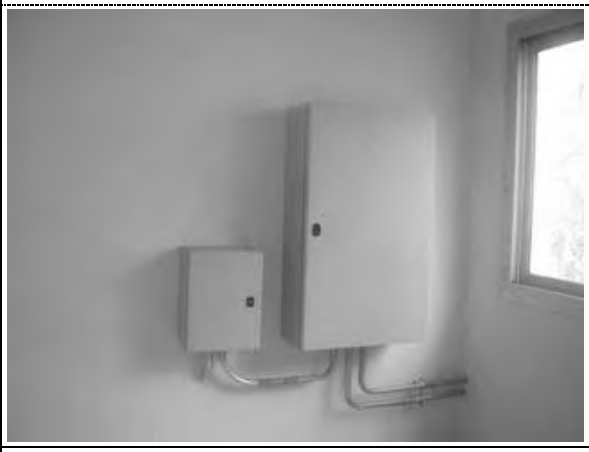
3.5 Situation of Flow Meter Installation (Action S3 & S5-1)

Situation photo of flow meter (1/4)

No.1	**No.2**
➢ Location; Inside of Zagazig WTP ➢ Group; Raw Water in Plant ➢ Diameter; 400mm	➢ Location; Inside of Abbasa WTP ➢ Group; Raw Water(1) in Plant ➢ Diameter; 800mm
	
No.3	**No.4&5**
➢ Location; Inside of Abassa WTP ➢ Group; Raw Water(2) in Plant ➢ Diameter; 800mm	➢ Location; Inside of Abbasa WTP ➢ Group; Treated Water(1) to Zagazig &Faqus ➢ Diameter; 900mm, 600mm
	
No.6	**No.7**
➢ Location; Inside of Abbasa WTP ➢ Group; Treated Water(3) to Abu Hamad-1 ➢ Diameter; 800mm	➢ Location; Inside of Abbasa WTP ➢ Group; Treated Water(4) to Abu Hamad-2 ➢ Diameter; 600mm
	

Situation photo of flow meter (2/4)

No.8	No.9
➢ Location; Inside of Abbasa WTP ➢ Group; Treated (5) to Bilbais ➢ Diameter; 600mm	➢ Location; Outside of Abassa WTP ➢ Group; Branch(1) to Unserrved Village ➢ Diameter; 800mm
	
No.10	**No.11&12**
➢ Location; Outside of Abbasa WTP ➢ Group; Branch(2) to Zagazig ➢ Diameter; 500mm	➢ Location; Outside of Abbasa WTP ➢ Group; Branch(3) (4) to Abu Kabier-1 &2 ➢ Diameter; 400mm, 300mm
	
No.13	**No.14**
➢ Location; Outside of New Faqus WTP ➢ Group; Branch(1) to Abu Kabier ➢ Diameter; 400mm	➢ Location; Inside of Old Faqus WTP ➢ Group; Raw Water in Plant ➢ Diameter; 500mm
	

Situation photo of flow meter (3/4)

No.15	**No.16**
➢ Location; Inside of Huseinia WTP ➢ Group; Raw Water in Plant ➢ Diameter; 800mm	➢ Location; Inside of Huseinia WTP ➢ Group; Treated Water in Plant ➢ Diameter; 800mm
	
No.17	**No.18**
➢ Location; Outside of Kafr Saqr WTP ➢ Group; Branch(1) on aqua duct ➢ Diameter; 1000mm	➢ Location; Outside of Kafr Saqr WTP ➢ Group; Branch(2) to Abu Kabier ➢ Diameter; 800mm
	
No.19	**No.20**
➢ Location; Inside of Bilbais BPS ➢ Group; Al Mohada line to Bilbais city ➢ Diameter; 300mm	➢ Location; Inside of Bilbais BPS ➢ Group; El Adlia line to Bilbais city ➢ Diameter; 300mm
	

Situation photo of flow meter (4/4)

No.21	No.22
➢ Location; Inside of Kafr Farag Fe/Mn RP ➢ Group; Treated Water to Menia Alqamah ➢ Diameter; 500mm	➢ Location; Outside of Hihiya WTP ➢ Group; Treated Water(1) to East Area ➢ Diameter; 800mm
	
No.23	**No.24**
➢ Location; Outside of Hihiya WTP ➢ Group; Treated Water(2) to Hoad Nogieh Area ➢ Diameter; 400mm	➢ Location; Outside of Hihiya WTP ➢ Group; Treated Water(3) to West Area ➢ Diameter; 600mm
	
No.25	**No.26**
➢ Location; Outside of Hihiya WTP ➢ Group; Treated Water(4) to Sobih Area ➢ Diameter; 400mm	➢ Location; Outside of Hihiya WTP ➢ Group; Treated Water(5) to El adwa Area ➢ Diameter; 400mm
	

3.6 Distribution Network and Hydraulic Analysis (Action S5-1 & 2)

Plant Name: ----------	Title **Distribution Network Management**	SOP TAG No. **DNM-0**

Issued		Developed by		Signature	
Revised		Approved by		Signature	

1. Purpose of Distribution Network Management

Following items can be shown by conducting of distribution network management.

(1) Current situation of daily consumption per each person in Sharkia Governorate, each markaz, and small area
(2) Estimated Unaccounted for water (UFW) in Sharkia Governorate, each markaz, and small area

Above basic data contribute to the long term plan for piping network. Usually piping plan is studied by hydraulic calculation by using software such as Water Cad. Daily consumption is most basic and most important value in study. When precision of these data rises, precision of a plan will rise. Also priority area for UFW Reduction Activity can be shown by above result. Furthermore these can serve pump operation in water treatment plant.

2. Necessity Information for Distribution Network Management

(1) Network map

GIS map including following information is required.

- Boundary markaz
- Water resource such as water treatment plant
- Main pipes
- Location of flow meter

(2) Distribution water volume

Distribution volume such as following data is required.

- Actual total distribution volume by bulk flow meter at water treatment plant
- Total distribution volume by pump capacity at well station
- Water volume distributed by flow meter measurement in each markaz

(3) Population data

Latest population data in each markaz is required.

(4) Sold water volume

Sold water volume in each markaz is required.

3. Method of Data Collecting

(1) Network map (GIS Center)

GIS center already prepared network map. However periodical revision is necessary by GIS Center for keep actual situation on site.

(2) Distribution water volume (Each Facilities)

1) Water treatment plant

Water treatment plant has bulk flow meter on transmission pipe line in each plant. The plant has recorded the volume by manual reading or data roger. The plant should collect the record and summarize it by their computer. Also the plant should report it to head quarter. In case of no flow meter such as direct filtration plant, plant should calculate production volume in the plant.

2) Well station

At the moment well station has no flow meter. Therefore it is necessary to calculate production water volume by pump capacity. Well monitoring has conducted since 2007. This monitoring suggests the situation of pump and production water.

3) Water volume Imported/ exported from other markaz

The main distribution pipe is located at boundary markaz. Some markaz has obtained water from other markaz due to water deficit. Some markaz has supplied water to other markaz where is under water deficit. Some of these pipes have bulk flow meter for understanding water volume. In this case, water volume imported/ exported from other markaz can be grasped. The water treatment plant supplying to water deficit markaz should collect the record from data roger and summarize it by their computer. Also the plant should report it to head quarter. If pipeline has no bulk flow meter, measurement by portable flow meter periodically is required. At the moment, UFW department only has portable flow meter and use it.

(3) Population data (Financial Department)

Population data in Sharkia every year can be obtain at Sharkia governorate. Financial department should obtain this information and keep population data.

(4) Sold water volume (Financial Department)

Each branch collects the charge from costumer. And they report it to financial department of head quarter. They should conduct statistical work.

4. Method of Data Analysis

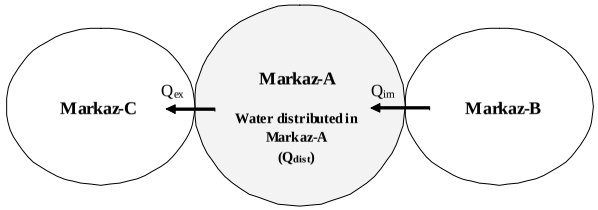
UFW and SOP department in head quarter should analyze it. Method of analysis in case of each Markaz is as follows.

(1) Daily consumption per each person

Analyst should collect data from above department and analyze. Daily consumption per each person is calculated by following formula.

Daily consumption per each person (LCD; litter per capita per day)
= Total water volume distributed in each markaz / Total population in each markaz

Where;
Total water volume distributed in each markaz
= Total water volume produced in each markaz
+ Total water volume imported from other markaz
– Total water volume exported to other markaz



Q_{dist} in Markaz-A = $Q_{prod} + Q_{im} - Q_{ex}$
Q_{prod} = Water produced in Markaz-A

Fig Water Distributed in Each Markaz

(2) Estimated uncounted for water (UFW)

Estimated uncounted for water (UFW) is calculated by following formula.

Estimated uncounted for water (UFW)
= Total water volume distributed in each markaz – Sold water volume in each markaz

Above result suggests priority area where SHAPWASCO should conduct UFW Reduction Activity.

5. Periodical Duty

Each department should conduct collection and analyzing work periodically. Target of period is as follows;

Item	Frequency	Implementation Section	Data Administration
GIS Revision for network	Time in main revision of facilities	GIS Center	GIS Center
Collecting water volume from Water Treatment Plant	Every month	Manager of WTP	SOP Department
Collecting water volume from pump operation	Every month (direct filter ration)	Manager of WTP	SOP Department
Imported/Exported volume by data roger	Every month	Manager of WTP in charge of Markaz	SOP Department
Imported/Exported volume by portable flow meter	As needed	UFW Department	SOP Department
Well monitoring record	Every year	Well Department	SOP Department
Collecting sold water volume	Every month	Financial Department	Financial Department
Analysis of LCD	Every month	SOP Department	SOP Department
Analysis of UFW	Every month	UFW Department	UFW Department

Distribution Network Management EXAPLE -1;
[Distribution control in small area in Hihya]

1. General

In Hihya markaz, five bulk flow meters were installed to grasp the actual flow volume. (Four flow meters were installed as of end of March 2009.) A location of flow meters was decided by several discussions. It is shown in map of summary. SHAPWASO has been able to grasp actual unit demand (water supply per capita per day; LCD) in small area in Hihya by this measurement. In this report the result for analysis is mentioned.

2. Data Analysis of flow meter record

Measurement has conducted since October 2008 by data roger and measurement records were collected from October 2008 until March 2009. The analysis on this report uses the measurement data in above period. These data have error data at electric power failure. The analysis should be conducted except these error data, therefore the average volume (m3/day) was calculated except error data at each month. The result is shown in section 4" Result of LCD".

3. Population data

Population year 2008 and 2009 was calculated in consideration of growth rate "2.3" based on population data year 2006 because actual population data could not be gotten. Each flow meter has supply areas/villages. These areas can be grasped by result of hydraulic analysis by Water Cad and were set by addition of inquiring survey from staff at Hihya branch office. Population data is shown following table. By the way, this growth rate"2.3" is using generally in SHAPWASCO. In the future the growth rate shall be analyzed by collecting actual data.

