records shall be as follows;
- Monitoring and visual check results
  - Filtered water quality
  - Turbidity
  - Free chlorine residual
  - Aluminum contains
- Operation condition
  - Flow rate inside sedimentation basin
  - Well water quality
  - Pre-chlorine dosing rate
  - Sludge drainage frequencies

2-2.Report

Generally almost of technical records shall be reported to people in technical sections in FMRP.
Any records have no value without utilizing them. Reports shall be useful tool for next improvement activities by utilizing of records.
Required Reports for filters is limited area, some recommendations will taken into consideration to operate the filter as follows;

2-2-1.Recommendations
- Rehabilitation
- Repairing or replacement of pumps and valves
- Filter media condition
- Replacing parts of facilities
- Required spare parts
- Review of SOP
- Procedures
- Criteria

Operation reports
- Produced water quantity
- Water used for backwashing
- Monthly and annually
- Free chlorine residual in discharge water

Plant Name: **Qenayate FMRP**	Title **Filter Pump**	SOP TAG No. **QEN-FMR06 –OP**

Issued		Developed by		Signature	
Revised		Approved by		Signature	

Introduction

Filtration is the final treatment stage of the Iron/Manganese Removal Plant (KFR-FMRP) which physically removes suspended particles and oxidizes contained manganese in the water from the sedimentation tank.
The effectiveness of this stage is very important on water quality control for the water supply, because suspended particles in the water hinder germs from the disinfection and because the soluble manganese cannot be oxidized by chlorine and must be physically and chemically removed.
The filter pump assists strongly this function of filtering process to be operated efficiently. Three functions are given to the filter pumps of this plant and these functions are changed by change-over operation of the valves around the filter.
-1.To feed the water from the sedimentation basin: Function as filter pump
-2.To feed the filtered water to the network: Function as transmission pump
-3.To backwash the filter: Function as backwash pump

Filter backwashing affects to filtering efficiency and performance.

1. Features of process

1-1.Function of the facility

Three functions are required for the filter pump as mentioned above, although filtration coating builds and penetrates into the filter bed, and the head loss across the filter becomes greater until the flow rate is greatly reduced. At this time the filter must be backwashed to cleanse the media of the flock and particulate matter by filter pump.

1-2.Impacts of facility

The filter pump has a great effect on the filtration process, so the proper operation for these pumps affects the efficiency of filtration.

1-3.Relations between other processes

1-3-1.The oxidation tower and sedimentation basin

The water from the oxidation tower is fed into the sedimentation basin and pre-chlorine is dosed. Then clarified water from the sedimentation basin is fed into the filter by filter pump.

1-3-2.The filter

Contained iron in the well water is oxidized by aeration in the oxidation tower and chlorination. But soluble manganese in the water is hardly oxidized and precipitated because of the pH condition of the well water. Hence, manganese in the water shall be removed in the filtration process by oxidation contact reaction on the oxidation sand in the filter.

Discharge capacity of a filter pump is same as the treatment capacity of a filter unit.

2. Criteria for operation

Control of pump operation shall be as follows;

-1. Flow rate of the discharge water from the filter pump
- Control of flow rate of inlet water for the filter: 140 m3/hr or less
- Check of flow rate of filtered water
- Check of backwash water

- 2. The capabilities required to the filter backwashing are as follows;
  - Suitable quantity for backwashing water
  - Suitable operation time for filter backwashing
  - Prevention of the filter sand flow-out

2-1. Procedures and specifications for filter backwashing

Water flow rate for backwashing: 0.6-0.8 (m3/m2/min)
Run time for backwashing: 15 (min)
Turbidity of drain water after filter washing: 1 NTU or less

2-2. Backwashing control

- Operation of the filter washing shall be evaluated by turbidity recovery of drain water of filter backwashing and by least loss of the filter sand by flown-out.
- Suspended particles are not removed by running of filter under the exceeding limit of pressure loss.
- Filter sand shall be checked periodically to confirm the proper filter backwashing operation.
- Procedures and specifications for filter backwashing operation shall be modified by results of the above to be more effective and suitable.

3. Operation under normal condition

3-1.Start-up and shut-down procedures for filter washing

The filter pump is operated manually.

☆ Pre-operation check
-1.Select the filter pump to be operated.
-2.Select the function of the filter pump
(Filtering, backwashing or pre-filtering)
-3.Confirm the valve position of the filter according to the required function
-4.Check the valve in suction pipe and discharge pipe are opened fully.
-5.Check the valve for pressure gauge is closed.
-6.The water level in the sedimentation basin is enough for the pump operation.
-7.The power supply is coming and circuit breaker for the pump is “ON”

☆ Start-up procedure
-1.Turn the starting switch on the switch board to “ON”
-2.Check the pressure gauge indication
-3.Check the ampere meter indication

☆ Shut down procedures
-1.Turn a starting switch on the switch board to “OFF”

3-2.Monitoring and visual check of facility

Monitoring and visual check during working of the pump are shown in KFR-FMR06-OPFC-01.

3-3 Control of filter backwashing

The filter pump is controlled depend on required function of the filter.
Number of the working filter pumps shall be controlled by required flow rate of the water to the filter.
Controllable operations regarding the filter pumps are as follows;
-1.Flow rate for the filtration and backwashing by the number of working pumps
The filter pumps can feed the water quantity to use two filters and to backwash one filter at a time.
-2.Operation time of the filter pump
-3.Frequency of filter backwashing
Above items are mentioned in SOPs of the “Filter” KFR-FMR07-OP.

4. Operation under unusual condition

4-1.Unusual condition for pump
Trouble shooting is shown in KFR-FMR06-OPTS-02.
4-2. Unusual condition for piping and valve
Trouble shooting is shown in KFR-FMR06-OPTS-03.

5. Report and record

5-1.Record

Records for filter pump facility are required as follows;
5-1-1.Records of filter pump
- No. of working pumps
- Time of start and stop
- Pressure gauge indication during operation
- Records of backwashing
- Electrical current during operation
- Result of monitoring and check

5-2.Report

Reports are required as follows;
5-2-1.Recomendation
- Rehabilitation
  - Repair or remove
  - Repainting
  - Replacement of parts or facilities
  - Required spare parts
- Review of SOPs
  - Procedures
  - The criteria
  - Required record and report

5-2-2.Operation report
- Consumption of water volume use for backwashing
  - Monthly and annually

Plant Name: **Qenayate FMRP**	Title **Chlorination Facility**	SOP TAG No. **QEN-FMR07-OP**

Issued		Developed by		Signature	
Revised		Approved by		Signature	

Introduction

There are Two injection points of chlorine in the chlorination system of QEN-FMRP, i.e. chlorine dosing point-1 and chlorine dosing point-2 . Three functions are provided to the chlorination facility, One is dosed in inlet water for chlorine dosing point -1 and the other is dosed in outlet water for chlorine dosing point-2 in the oxidation tower.

1. Features of process

1-1.Function of process

Function of chlorination is to oxidize iron, manganese, ammonium and organic matter and so which are contained in the raw well water.

1-2.Impacts of process

Chlorine dosing point-1 is dosed into the well water supply pipe to oxidation tower.
Chlorine dosing point-2 is dosed into the outlet water prior to the sedimentation basin.
Chlorine dosing point-1 aids oxidation reaction by free chlorine residual in the inlet water for filtering in the contact oxidization process.
Chlorination is an essential process in the iron and manganese removal plant with contact filtration process. Soluble iron and manganese in the water cannot be removed where chlorine is not dosed.

It is important to recognize that the combination of sufficient free chlorine residual and adequate contact time are essential for effective killing of the pathogenic organisms.