Flow meter no 1

	Area Name	Population Data				
		1996	2005	2006	2008	2009
1	Hihya city *1	9,064	10,769	10,959	11,463	11,715
2	Zar zamoon	7,195	8,548	8,699	9,099	9,299
3	Sobieh	7,945	9,439	9,606	10,048	10,269
4	Adwa	8,818	10,477	10,661	11,151	11,397
5	Hoad Nogieh	6,332	7,534	7,655	8,007	8,183
6	Sakakra	3,708	4,405	4,483	4,689	4,792
7	Shr shima	5,257	6,246	6,356	6,648	6,795
8	Metawa	4,887	5,706	5,908	6,180	6,316
9	Meslami	2,959	3,516	3,577	3,742	3,824
10	Fawagsa	5,016	5,960	6,064	6,343	6,482
25	Elalakma	9,173	10,898	11,090	11,600	11,855
26	Elsalamon	6,125	7,277	7,405	7,746	7,916
27	Elawaska	9,655	11,471	11,673	12,210	12,478
28	Kafr hamoda	4,393	5,219	5,311	5,555	5,677
29	Kafr ageiba	2,608	3,099	3,153	3,298	3,371
	Total				117,779	120,369

*1; approx 25% of whole city

Flow meter no 3

	Area Name	Population Data				
		1996	2005	2006	2008	2009
1	Hihya city *2	5,439	6,462	6,575	6,878	7,029
11	El mahmoudia	3,983	4,732	4,815	5,036	5,147
12	Kafr El aaid	777	923	939	982	1,004
13	Kafr awladatia	1,886	2,241	2,280	2,385	2,437
14	Kafr El mahmoudia	3,896	4,629	4,710	4,927	5,035
15	Ghaly Mansour	1,299	1,543	1,570	1,642	1,678
16	Manzal Hian	4,425	5,257	5,350	5,596	5,719
17	El sheikh El zawahry	3,677	4,369	4,445	4,649	4,752
18	El khodary	2,748	3,265	3,322	3,475	3,551
19	Khelwat abu hatab	2,371	2,817	2,867	2,999	3,065
20	Kafr dapous	3,583	4,257	4,332	4,531	4,631
21	El Mahdieh	9,483	11,267	11,465	11,992	12,256
22	Kafr Abu hatab	2,256	2,680	2,728	2,853	2,916
23	Shabrawien	8,660	10,289	10,470	10,952	11,192
24	El ihsanien	1,856	2,205	2,244	2,347	2,399
	Total				64,368	65,783

*2; approx 15% of whole city

Flow meter no 4

	Area Name	Population Data				
		1996	2005	2006	2008	2009
2	Zar zamoon	7195	8,548	8,699	9099	9299
3	Sobieh	7945	9,439	9,606	10048	10269
9	Meslami	2959	3,516	3,577	3742	3824
10	Fawagsa	5016	5,960	6,064	6343	6482
25	Elalakma	9173	10,898	11,090	11600	11855
29	Kafr ageiba	2608	3,099	3,153	3298	3371
	Total	34896	41,460	42,189	44,130	45,100

Flow meter no 5

	Area Name	Population Data				
		1996	2005	2006	2008	2009
27	Elawaska	9655	11,471	11,673	12210	12478
28	Kafr hamoda	4393	5,219	5,311	5555	5677
	Total	9655	11,471	11,673	17,765	18,156

	Area Name	Population Data				
		1996	2005	2006	2008	2009
1	Hihya city *3	21,754	25,846	26,301	27,511	28,116

*3; approx 60% of whole city

Summary	Pupulation 2008	Pupulation 2009
Flow meter no 1	117779	120369
Flow meter no 3	64368	65783
Flow meter no 4	44130	45100
Flow meter no 5	17,765	18,156
Flow meter no 1- (4,5)	55884	57113
part of Hihya city	27,511	28116
Total markaz	209,658	214,268

4. Result of LCD

Calculation result of unit demand (water supply per capita per day; LCD) is shown following table and figure.

The result which consists of record from October 2008 until March 2009 except Flow Meter No.2 suggests that there is difference of LCD between City Area and Village Area.

- City Area ; Approx 190 LCD
- Village Area; Approx 120 LCD

(Reference; Average LCD in Hihya is 145 LCD)

In addition annual analysis is necessary because this analysis can not show an average consumption for a year and peak month. It is aspect for next step.

No.	Month	Flow(m3 /day)	Flow ratio	LCD
Flow meter No 1	october	19,591	1.13	166.3
	Nov	18,146	1.05	154.1
	Dec	17,021	0.98	144.5
	Jan	14,094	0.81	117.1
	Feb	17,314	1.00	143.8
	Mar	17,901	1.03	148.7
	Average	17,345		**145.8**
	Pupulation 2008		117,779	
	Pupulation 2009		120,369	

No.	Month	Flow(m3 /day)	Flow ratio	LCD
Flow meter No 3	oct	9,791	1.11	152.1
	Nov	8,728	0.99	135.6
	Dec	8,962	1.02	139.2
	Jan	7,941	0.90	120.7
	Feb	8,461	0.96	128.6
	Mar	8,825	1.00	134.2
	Average	8,785		135.1
	Pupulation 2008		64,368	
	Pupulation 2009		65,783	

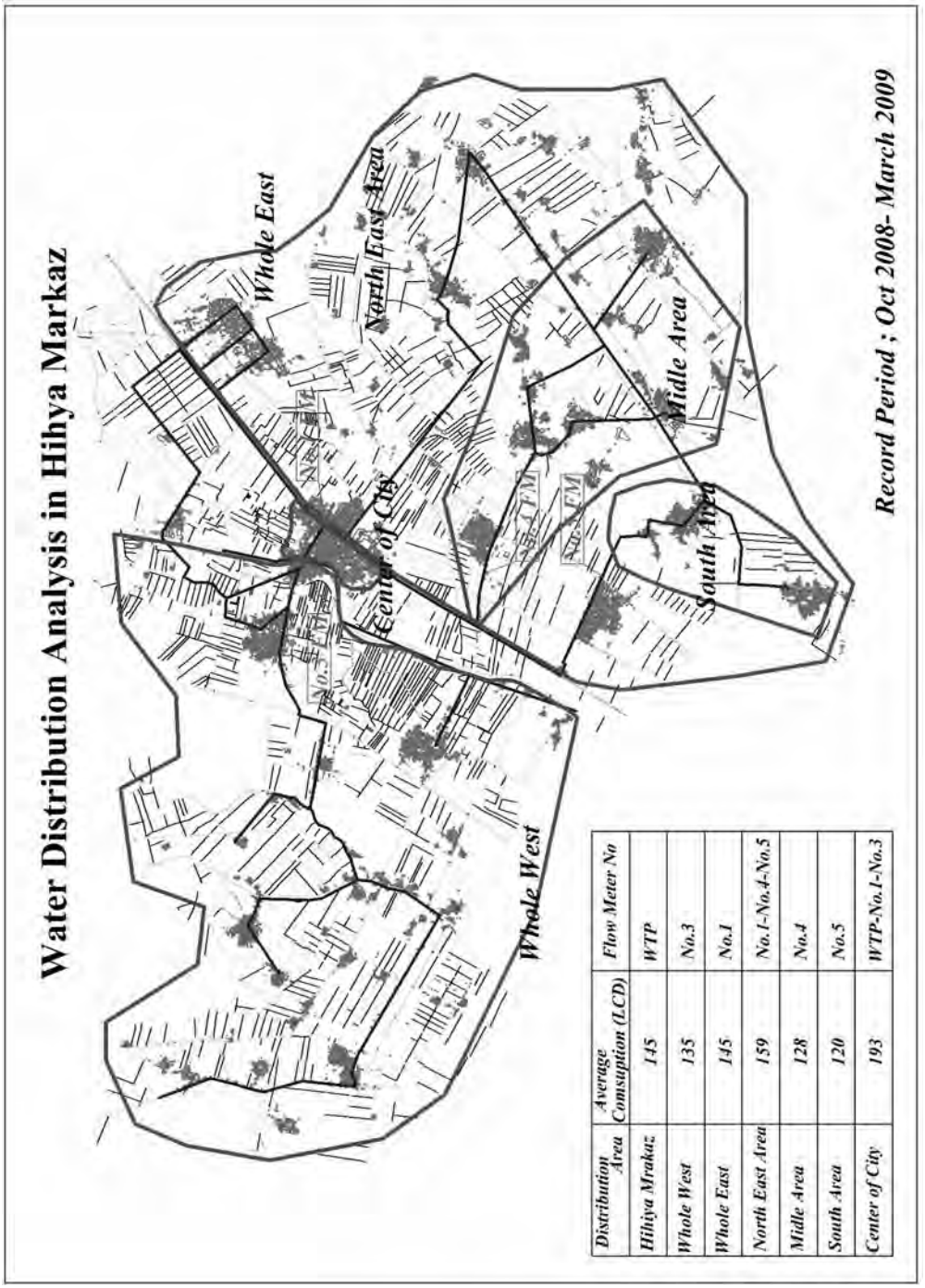
No.	Month	Flow(m3 /day)	Flow ratio	LCD
Flow meter No 4	Nov	6,042	1.06	136.9
	DEC	5,751	1.00	130.3
	Jan	5,405	0.94	119.8
	Feb	5,662	0.99	125.5
	Mar	5,757	1.01	127.6
	Average	5,723		128.1
	Pupulation 2008		44,130.0	
	Pupulation 2009		45,100.0	

No.	Month	Flow(m3 /day)	Flow ratio	LCD
Flow meter No 5	Nov	1,936	0.90	109.0
	Dec	2,228	1.04	125.4
	Jan	2,146	1.00	118.2
	Feb	1,948	0.91	107.3
	Mar	2,500	1.16	137.7
	Average	2,152		119.5
	Pupulation 2008		17,765.0	
	Pupulation 2009		18,156.0	

No.	Month	Flow(m3 /day)	Flow ratio	LCD
Flow meter No 1-(4,5)	Nov	10,168	1.13	181.9
	Dec	9,042	1.00	161.8
	Jan	6,543	0.73	114.6
	Feb	9,704	1.08	169.9
	Mar	9,644	1.07	168.9
	Average	9,020		159.4
	Pupulation 2008		55,884	
	Pupulation 2009		57,113	

No.	Month	Flow(m3 /day)	Flow ratio	LCD
Part of Hihya city	Nov	4,853	0.90	176.4
	DEC	5,626	1.05	204.5
	Jan	6,885	1.28	244.9
	Feb	4,591	0.85	163.3
	Mar	4,919	0.92	175.0
	Average	5,375		192.8
	Pupulation 2008		27,511	
	Pupulation 2009		28,116	

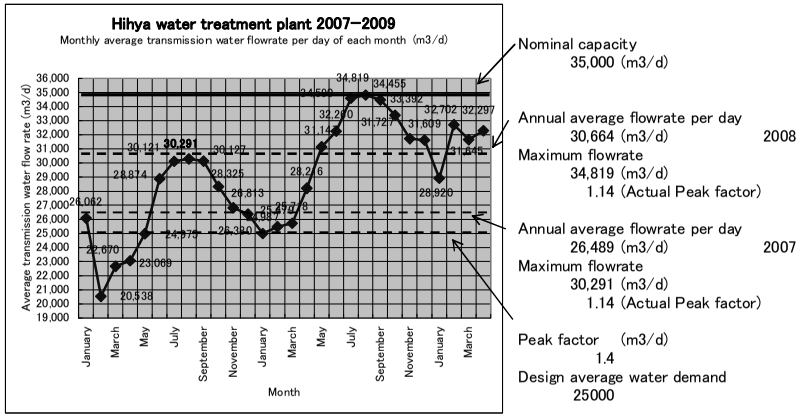
No.	Month	Flow(m3 /day)	Flow ratio	LCD
Hihya WTP	Nov	31,727	1.03	151.3
	DEC	31,602	1.02	150.7
	Jan	28,920	0.94	135.0
	Feb	30,366	0.98	141.7
	Mar	31,645	1.03	147.7
	Average	30,852		145.3
	Pupulation 2008		209,658	
	Pupulation 2009		214,268	



5. Additional study

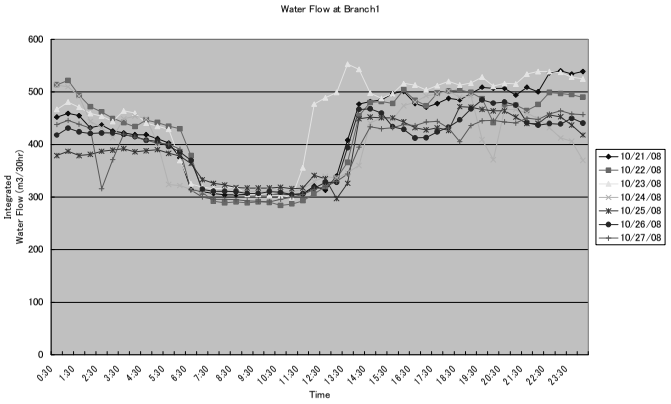
5.1 Peak factor of monthly maximum water supply

Following chart is made by annual record of water supply from water treatment plant. This result suggests that peak factor of monthly maximum water supply is approx “1.14”.



5.2 Peak factor of hourly maximum water supply

Following chart is made by actual record (Flow meter No.1 in Hihya) of water supply during fixed period. This result suggests that peak factor of hourly maximum water supply is approx “1.2”.



Measurement Volume at branch1 in Hihya (one week : from October 21,2008 until October 27,2008)

	Branch1									Peak Factor for Hourly Maximum Flow							
Actual time	Modified time	10/21/08	10/22/08	10/23/08	10/24/08	10/25/08	10/26/08	10/27/08		10/21/08	10/22/08	10/23/08	10/24/08	10/25/08	10/26/08	10/27/08
0:37:56	0:30	452	514	467	513	379	418	438								
1:07:56	1:00	459	522	481	510	387	431	446		1.07	1.22	1.05	1.27	0.97	1.06	1.13
1:37:56	1:30	455	494	471	492	379	424	439								
2:07:56	2:00	432	472	459	444	381	421	431		1.04	1.14	1.03	1.16	0.97	1.06	1.12
2:37:56	2:30	437	462	454	432	387	422	316								
3:07:56	3:00	426	450	444	413	389	422	371		1.02	1.08	0.99	1.05	0.99	1.05	0.88
3:37:56	3:30	422	442	464	449	392	419	420								
4:07:56	4:00	419	434	460	454	386	415	414		0.99	1.03	1.02	1.12	0.99	1.04	1.07
4:37:56	4:30	419	447	441	450	388	408	408								
5:07:56	5:00	411	442	435	403	390	406	402		0.98	1.05	0.97	1.06	0.99	1.02	1.04
5:37:56	5:30	403	435	429	324	383	396	401								
6:07:56	6:00	375	430	370	322	378	386	391		0.92	1.02	0.88	0.80	0.97	0.98	1.02
6:37:56	6:30	315	379	325	315	364	370	313								
7:07:56	7:00	310	309	319	312	333	315	300		0.74	0.81	0.71	0.78	0.89	0.86	0.79
7:37:56	7:30	307	292	316	310	326	311	296								
8:07:56	8:00	304	289	317	312	323	311	296		0.72	0.69	0.70	0.77	0.82	0.78	0.76
8:37:56	8:30	304	291	319	309	318	310	295								
9:07:56	9:00	305	289	305	311	317	307	293		0.72	0.68	0.69	0.77	0.81	0.77	0.75
9:37:56	9:30	304	291	305	311	317	307	292								
10:07:56	10:00	304	290	304	311	317	310	291		0.72	0.69	0.67	0.77	0.81	0.77	0.75
10:37:56	10:30	306	284	303	310	319	309	296								
11:07:56	11:00	305	287	299	309	316	305	300		0.72	0.67	0.66	0.77	0.81	0.77	0.77
11:37:56	11:30	306	293	356	316	317	306	305								
12:07:56	12:00	321	306	477	330	341	317	315		0.74	0.71	0.92	0.80	0.84	0.78	0.80
12:37:56	12:30	313	320	489	339	335	328	320								
13:07:56	13:00	340	336	499	336	297	328	330		0.77	0.77	1.09	0.84	0.80	0.82	0.83
13:37:56	13:30	408	366	553	346	326	394	344								
14:07:56	14:00	477	455	543	360	449	467	395		1.04	0.97	1.21	0.88	0.98	1.08	0.95
14:37:56	14:30	482	480	498	441	452	468	434								
15:07:56	15:00	485	482	488	451	451	460	430		1.14	1.14	1.09	1.11	1.15	1.16	1.11
15:37:56	15:30	497	478	497	448	451	434	432								
16:07:56	16:00	501	504	516	474	443	429	438		1.18	1.16	1.12	1.14	1.14	1.08	1.12
16:37:56	16:30	478	484	513	481	432	412	436								
17:07:56	17:00	471	474	504	493	428	413	443		1.12	1.13	1.12	1.21	1.09	1.03	1.13
17:37:56	17:30	478	498	512	496	432	424	444								
18:07:56	18:00	488	502	520	502	427	433	431		1.14	1.18	1.14	1.24	1.09	1.07	1.12
18:37:56	18:30	485	504	513	490	472	447	405								
19:07:56	19:00	497	499	517	493	471	468	436		1.16	1.18	1.14	1.22	1.20	1.14	1.08
19:37:56	19:30	509	487	528	409	467	485	445								
20:07:56	20:00	507	442	511	371	464	479	446		1.20	1.10	1.15	0.97	1.18	1.20	1.14
20:37:56	20:30	507	474	516	467	464	481	443								
21:07:56	21:00	494	475	515	467	452	475	441		1.18	1.12	1.14	1.16	1.16	1.19	1.13
21:37:56	21:30	509	465	534	460	440	442	450								
22:07:56	22:00	500	476	539	449	440	437	448		1.19	1.11	1.18	1.13	1.12	1.10	1.15
22:37:56	22:30	536	499	539	432	456	440	458								
23:07:56	23:00	540	497	537	412	453	439	464		1.27	1.18	1.19	1.05	1.16	1.10	1.18
23:37:56	23:30	534	495	528	406	437	450	458								
0:07:56	24:00	539	490	525	370	418	441	457		1.26	1.16	1.16	0.96	1.09	1.11	1.17
Total	(m3/day)	20,376	20,326	21,754	19,355	18,884	19,220	18,697	Maximun	1.27	1.22	1.21	1.27	1.20	1.20	1.18
Average of day	(m3/hr)	849	847	906	806	787	801	779	Average							1.22
Average of week	(m3/hr)							825								

6. Review of hydraulic analysis

Hydraulic analysis by water cad was conducted by only using peak factor "1.4". This is peak factor of monthly maximum water supply in Egyptian cord. However actual peak factor was not corresponded to Egyptian cord. When present situation reproduction is analyzed is planed, the Egyptian cord should not be used simply. Additionally peak factor of hourly maximum water supply should be considered for distribution network. Above result suggests that peak factor should be used following value. However this number is example and will be changed when actual data will be accumulated. Therefore this number shall be modified periodically. Meanwhile it is better to use the peak factor in Egyptian cord for future planning.

Design peak factor at present situation
= Actual peak factor of monthly maximum water supply (1.14)
x actual peak factor of hourly maximum water supply(1.2)
= 1.368 --> 1.4

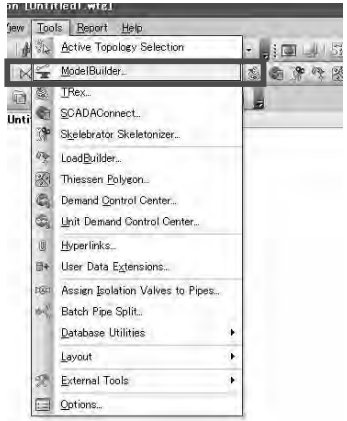
Ⅰ : Zagazig City East Area-4

1. General

UFW Team of SHAPWASCO conducted minimum night flow (MNF) survey at zagazig city east. Zagazig city east has five candidate areas and UFW team got the flow and pressure data in five areas. We analysis select Zagazig city east Area-4 by actual flow data and pressure data where is lowest pressure area in the five areas.

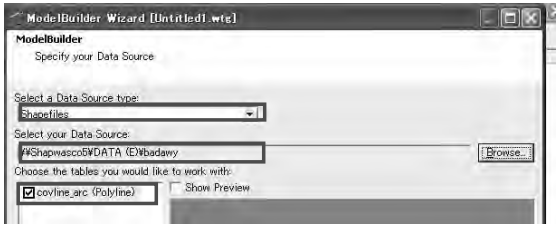
2. Importing from GIS data

(1) Selection model builder



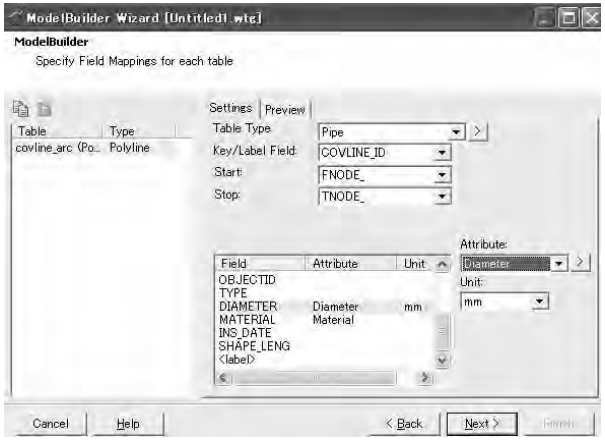
(2) Import Piping data

- Select a New file.
- Select a Data Source from Tab. In this case, you select a shape files.
- Select the pipe data prepared by GIS. In this case, you select " covline_arc.shp".
- Select "NEXT".

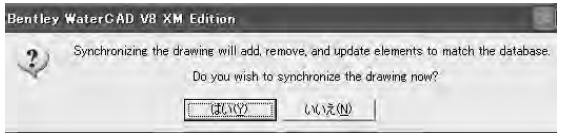


- Select unit which operated by GIS. In this case, you select unit “m”.
- Select “NEXT”.