1-3.Relations between other processes

1-3-1.The well water
Chlorine dosing rate is depend on the raw well water quality, especially iron, manganese, ammonia and organic matter concentration.
1-3-2.The oxidation tower
Iron in the raw well water is oxidized in the oxidation tower by Chlorine dosing point-1 and aeration. This process is the first step of the oxidation process in this

plant. and is the second process of the oxidation of iron in the well water after aeration process in the oxidation tower.

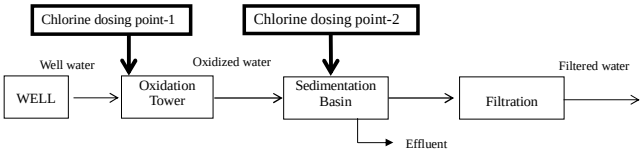
1-3-3.The sedimentation basin

The oxidized iron particles in the process water are precipitated in the sedimentation basin. The water removed oxidized iron in the sedimentation basin is fed to the filter by the filter pump.

Contained ammonia in the well water is also oxidized by the aeration and the chlorination. Duration time for the oxidation reaction of ammonia by chlorination is needed for 40 minutes or more but actual detention time for the oxidation of ammonia in the sedimentation basin is approx. 30 minutes or less.

Ammonia shall be oxidized prior to the filtration process to maintain free chlorine residual of Oxidized water in the required value.

Hence, when ammonia is contained in the well water, the Chlorine dosing point-1 shall be dosed in the well water prior to the oxidation tower to oxidize ammonia.



Note: “Process water” is also used as general word for the water flowing in the Plant.

2. Criteria for operation

2-1.For the pre-chlorination

Free chlorine residual for filtered water: 0.2 mg/l or more and less than 0.3 mg/l

Free chlorine residual for inlet water for the filter: 0.2 mg/l or more and less than 0.3 mg/l

Dosing flow rate for chlorination shall be changed at the same time when the well water flow rate is changed

3. Operation under normal condition

Basically, operation procedures for facility such as chlorinator shall be kept strictly according to manufacturers recommendations in instruction manuals.

3-1.Common notice for operation of chlorination facility

3-1-1. early detection and rapid response to chlorine leak accidents is a corrective action of chlorine leak. It is a very important action for operation of chlorination facility.

And we shall be carry out check of chlorine leakage about all of chlorine piping and valves, cylinders also opening and close of valve in chlorine line piping.

3-1-2. Close all doors in chlorination house to avoid diffusing leaked chlorine to outside of chlorination house.

3-1-3. Knowledge and skills on handling of chlorine and chlorination facility are required for persons to handle chlorination facility.

Persons to operate chlorination facility shall be be trained on chlorine, chlorination facility and handling skills on them.

3-1-4. Periodical practice on activity in emergency situation

Emergency case means situation of accident with severe chlorine leak.

Under emergency situation, we shall be act immediately according to prepared action plan and program. Safety devices and tools shall be be provided and maintained and kept in proper condition to use any time. And they shall be stored in the room without chorine such as chlorine neutralization room.

3-1-5. No smoking in the room of chlorination house

3-2. Start-up and shut-down procedures

3-2-1.Facility component of the chlorination equipment

The chlorination equipment consists of 3 main component init as following;

-1.Chlorine cylinder

-2.Injector and chlorinator

-3.Pipes and valves

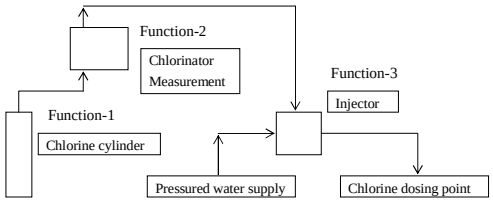
Chlorine gas is taken out from chlorine cylinder and the gas is sucked with negative pressure by the injector. The sucked chlorine gas can be measured and the chlorine dosing flow rate is controlled by the chlorinator. Controlled and measured chlorine gas is sucked by the injector and sucked chlorine gas is mixed with the water supplied into the injector and mixed chlorine water is dosed into the dosing point. Functions for the chlorination equipment are following;

Function-1: Supplying of chlorine gas with positive pressure

Function-2: Measuring and control of dosed chlorine

Function-3:.Making of chlorine water and feeding of chlorine water with pressurized water

Even if one of the above 3 shall not be functioned, function of the chlorination shall be stopped.