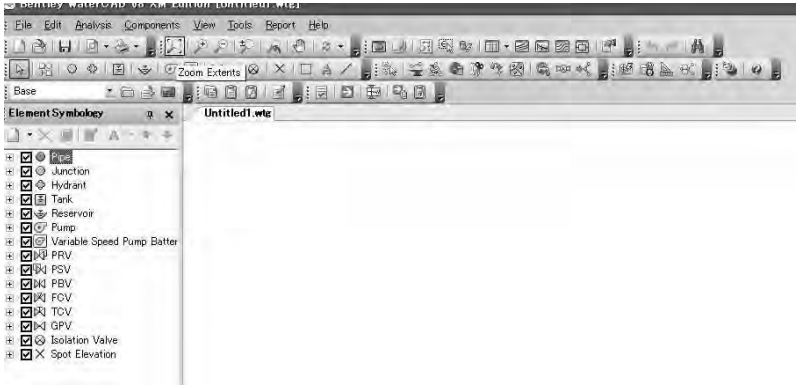
- Select “Pipe” from table pipe tab.
- Select “Coverline_ID” from Key/label field tab.
- Select “FNODE” from Start tab.
- Select “TONODE” from Stop tab.
- Select “Diameter”& “mm” from Attribute &Unit tab on Diameter Field.
- Select “Material” from Attribute on Material Field.
- Select “NEXT”.



- Select “YES”, when the comment “Would you like to build a model now?” appeared.
- Select “Finish”.
- Select “YES”, when following message is appeared.

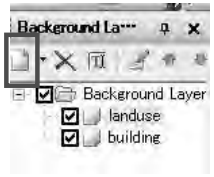


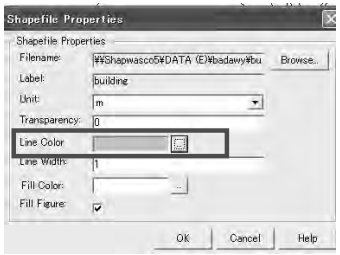
- Select “Zoom Extents”, if it’s not appeared on screen.

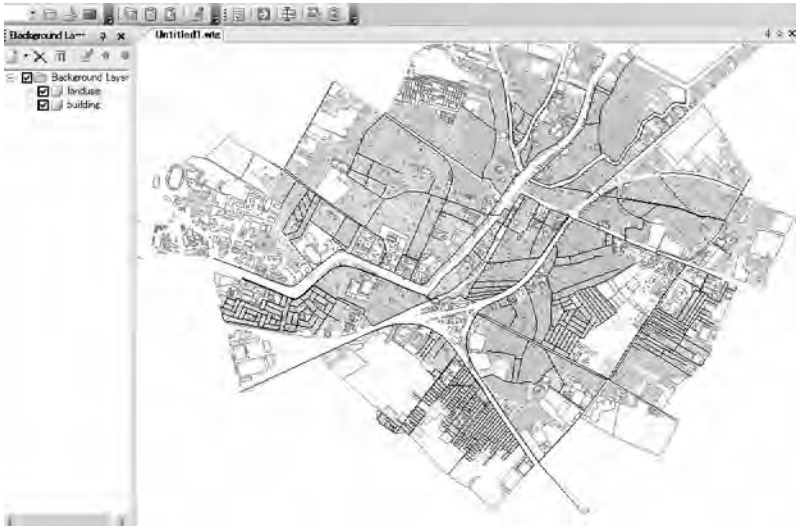


(3) Import Background data

- Select Background New layer. In this case, you select the “landuse” and “building” which is prepared from GIS.
- Select Unit “m”.
- Change the color, if it is hard to look.



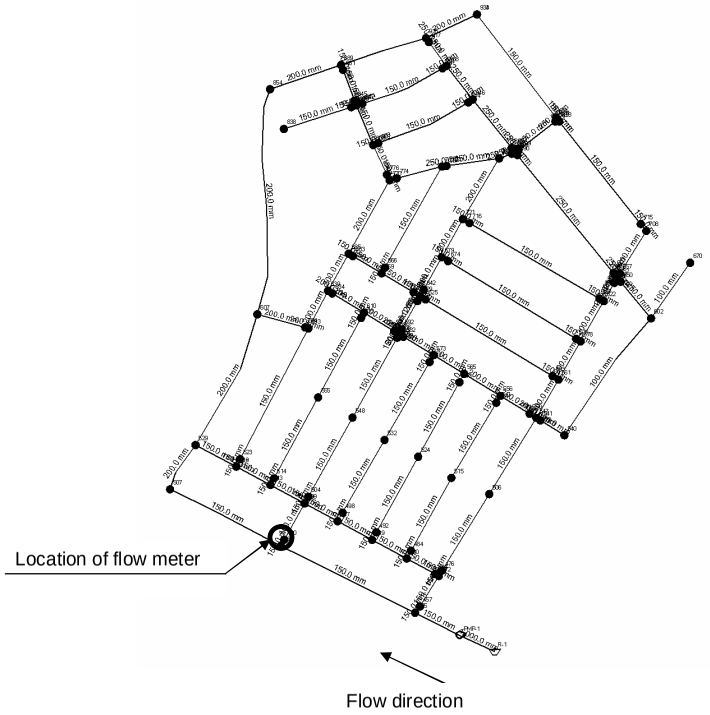




3. Arrangement of input condition

1) Pipe network

Pipe network in Zagazig East Area-4 is shown as follows;



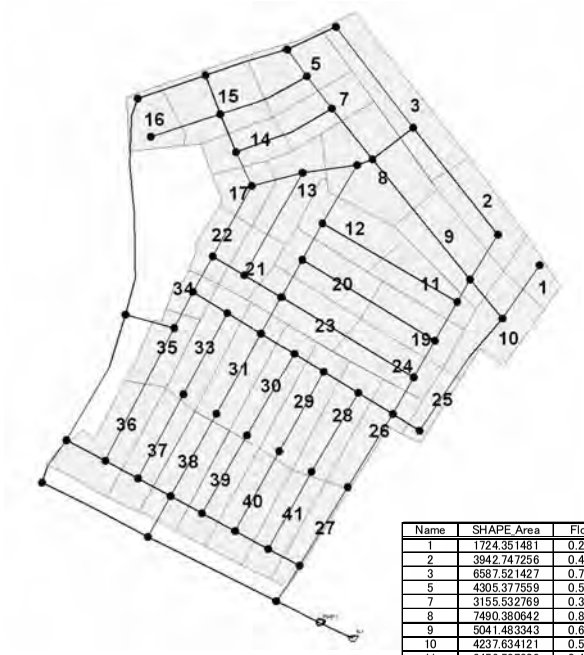
2) Node demand

Flow measurement means consumption. Measurement result at minimum night flow (MNF) survey shows as follow;

Maximum consumption : 16 L/s

We use maximum consumption and this maximum each demand is calculated by area which is given by node.

Demand of node = Node area ÷ Total area X Total consumption (Maximum consumption)

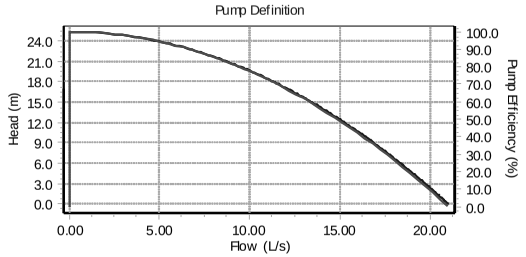


Name	SHAPE_Area	Flow	Name	SHAPE_Area	Flow
1	1724.351481	0.206	26	3262.266453	0.389
2	3942.747256	0.471	27	2147.000021	0.256
3	6587.521427	0.786	28	3900.375392	0.466
5	4305.377559	0.514	29	4086.281299	0.488
7	3155.532769	0.377	30	3721.088468	0.444
8	7490.380642	0.894	31	4377.928582	0.523
9	5041.483343	0.602	33	3892.682479	0.465
10	4237.634121	0.506	34	1345.563367	0.161
11	3456.537308	0.413	35	2708.976411	0.323
12	4164.905023	0.497	36	4992.775337	0.596
13	3690.646722	0.441	37	3787.281459	0.452
14	2573.04317	0.307	38	4037.716561	0.482
15	5325.121334	0.636	39	3383.049766	0.404
16	2508.25939	0.299	40	3883.78678	0.464
17	2229.65652	0.266	41	3268.182467	0.39
19	3715.318934	0.443	Total	134049.2938	16
20	3872.134431	0.462			
21	2194.296027	0.262			
22	2286.686128	0.273			
23	3848.292782	0.459			
24	3518.912023	0.42			
25	1385.500579	0.165			

3) Pump condition

Pump curve is decided by flow volume and pressure at inlet of this area. The actual data is shown as follows;

	Actual Flow	Actual Pressure
Maximum consumption in evening	16.0 L/s	1.0 Bar
Minimum consumption in midnight	9.0 L/s	2.0 Bar



4. Analysis of current condition

We got information from network administrator of Zagazig East which water main direction is from well at east.Actually water is coming from north at whole network system, but analysis model is decided at one direction model by analysis of actual flow rate and above information.

According to analysis result, the difference of pressure is about 40cm between inlet point and end point. Because total volume flow in only one pipe at inlet. So if water volume will increase, friction loss will increase by Hazen William formula. Thereby, deploy of distribution water is one of the answers.
Usually, this area has two opened valve. And so, we conducted analysis under situation that two valves are opened. We got result that friction loss decreased but pressure was not balance. Actually difference of measurement pressure in this area is 5m between inlet point and end point in the both situations one valve is opened and two valves are opened. This is big difference pressure and we can not understand this difference factor by analysis, but we can guess one of the factor. For example, the invisible valves are closed.

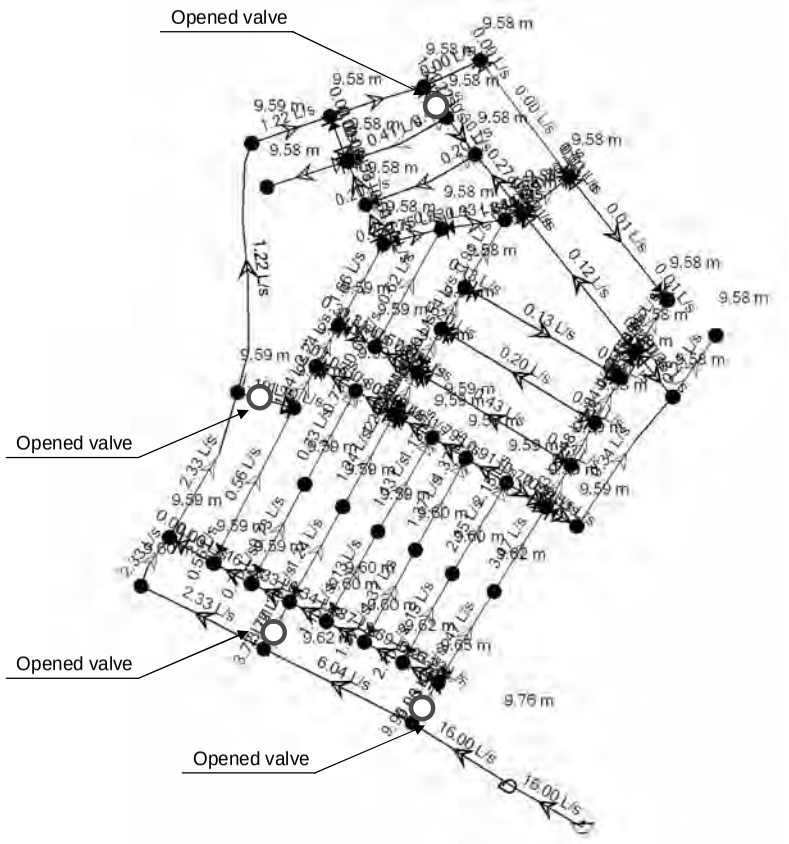
Table Actual pressure at two cases

	Condition of valve		Pressure on maximum consumption (bar)		Note
	No.1	No.2	Inlet of area-4	End of area-4	
Case-1	Open	Close	1.0	0.5	At MNF survey
Case-2	Open	Open	1.0	0.5	Usually condition

Meanwhile, we can grasp that pressure is balanced when four valves is opened by analysis. And these four valves were visible and have been opened. And actual pressure has been balanced.