3-2-2.Start up procedures

Procedures for start up of chlorinator shall be according the instruction manual issued by a manufacturer of the chlorinator as follows.

-1. Connect a lead tube with chlorine cylinder and manifold inlet valve
-2. Feed the pressured water into the injector
-3. Confirm the arising of negative pressure in the chlorinator
-4. Flow rate of chlorine shall be set at zero in the chlorinator
-5. Open slightly outlet valve of chlorine in the chlorinator
-6. Check a close of inlet and outlet valves for chlorine gas manifold
-7. Check the connection parts of the lead tube and tighten a cover nut
-8. Open the master valve for cylinder and close it immediately.
-9. Check no leak around connection parts of lead tube from cylinder to manifold
-10. Leak check shall be conducted by use of ammonia solution water.
-11. After confirmation of above, open the outlet valve for manifold and check no leak of chlorine around connection part of the chlorinator.
-12. Confirm the flow rate of chlorine gas is zero in the chlorinator.
-13. Open the master valve for cylinder gradually and open it fully.
Master valve for cylinder shall be opened fully when it needs to be opened.
Check again the connection parts of chlorine gas line for leaks.
Sealing characteristic of master valve for cylinder shall be effective in a condition of opened fully.
-14. Adjust the flow rate of chlorine gas of the chlorinator to needed dosing flow rate. Flow rate of chlorine gas can be confirmed by flow meter in the chlorinator.
-15. After 30 minutes of above adjustment, confirm a condition of flow rate that it shall be kept in needed value.

Key points for start up procedures are as follows;

☆ Chlorine gas feeding into the tube or pipe from cylinder shall be conducted step by steps.
- Check for leaks of chlorine gas shall be done by as small amount chlorine gas as possible at the first step.
- Check for leaks from cylinder to connection part and to manifold one by one. Do not feed the gas at a time into whole pipe line and facilities.

☆ Negative pressure shall be arisen from injector prior to feed chlorine gas into the manifold and the chlorinator.

☆ Required chlorine dosing rate shall be grasped prior to start up the chlorinator. Chlorine dosing flow rate is calculated by following formula;
Chlorine dosing rate: R (mg/l)
Chlorine dosing flow rate: W (kg/h)
Flow rate of the process water: Q (m3/h)
W = Q * R * 1/1000 -------- (kg/h)

3-2-3.Shut down procedures

Cases of shut down
- Periodic shut down
- Long term shut down
-Changing cylinders

Procedures for shut down of chlorinator for above shall be according as the instruction manual issued by a manufacturer of the chlorinator.

Procedures are shown in the following for reference.

-1. Close the master valve for cylinder and keep this condition for several minutes. Confirm indication of a pressure in the manifold is zero. Keep this condition for 10 minutes or more.
-2. Check for leaks of chlorine gas from cylinder and pipe connection parts.
-3. Close the inlet valve of chlorine gas to the injector.
-4. Stop the water supply to the injector. At first close a inlet valve for the injector and then close a outlet valve for the injector.
Regarding of actions for long term stopping of the facilities, refer to the instruction manual issued by a manufacturer of the chlorinator.

Key points for shut down procedures are following;

☆ To avoid water flowing into the chlorinator, be sure the procedures from-3 to -4 in above mentions.

☆ The often cause of trouble of the chlorinator is backward flow of the water into the chlorinator.

3-3.Monitoring and visual check of facility

Monitoring and visual check during operation shall be conducted according to the check list.

3-4 Operation procedures for control of facility

Dosing flow rate of chlorine shall be controlled by the chlorinator.