Table Result of pressure head at two cases

	Condition of valve				Pressure head		Note
	No.1	No.2	No.3	No.4	Inlet of area-4	End of area-4	
Case-3	Open	Open	Open	Open	9.62m	9.58m	Modified condition



5. Analysis of standard plan

Zagazig city east Area-4 is built-up area. So analysis of population growth is skipped. We use demand data by standard plan.

1) Daily average water supply

The design daily average water supply per capital shall be as follows in accordance with the national plan for drinking water which has been applied by NOPWASD for the water supply facility planning in the whole region of Egypt. In this study, we use 250LCD due to capital of Sharkia.

* For cities (capital)	: 250 LCD
* For cities	: 215 LCD
* For villages	: 125LCD (for the population of more than 10,000)
* For villages	: 100LCD (for the population of not more than 10,000)

2) Design water supply

Design water supply shall be calculated as follows;

Design water supply = Daily average water supply x Peek factor x Number of population
= 250 x 1.4 x 1500 x 5 / 24 / 60 / 60 = 30 L/s

Number of population = Number of house connection x Number of house persons

Number of house connections	:Approx 1500 connections (This information is from customers center)
Number of house persons	: Approx 5persons
Peak facor	: 1.4 (This number is average of the number which is 1.25 to 1.5 according to Egyptian Code No.52)

3) Changing pipe material and diameter

This area has asbestos pipe. Shapwasco has to change the asbestos pipe to another material for health in the future. So Shapwasco can propose the pipe diameter by analysis.

a) Contrariety

The distribution water in this area is coming from main pipe which diameter in north is 200mm. The pipe diameter of main pipe is smaller than distribution pipe in this area. The pipe diameter should be decided by a reason.

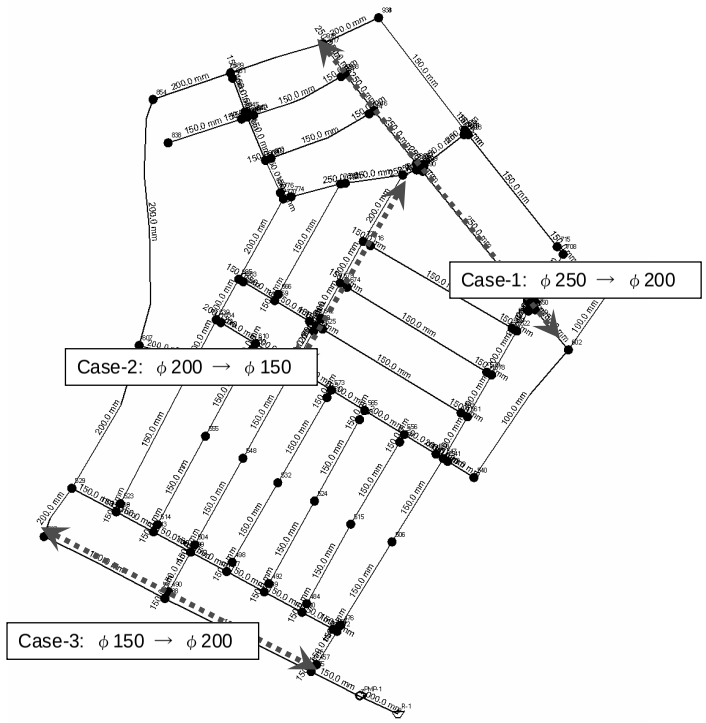
b) Piping plan

In this study, an analysis conducted on three cases.

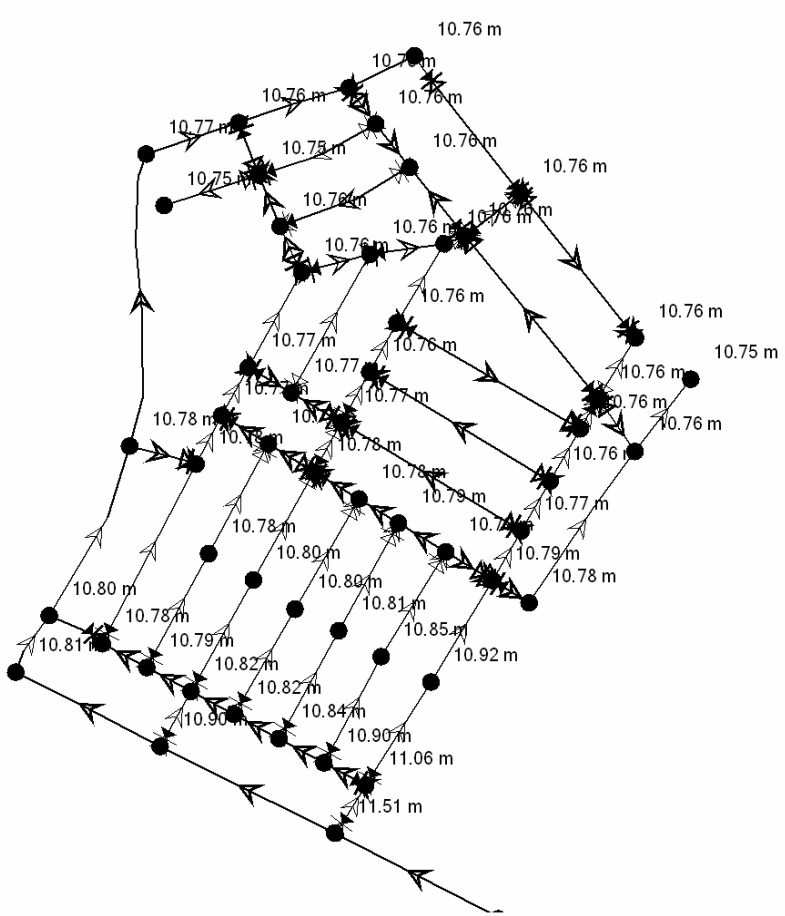
Case-1 : Changing pipe from ϕ 250mm to ϕ 200mm only

Case-2 : Changing pipe from ϕ 200mm to ϕ 150mm and Case-1 condition

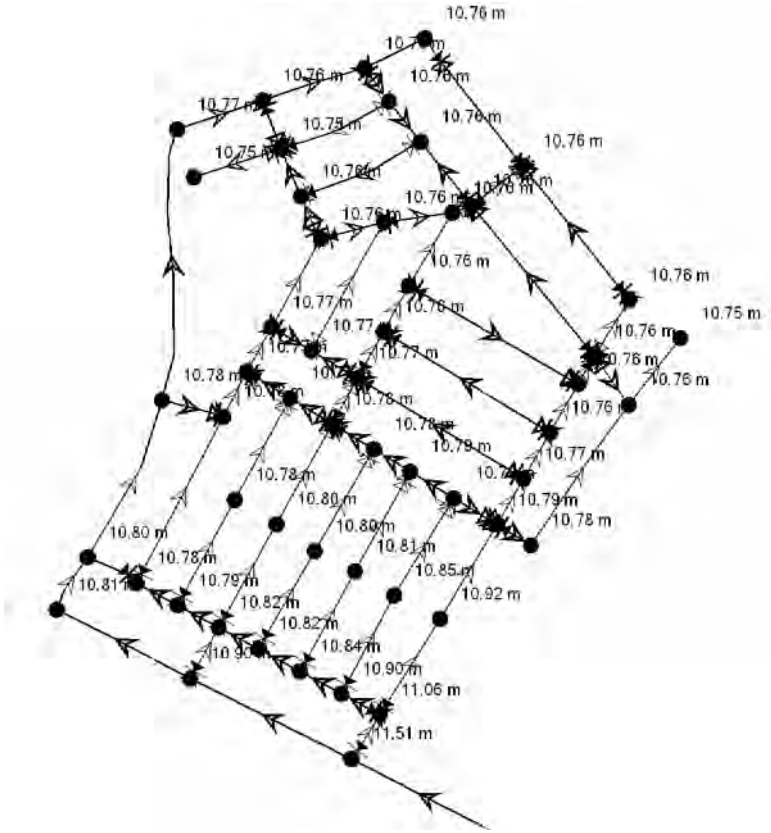
Case-3 : Changing pipe from main pipe ϕ 150mm to main pipe ϕ 200mm and Case-2 condition



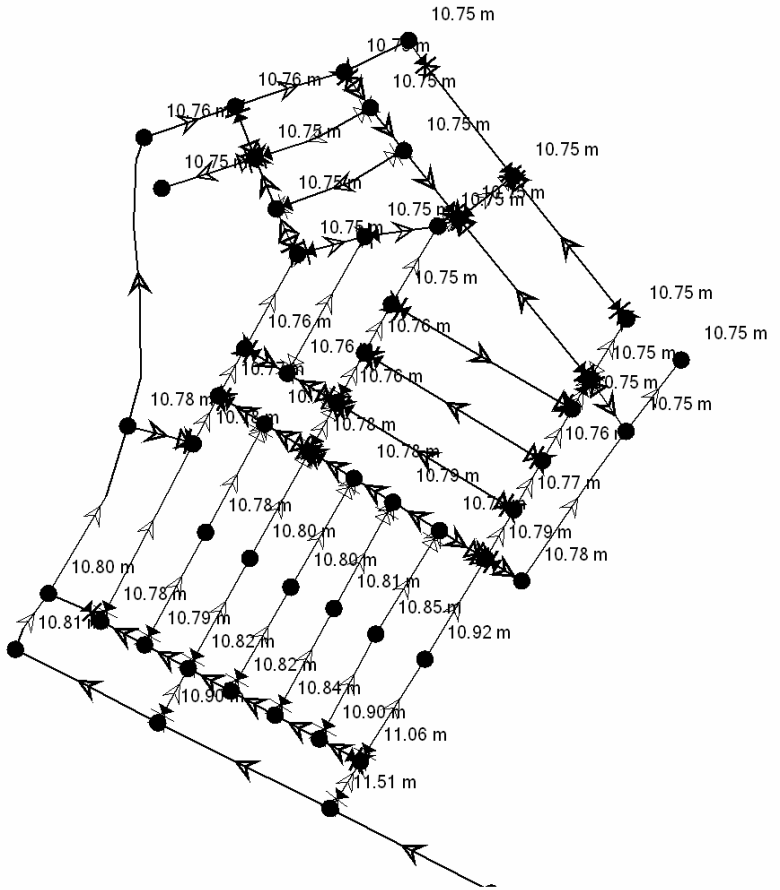
Result is shown next page. The pressure condition between Base and Case-1 & Case-2 is almost same. And pressure condition on case-3 is better than another condition.



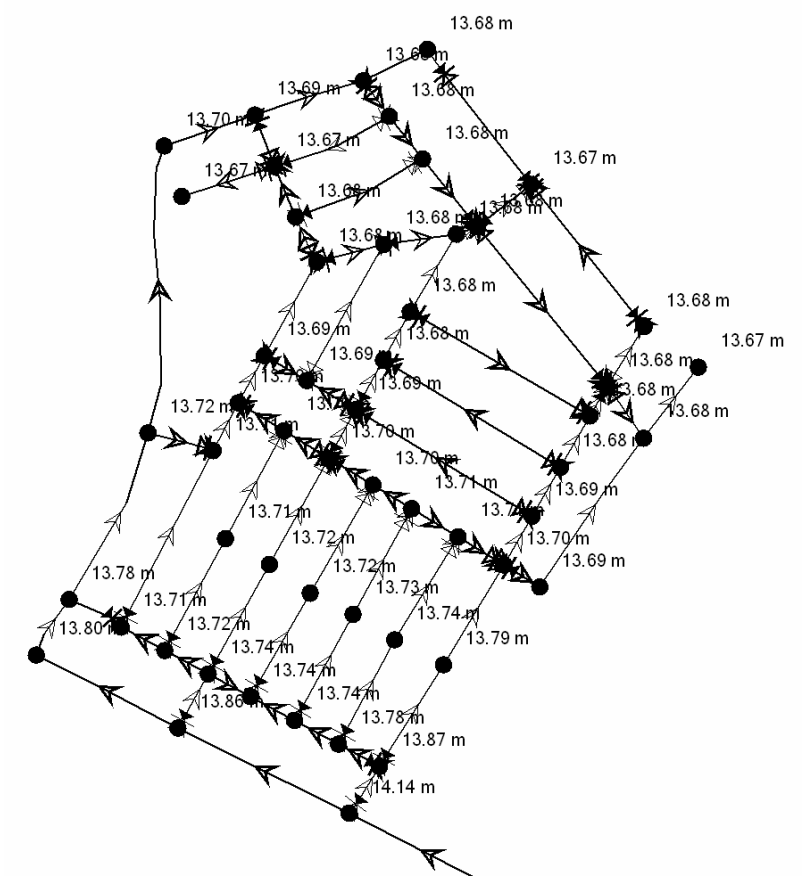
[Base Condition]



[Case-1: Changing pipe from φ250mm to φ200mm only]



[Case-2: Changing pipe from φ200mm to φ150mm and Case-1 condition]



[Case-3: Changing pipe from φ150mm to φ200mm and Case-2 condition]

4) Synthetic consideration

SHAPWASCO considered as follows;

- When changing main pipe diameter, the change in water head will be big
- When changing main pipe diameter from 150mm to 200mm, the water head will increase. So it's better to use a big diameter in main pipe and choosing the diameter according to discharge.
- When changing branch pipe diameter, the change in water head will be very small.
- When changing main pipe diameter from 250mm to 200mm, water head will decrease so,
  - It's better to use a small diameter in branch pipe.
  - It's better to use a big diameter in main pipe.
  - It's useful to open more than one valve to increase water head and decrease head losses.
  - It's also better to charge "AC" pipe to "PVC" pipe for health.

Issue in the future is as follows;

Although considering the Egypt standard, there were quite few amounts demanded of this area and their water pressure was also remarkably low. Fundamental solution of amount of water is necessary. It is also necessary to judge network increase in efficiency from the viewpoint of the whole pipe network.

Ⅱ : Hihya Markaz

1. General

Hihya Markaz has New Water Treatment Plant and new piping network planed by NOPWASD. Therefore we can understand the situation easily and we selected the Hihya Markaz as a training project area.

2. Arrangement of input condition

1) Pipe network

Pipe network should be prepared by GIS for more exactly. However GIS data is not prepared yet at this time, so we prepared the drawing by hand writing on GIS base map (Attachment -1).

2) Node demand

Node demand was calculated by population of each village as design water supply. Design water supply shall be calculated as follows;

Design water supply = Daily average water supply x Peek factor x Number of population

herein

- Daily average water supply
  - * For cities (capital) : 250 LCD
  - * For cities : 215 LCD
  - * For villages : 125LCD (for the population of more than 10,000)
  - * For villages : 100LCD (for the population of not more than 10,000)
- Peak facor : 1.4
  (This number is average of the number which is 1.25 to 1.5 according to Egyptian Code No.52)
- Number of population : Attachment-2

The result calculated the amount demanded in 2007 and 2017 from above conditions is shown in the following page.

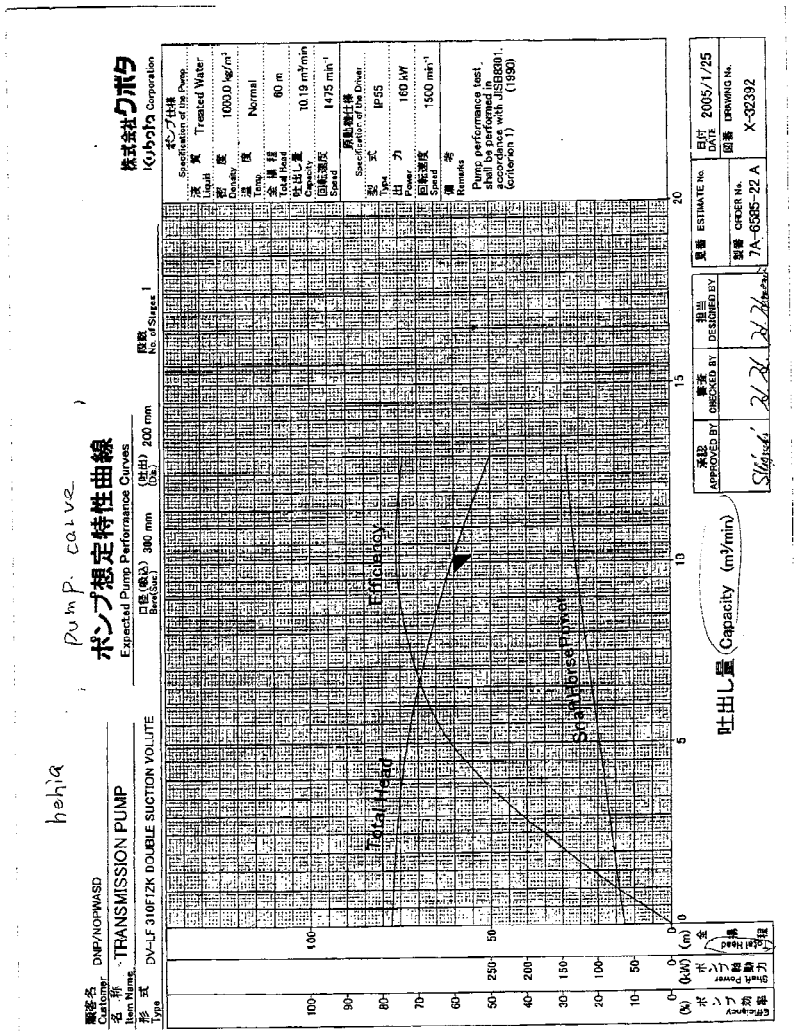
Area Name		Population Data			Population growth rate	Predictive value on 2007				Predictive value on 2017			
		1996	2005	2006	1996-2005	2005-2006	Population	LCD	Peak factor	Demand L/s	Population	LCD	Peak factor	Demand L/s
1	Hihya city	36257	43,077	43,835	1.88	1.76	44,843	215	1.4	156.2	54,925	215	1.4	191.3
2	Zar zamoon	7195	8,548	8,699	1.88	1.77	8,899	100	1.4	14.4	10,899	125	1.4	22.1
3	Sobieh	7945	9,439	9,606	1.83	1.77	9,826	100	1.4	15.9	12,036	125	1.4	24.4
4	Adwa	8818	10,477	10,661	1.88	1.76	10,906	125	1.4	22.1	13,358	125	1.4	27.1
5	Hoad Nogieh	6332	7,534	7,655	1.90	1.61	7,831	100	1.4	12.7	9,591	100	1.4	15.5
6	Sakakra	3708	4,405	4,483	1.88	1.77	4,586	100	1.4	7.4	5,617	100	1.4	9.1
7	Shr shima	5257	6,246	6,356	1.88	1.76	6,502	100	1.4	10.5	7,964	100	1.4	12.9
8	Metawa	4887	5,706	5,908	1.68	3.54	6,043	100	1.4	9.8	7,402	100	1.4	12.0
9	Meslami	2959	3,516	3,577	1.88	1.73	3,659	100	1.4	5.9	4,481	100	1.4	7.3
10	Fawagsa	5016	5,960	6,064	1.88	1.74	6,203	100	1.4	10.1	7,598	100	1.4	12.3
11	El mahmoudia	3983	4,732	4,815	1.88	1.75	4,925	100	1.4	8.0	6,033	100	1.4	9.8
12	Kafr El aaid	777	923	939	1.88	1.73	960	100	1.4	1.6	1,176	100	1.4	1.9
13	Kafr awladatia	1886	2,241	2,280	1.88	1.74	2,332	100	1.4	3.8	2,856	100	1.4	4.6
14	Kafr El mahmoudia	3896	4,629	4,710	1.88	1.75	4,818	100	1.4	7.8	5,901	100	1.4	9.6
15	Ghaly Mansour	1299	1,543	1,570	1.88	1.75	1,606	100	1.4	2.6	1,967	100	1.4	3.2
16	Manzal Hian	4425	5,257	5,350	1.88	1.77	5,473	100	1.4	8.9	6,703	100	1.4	10.9
17	El sheikh El zawahry	3677	4,369	4,445	1.88	1.74	4,547	100	1.4	7.4	5,569	100	1.4	9.0
18	El khodary	2748	3,265	3,322	1.88	1.75	3,398	100	1.4	5.5	4,162	100	1.4	6.7
19	Khelwat abu hatab	2371	2,817	2,867	1.88	1.77	2,932	100	1.4	4.8	3,592	100	1.4	5.8
20	Kafr dajous	3583	4,257	4,332	1.88	1.76	4,431	100	1.4	7.2	5,427	100	1.4	8.8
21	El Mahdieh	9483	11,267	11,465	1.88	1.76	11,728	125	1.4	23.8	14,365	125	1.4	29.1
22	Kafr Abu hatab	2256	2,680	2,728	1.88	1.79	2,790	100	1.4	4.5	3,418	100	1.4	5.5
23	Shabrawien	8660	10,289	10,470	1.88	1.76	10,710	125	1.4	21.7	13,118	125	1.4	26.6
24	El ihsainien	1856	2,205	2,244	1.88	1.77	2,295	100	1.4	3.7	2,811	100	1.4	4.6
25	Elalakma	9173	10,898	11,090	1.88	1.76	11,345	125	1.4	23.0	13,895	125	1.4	28.1
26	Elsalamon	6125	7,277	7,405	1.88	1.76	7,575	100	1.4	12.3	9,278	100	1.4	15.0
27	Elawaska	9655	11,471	11,673	1.88	1.76	11,941	125	1.4	24.2	14,626	125	1.4	29.6
28	Kafr hamoda	4393	5,219	5,311	1.88	1.76	5,433	100	1.4	8.8	6,654	100	1.4	10.8
29	Kafr ageiba	2608	3,099	3,153	1.88	1.74	3,225	100	1.4	5.2	3,950	100	1.4	6.4
	Total	171228	203,346	207,013	2.30	2.30	211,762			449.8	259,372			560.0

*Note Growth rate "2.3%" is used usually in Zagazig

3.6-14

3) Pump condition

Pump carve was used on New Hihya Water Treatment Plant. This carve is as follows.