3-4-1.Pre-chlorination

Dosing flow rate of chlorination shall be changed depend on the following;

- Quality of the well water
  - Chlorine demand of the well water
- Quality of the outlet water from oxidation tower
  - Chlorine demand of the outlet water from oxidation tower

Consumed quantity is varied in characteristics of contained substances.

Contained substance (as 1 mg/l)	Consumed chlorine (mg/l)
Iron	0.635
Manganese	1.29
Ammonia	7.6

Required dosing rate of pre-chlorine shall be determined based on laboratory test of chlorine demand for the sampling water from a process.

Determination procedures of dosing rate are shown in QEN-FMRP07-QC.

4. Operation under unusual condition

4-1 Prospect troubles and trouble shootings

4-1-1.Chlorinator

Troubleshooting chart of the chlorinator shall be according as the instruction manual issued by a manufacturer of the chlorinator.

Examples of prospect trouble for reference are as follows;

-1.Gas leak
-2.The required gas feed rate is not achieved at start-up
-3.Out-of-gas indications occurs during normal operation
-4.Insufficient ejector vacuum
-5.Loss of gas feed
-6.Flowmeter ball bounced and/or maximum gas feed rate cannot be achieved during normal operation
-7.Flooded metering tube
-8.Vacuum leaks

Probable causes and corrective actions for above are shown in troubleshooting chart QEN-FMR07-OPTS-01.

4-1-2.Piping and valves

-1.Gas leak from
  -Copper tube
  -Connection part
  -Valves

4-1-3.The chlorination process

-1.Insufficient free chlorine residual in the filtered water

-2. Insufficient free chlorine residual in the inlet water for the filter

Probable causes and corrective actions for above are shown in troubleshooting chart QEN-FMR07-OPTS-02.

Important Note

Insufficient free chlorine residual in the filtered water is caused to severe damage of oxidation filter sand in the filter tank. When detected this condition, cause of this condition shall be found immediately and corrective action shall be done. Detail information for above is shown in QEN-FMRP07-QC.

5. Report and record

5-1.Resord

5-1-1.Records for operation condition

1-.Chlorine gas feed
- Pressure gauge indication of chlorine gas feed for the chlorine gas manifold

2-Records for the chlorinator
- Chlorine dosing flow rate
- Water supply pressure fed to the chlorinator

3-.Indication of chlorine gas leak detector

4-Visual check list in a routine work

5-2.Report

Reports are required as shown in the following;

5-2-1.Consumption tendency of the chlorine
- Weight of chlorine used each 24-hour period during a month
- Total weight of chlorine used for a month
- Average weight of chlorine dosed during a 24-hour period for a month

- Maximum weight of chlorine used during any 24-hour period during a month
- Minimum weight of chlorine used during any 24-hour period during a month

5-2-2. Recommendation on facility
- Rehabilitation and upgrading
  - Repairing
  - Replacement
  - Repainting
  - Additional parts or facilities
  - Required spare parts
- Recommendation on modification of the criteria
- Recommendation on training for persons
- Recommendation on review of O&M plan

Rev.	Version	Revised Date	Description of revision
0	Original Version		

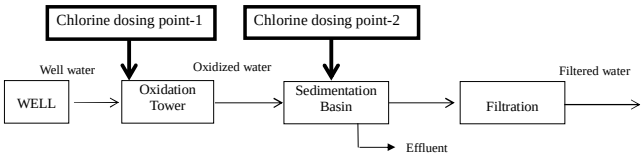
Plant Name: **Qenayate FMRP**	Title **Chlorination Facility**	SOP TAG No. **QEN-FMR07-QC**

Issued	13/Nov./07	Developed by		Signature	
Revised		Approved by		Signature	

Introduction

In iron and manganese removal plant, iron and manganese in the well water is removed by an oxidation, sedimentation and filtration treatment process.

Process flow of the Qenayate iron and manganese removal plant is as shown below;



Note: “Process water” is also used as general word for the water flowing in the Plant.

1. Potable Water Standards

Maximum allowable limit value of iron and manganese contained in the potable water are limited by new and previous Egyptian standards as follows;

Iron: 0.3 mg/l (1.0 mg/l for ground water by the previous standard)

Manganese: 0.4 mg/l (0.5 mg/l for ground water by the previous standard)

Color of water is also limited by new and previous Egyptian standards as follows;

Color: Nil (20-30 as a maximum limit using platinum cobalt by the previous standard)

The water contained manganese is colored result of oxidation by chlorination and colored degree of above is approx. 300 times as much as manganese contained concentration. If concentration of 0.5 mg/l manganese is contained in the water, color of the water is 150 after oxidation by chlorination. Hence, manganese in the filtered water shall be controlled less than 0.1 mg/l actually.

The functions of the chlorination consist of 2 kinds as follows;

-1.Oxidation

-2.Disinfection

Both functions are essential for the plant. Especially function of the oxidation shall be controlled securely in a routine work of the water quality control activity.

The oxidation treatment is performed by 3 steps.
-1st step: Aeration in the oxidation tower for oxidation of iron
-2nd step: Pre-chlorination in the sedimentation basin for oxidation iron
-3rd step: Contact oxidation in the filter by oxidation filter media for oxidation of manganese

pH value of the well water is around 7.8 in this plant.
The 1st step oxidation process of iron by the aeration is insufficient to remove in condition of low pH as 8.5 or below.
Hence, pre-chlorination shall be needed as 2nd oxidation process in this plant.
The 3rd step of oxidation is performed by contact oxidation filtration in the filter for oxidation of manganese. Free chlorine residual in the inlet water for the filter shall be needed to keep an oxidation potential of filter media in activated condition.
Disinfection treatment is final treatment process before transmission of the potable water in this plant. Chlorine residual measurement shall be done on the distribution system at the area farthest from the source of the water treatment plant. This ensures that the entire distribution system is receiving enough chlorine.

2. Monitoring Frequencies

2.1 Frequency of water quality analysis
- -The well water: Once in 6 months
- The outlet water from oxidation tower: Once in 6 months
- The inlet water to the filter: Once in 6 months
- Measurement of free chlorine residual: Twice a day
- The filtered water: Once a day
- Measurement of free chlorine residual: Twice a day
- Measurement of iron and manganese: Once a day
- Distributed water at the farthest tap in the network: Once a day

2.2 Frequency of chlorine demand test
- For the well water: Once in 6 months
- For the outlet water from oxidation tower: Once in 6 months

3. Water quality control under normal condition

3-1.Monitoring of the well water

3-1-1.Laboratory test of chlorine demand

Chlorine demand test shall be conducted according to a standard procedure in SHAPWASCO including sampling procedures.

- Water quality analysis
  - Iron
  - Manganese
  - Ammonia
  - pH
  - Other items as needed

3-1-2. Determination of the dosing rate of the pre-chlorine

Dosing rate of the pre-chlorine shall be determined based on water quality of the well water and prospect free chlorine residual in the filtered water.

Dosed chlorine is consumed by consumed substances in the well water such as iron, manganese, ammonia and organics. And consumed amount is varied contained amount of above substances and water condition such as a water temperature, an air temperature and so.
Consumed amount is varied in characteristics of contained substances.
Typical examples of theoretical consumed amount of chlorine are following;

Contained substance (as 1 mg/l)	Consumed chlorine (mg/l)
Iron	0.635
Manganese	1.29
Ammonia	7.6

Required dosing rate of pre-chlorine shall be determined based on laboratory test of chlorine demand for the sampling water from a process.

Free chlorine residual in the filtered water shall be controlled in a range of 0.5-1.0 mg/l.
Activation potential of filter media for contact oxidation filtration is affected by concentration of free chlorine residual in the inlet water to the filter.
If free chlorine residual in the filtered water is less than 0.5 mg/l, coating layer of oxidation sand is damaged and removal potential of the contact filter is reduced.