3. Analysis

1) Analysis case

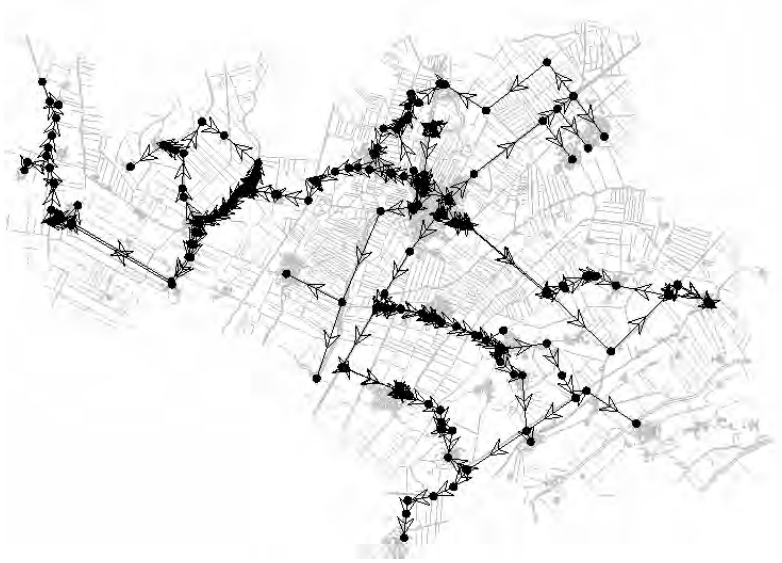
Analysis case is as follows;

Case1 : Current situation

Hihya Markaz has asbestos pipe. This pipe is coming from Zagazig and connected to Abu kabier Markaz. And the water from this pipe is distributed to Hiihya Markaz. However we don't grasp how much water is coming from Zagazig and is distributed to Abu Kabier Markaz. Shapwasco can grasp the actual volume by using portable flow meter in the future and this actual volume should be input the water cad as the demand. If measurement is possible, this analysis will be conducted. In any case, we skip the case1 at this time.

Case2 : One year later

Shapwasco already has plan next year. According to this plan, shapwasco has constructed new pipe which is bigger than existing pipe, and asbestos pipe will be canceled. The water by asbestos pipe will distribute from Zagazig to Abu Kabier Markaz directly. An analysis of case 2 conducted under this situation. Analysis Model is according to pipe plan of NOPWASD. On the other hand, the information of well is cancelled, since the well of Hihya is very old and production volume is a few.



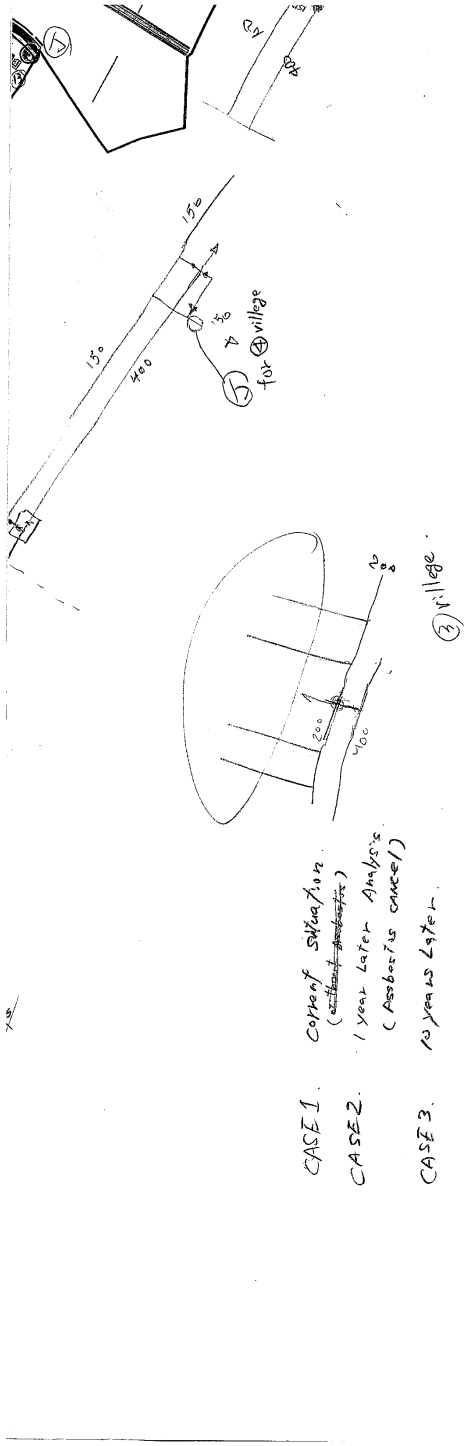
Piping Model

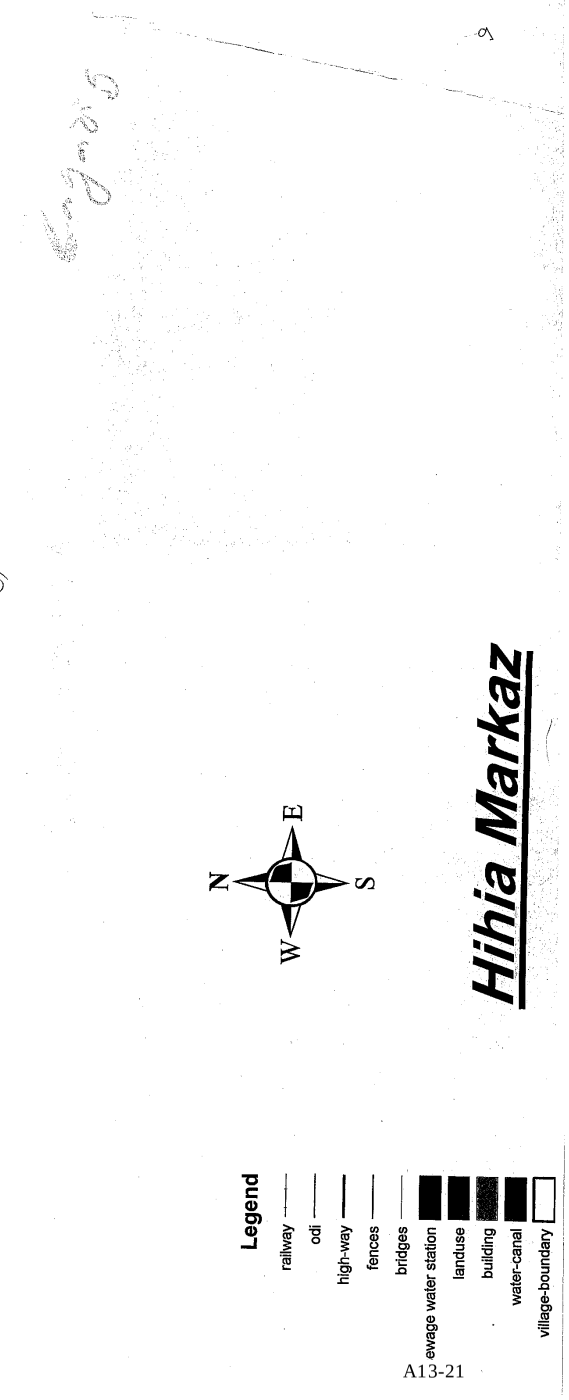
Case3 : Ten years later

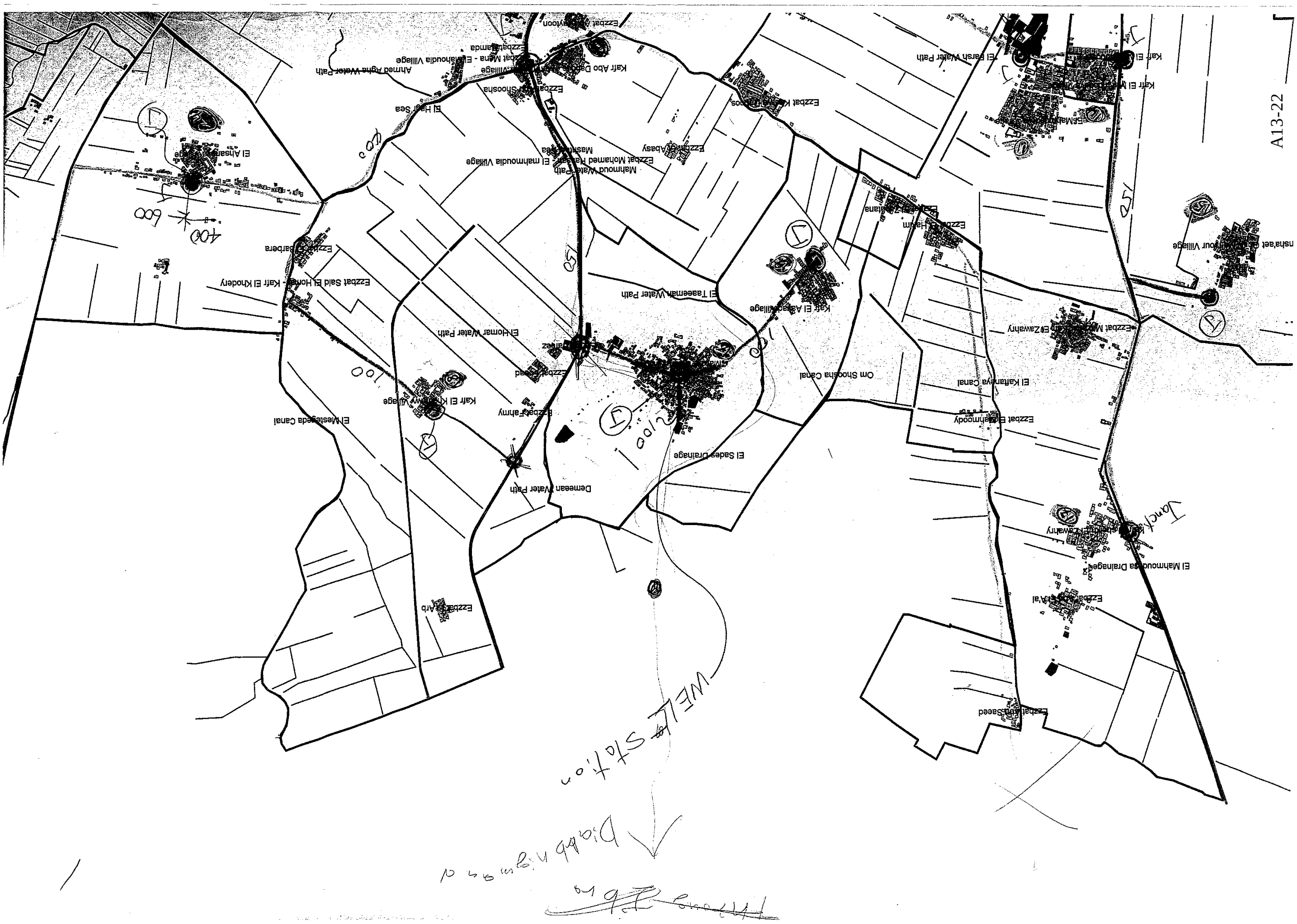
We estimated population in Hihya Markaz after ten years and analyzed conducted analysis. However, distribution volume to another Markaz is not considered. Shapwasco can grasp the actual volume by using portable flow meter and this actual volume should be input the water cad as the demand. If measurement is impossible, we can grasp the demand by population of Abu Kabier. Abu Kabier markaz will need the more water, shapwasco should examine the measures including the using of asbestos pipe which is one of the answer for analysis. In any case, we skip the case3 at this time.