Determination procedures of dosing rate are shown in flow chart QEN-FMR07-QCFC01.

3-2.Determination of the dosing point of the pre-chlorine

Two pre-chlorination dosing pipes are prepared in this plant. One is dosed in inlet water and another is dosed in outlet water in the oxidation tower.

Contained ammonia in the well water also oxidized by the aeration and the pre-chlorination. Duration time for the oxidation reaction of ammonia by pre-chlorination shall be needed for 40 minutes or more but detention time for the oxidation of ammonia in the sedimentation basin is approx. 30 minutes or less.

Ammonia shall be be oxidized prior to the filtration process to maintain free chlorine residual of filtered water in the required value.
Hence, when ammonia is contained in the well water, the chlorination shall be dosed in the well water prior to the oxidation tower to oxidize ammonia.

Hence, proper dosing point shall be chosen depend on water analysis result of the well water on ammonia contained.

Dosing point	Contained ammonia (mg/l)
Outlet of the oxidation tower	0.1 or less
Inlet of the oxidation tower	More than above

3-3.Monitoring of the outlet water from the oxidation tower

- Laboratory test of chlorine demand

Iron removal amount is monitored in the first step of oxidation process as aeration. Dosing rate of pre-chlorine is expected by a result of chlorine demand for the outlet water from the oxidation tower.
Removal efficiency by the aeration treatment is changed slightly through a season. If quality of the well water is not changed, this chlorine demand value is changed slightly.
This value can be realized depend on the operation record in the past.
The operation record in the past shall be collected and kept, and utilized to determination of dosing rate of pre-chlorine.

3-4. Monitoring of the outlet water from the sedimentation basin

- Water quality analysis
  - Iron
  - Manganese
  - Ammonia
  - Free chlorine residual
  - Total chlorine residual
  - pH
  - Other items as needed

The outlet water from sedimentation basin is fed into the filter.

This water is inlet water for the filter and affects to the water quality of the filtered water directly.

Free chlorine residual in this water is a key factor of the filtering treatment by contact oxidation system. Insufficient concentration of residual chlorine causes to severe damage of oxidation filter media and poor quality of the filtered water.

3-5. Monitoring of the filtered water and pre-filtered drain water

- Iron
- Manganese
- Ammonia
- Color
- Turbidity
- Free chlorine residual
- Total chlorine residual
- pH
- Other items as needed

Pre-filter shall be done after backwashing and before filtering of the filter.
The functions of the pre-filtering are as follows;
-1.Initial drain of waste water after backwashing before filtering shall be confirmed by measurement result of turbidity of the pre-filtered drain water.
Turbidity of the pre-filtered drain water: 1 NTU or less
-2.Re-activation of filter media of oxidation sand in the filter tank shall be confirmed by measurement result of free chlorine residual in the pre-filtered drain water.
Free chlorine residual in the pre-filtered drain water: 0.5 mg/l or more

Monitoring of filtered water quality shall be conducted with standard frequency in a routine monitoring according to the criteria.
Free chlorine residual in the filtered water: 0.2 mg/l or more
Iron contained in the filtered water: 0.3 mg/l or less
Manganese contained in the filtered water: 0.4 mg/l or less
Other substances contained in the filtered water: Less than Egyptian standard

3-6. Monitoring of the distributed water at the farthest tap in the network

- Iron
- Manganese

- Ammonia
- Color
- Turbidity
- Free chlorine residual
- Total chlorine residual
- pH
- Bacteria and coliforms
- Other items as needed

Free chlorine residual in the distribution water is consumed during a distribution of the water in the network. Consumed amount of chlorine is varied a condition in the network such as contamination, water temperature, condition of network pipe lines and so.

And the outlet water from the plant is mixed with the water from the well stations in the network.

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Free chlorine residual in the distributed water shall be maintained at least 0.2 mg/l to 0.3 mg/l at a point of the farthest tap in the network.

If combined chlorine residual is being used for chlorination, the residual shall be 1 to 2 mg/l.

3-7.Control of the chlorine dosing rate

As mentioned in 3-1-2, this is realized by applying the followings;

-1.Set a target for the filtered water
-2.Set a target for the inlet water of the filter
-3.Confirm a water quality of the well water
-4.Presume a consumed chlorine in the process
-5.Set a chlorine dosing rate of the pre-chlorine
-6.Confirm the flow rate of the well water
-7.Set a chlorine dosing flow rate of Chlorine dosing point-1 by the chlorinator
-8.Monitor a free chlorine residual in the water
- The inlet water of the filter
- The filtered water

-9.Compare a monitored date with the targets
-10.Determin that chlorine dosing rate shall be changed or not
-11.If a chlorine dosing rate shall be changed, change a dosing flow rate by operation of Chlorine dosing point-1 to be increase or decrease
-12. Monitor a free chlorine residual in the water
- The inlet water of the filter
- The filtered water

-13.Compare a monitored date with the targets

-14.Determin that chlorine dosing rate shall be changed or not
-15.Repeat from control actions 11 to 14 in the routine work

The free chlorine residual in the distributed water at a point of the farthest tap in the network shall be measured periodically according to the frequency of the criteria.

The control action of free chlorine residual shall be done by following activities;

-1.Set a target for the distributed water at a point of the farthest tap in the network
-2.Confirm the well water connected with the network
- Numbers of the well stations
- Free residual chlorine from each well station
- Flow rate of the distribution water from each well station

-3.Set a target for the filtered water
-4.Presume consumed chlorine in the process
-6.Confirm the flow rate of the filtered water (inlet water to the filter)
-8.Monitor a free chlorine residual in the water
- The filtered water
- The distributed water at a point of the farthest tap in the network

-9.Compare a monitored date with the targets
-10.Determin that chlorine dosing rate shall be changed or not
-11.If a chlorine dosing rate shall be changed, change a dosing flow rate by operation of the chlorinator to be increase or decrease
-12. Monitor a free chlorine residual in the water
- The filtered water
- The distributed water at a point of the farthest tap in the network

-13.Compare a monitored date with the targets
-14.Determin that chlorine dosing rate shall be changed or not
-15.Repeat from control actions 11 to 14 in the routine work

3-9.Visual check of operation condition

Operation condition of the chlorination facilities and the treatment process shall be checked in the routine work to confirm proper operation of the facilities.

4. Operation under unusual condition

4-1 Prospect troubles and trouble shootings

4-1-1.The chlorination process

-1.Insufficient free chlorine residual in the filtered water
-2. Insufficient free chlorine residual in the inlet water for the filter
-3.Unusual colored water
- The water in the sedimentation water
- The filtered water
- The distribution water in the network

5. Report and record

5-1.Record

5-1-1.Records for water quality

-1.Water quality analysis result
- The well water
- Outlet water from the oxidation tower
- Inlet water to the filter
- The filtered water
- The distributed water (Outlet water from the plant)
- The distributed water at a point of the farthest tap in the network

-2.Records for the chlorinator
- Pre-chlorine dosing rate and dosing flow rate
- Post-chlorinator dosing rate and dosing flow rate

-3.Visual check list in a routine work

5-2.Report

Reports are required as shown in the following;

5-2-1.Consumption tendency of the chlorine
- In the sedimentation process
- In the filtering process
- In the network

5-2-2.Contamination of the wells
- Changing tendency of the well water

5-2-3. Recommendation on facility
- Rehabilitation
  - Repairing
  - Replacement
  - Additional facility
- Recommendation on modification of the criteria
- Recommendation on training for persons

- Recommendation on review of O&M plan

Rev.	Version	Revised Date	Description of revision
0	Original Version		