2) Output

The pressure of case2 is shown over fifteen (15) m. The result means that the plan of NOPWASD is considered reasonable and proper. Output data is as follows;








A13-25
WELL Station
Gowhar Water Path
El Tesmeen Water Path
Om El Hag Hassan Water Path
Aboor el Beid Water Path
El Farsh Water Path
El Ibrahimeya Drainage
El Saltan Hassan Water Path
Awayna Sea
El Dahr Sea
El Wasla
El Nasr Canal
Ezzbat Abu Hena
Ahmed Agha Water Path
El Hagr Sea
Kafr Abo Dahab Village
Mashaheer Village
Mahmoud Water Path


A13-24
Ezzbat Nagib Hassan
Mostafa Basha Khalil Canal
El Abaseeh Gulf
Abu Salama Canal


A13-27


A13-26

A13-29

A13-28

تعداد السكان التقديري عن عام ٢٠٠٥، ٢٠٠٦طبقا لمعدل الزياده الصادر من الجهاز المركزي للتعبئه العامه والاحصاء ٢٠٠٩.

	Total الجملة	Female الاناث	Male الذكور	الجمله	الاناث	الذكور	Total الجملة	Female الاناث	Male الذكور	البيان	
	2006			٢٠٠٥			١٩٩٦				
(1)	٤٣٨٣٥	٢١٣٧٥	٢٢٤٦٠	٤٣٠٧٧	٢١٠٠٦	٢٢٠٧١	٣٦٢٥٧	١٧٦٨٠	١٨٥٧٧	ههيا	Hehia city
(2)	٨٦٩٩	٤١١٢	٤٥٨٧	٨٥٤٨	٤٠٤١	٤٥٠٨	٧١٩٥	٣٤٠١	٣٧٩٤	زرزمون	Zarzamoon
(3)	٩٦٠٦	٤٨٨٤	٤٧٢١	٩٤٣٩	٤٨٠٠	٤٦٤٠	٧٩٤٥	٤٠٤٠	٣٩٠٥	صبيح	Sobieh
(4)	١٠٦٦١	٥٣٣٩	٥٣٢٢	١٠٤٧٧	٥٢٤٧	٥٢٣٠	٨٨١٨	٤٤١٦	٤٤٠٢	العدوة	Adwa
(5)	٧٦٥٥	٣٥٩٠	٤٠٦٦	٧٥٢٣	٣٥٢٧	٣٩٩٦	٦٣٣٢	٢٩٦٩	٣٣٦٣	حوض نجيح	Hood Nogieh
(6)	٤٤٨٣	٢١٦٨	٢٣١٥	٤٤٠٥	٢١٣٠	٢٢٧٥	٣٧٠٨	١٧٩٣	١٩١٥	السكاكرة	Sakakra
(7)	٦٣٥٦	٣١٦٤	٣١٩٢	٦٢٤٦	٣١٠٩	٣١٣٧	٥٢٥٧	٢٦١٧	٢٦٤٠	شرشيمة	Shrshima
(8)	٥٩٠٨	٢٨٧٣	٣٠٣٦	٥٨٠٦	٢٨٢٣	٢٩٨٣	٤٨٨٧	٢٣٧٦	٢٥١١	المطاوعة	Metawa
(9)	٣٥٧٧	١٦٥١	١٩٢٦	٣٥١٦	١٦٢٣	١٨٩٣	٢٩٥٩	١٣٦٦	١٥٩٣	المسلمى	Meslami
(10)	٦٠٦٤	٢٩١٥	٣١٤٩	٥٩٦٠	٢٨٦٥	٣٠٩٥	٥٠١٦	٢٤١١	٢٦٠٥	الفواقسة	Fawaqsa
	٦٣٠٠٩	٣٠٦٩٥	٣٢٣١٤	٦١٩٢٠	٣٠١٦٥	٣١٧٥٦	٥٢١١٧	٢٥٣٨٩	٢٦٧٢٨	الاجمالى	Total

A13-30

تعداد السكان التقديري عن عام ٢٠٠٥، ٢٠٠٦طبقا لمعدل الزياده الصادر من الجهاز المركزي للتعبئه العامه والاحصاء ٢٠٠٩.

	الجمله	الاناث	الذكور	الجمله	الاناث	الذكور	الجمله	الاناث	الذكور	البيان	
	2006			٢٠٠٥			١٩٩٦				
(11)	٤٨١٥	٢٣٣٠	٢٤٨٦	٤٧٣٢	٢٢٨٩	٢٤٤٣	٣٩٨٣	١٩٢٧	٢٠٥٦	المحمودية	Elmahmoudi
(12)	٩٣٩	٤٤٩	٤٩١	٩٢٣	٤٤١	٤٨٢	٧٧٧	٣٧١	٤٠٦	ك العابد	Kafr Elaabid
(13)	٢٢٨٠	١١٢١	١١٥٩	٢٢٤١	١١٠١	١١٣٩	١٨٨٦	٩٢٧	٩٥٩	ك أولادعطية	Kafrawladatia
(14)	٤٧١٠	٢٢٤٦	٢٤٦٤	٤٦٢٩	٢٢٠٧	٢٤٢١	٣٨٩٦	١٨٥٨	٢٠٣٨	ك المحمودية	KafrElmahmo
(15)	١٥٧٠	٧٢٥	٨٤٥	١٥٤٣	٧١٣	٨٣٠	١٢٩٩	٦٠٠	٦٩٩	م غالى منصور	GhalyMansoa
(16)	٥٣٥٠	٢٥٩٠	٢٧٦٠	٥٢٥٧	٢٥٤٥	٢٧١٢	٤٤٢٥	٢١٤٢	٢٢٨٣	منزل حيان	Manzal Hiin
(17)	٤٤٤٥	٢١٠٤	٢٣٤٢	٤٣٦٩	٢٠٦٧	٢٣٠١	٣٦٧٧	١٧٤٠	١٩٣٧	ك الشيخ الظواهرى	ElsheikhElzawahry
(18)	٣٣٢٢	١٥٦٠	١٧٦٣	٣٢٦٥	١٥٣٣	١٧٣٢	٢٧٤٨	١٢٩٠	١٤٥٨	ك الخضيرى	ELKhodary
(19)	٢٨٦٧	١٤١٣	١٤٥٣	٢٨١٧	١٣٨٩	١٤٢٨	٢٣٧١	١١٦٩	١٢٠٢	خلوة أبو حطب	Khelwat abu hatab.
(20)	٤٣٣٢	٢١٠٤	٢٢٢٨	٤٢٥٧	٢٠٦٧	٢١٩٠	٣٥٨٣	١٧٤٠	١٨٤٣	ك دبوس	Kafrdapous
	٣٤٦٣٢	١٦٦٤١	١٧٩٩١	٣٤٠٣٣	١٦٣٥٣	١٧٦٨٠	٢٨٦٤٥	١٣٧٦٤	١٤٨٨١	الاجمالى	Total.

A13-31

تعداد السكان التقديري عن عام ٢٠٠٥، ٢٠٠٦طبقا لمعدل الزياده الصادر من الجهاز المركزي للتعبئه العامه والاحصاء ٢٠٠٩.

البيان	الذكور	الاناث	الجمله	الذكور	الاناث	الجمله	الذكور	الاناث	الجمله	
	١٩٩٦			٢٠٠٥			2006			
المهدية	٥٠٥٢	٤٤٣١	٩٤٨٣	٦٠٠٢	٥٢٦٤	١١٢٦٧	٦١٠٨	٥٣٥٧	١١٤٦٥	(21) El-Mahdieh
ك أبوحطب	١١٢٦	١١٣٠	٢٢٥٦	١٣٣٨	١٣٤٣	٢٦٨٠	١٣٦١	١٣٦٦	٢٧٢٨	(22) Kafr Abu hata
الشبراويين	٤٥٠٨	٤١٥٢	٨٦٦٠	٥٣٥٦	٤٩٣٣	١٠٢٨٩	٥٤٥٠	٥٠٢٠	١٠٤٧٠	(23) Shabrawien
الاحسانين	٩٩٠	٨٦٦	١٨٥٦	١١٧٦	١٠٢٩	٢٢٠٥	١١٩٧	١٠٤٧	٢٢٤٤	(24) El ihsanien
الجملة	١١٦٧٦	١٠٥٧٩	٢٢٢٥٥	١٣٨٧٢	١٢٥٦٩	٢٦٤٤١	١٤١١٦	١٢٧٩٠	٢٦٩٠٦	

تعداد السكان التقديري عن عام ٢٠٠٥، ٢٠٠٦طبقا لمعدل الزياده الصادر من الجهاز المركزي للتعبئه العامه والاحصاء ٢٠٠٩.

البيان	الذكور	الاناث	الجمله	الذكور	الاناث	الجمله	الذكور	الاناث	الجمله	
	١٩٩٦			٢٠٠٥			2006			
العلاقمة	٤٦٩١	٤٤٨٢	٩١٧٣	٥٥٧٣	٥٣٢٥	١٠٨٩٨	٥٦٧١	٥٤١٩	١١٠٩٠	(25) Elala Kma
السلامون	٣٢٥٥	٢٨٧٠	٦١٢٥	٣٨٦٧	٣٤١٠	٧٢٧٧	٣٩٣٥	٣٤٧٠	٧٤٠٥	(26) ELsalamon
العواسجة	٤٩٦٦	٤٦٨٩	٩٦٥٥	٥٩٠٠	٥٥٧١	١١٤٧١	٦٠٠٤	٥٦٦٩	١١٦٧٣	(27) Elawas Ka
ك حمودة أرناؤوط	٢٣٠٦	٢٠٨٧	٤٣٩٣	٢٧٤٠	٢٤٨٠	٥٢١٩	٢٧٨٨	٢٥٢٣	٥٣١١	(28) Kafr hamod
ك عجيبة	١٣٢٤	١٢٨٤	٢٦٠٨	١٥٧٣	١٥٢٦	٣٠٩٩	١٦٠١	١٥٥٢	٣١٥٣	(29) Kafr ageiba
الاجمالي	١٦٥٤٢	١٥٤١٢	٣١٩٥٤	١٩٦٥٤	١٨٣١١	٣٧٩٦٥	١٩٩٩٩	١٨٦٣٣	٣٨٦٣٢	Total.

Total population = 163179

Total Number of customers = 28944

3.7 Summary Report of “Filter Refreshment Activity in “WTPs” (Action S6)

Summary Report of Filter Refreshment Activity

1. Purpose of OJT about filter refreshment

Improvement of implementation capacity regarding O&M activity for the filter

2. Target of achievement by OJT activity

2-1 Improvement of the filter

1) Recovery the dirty sand layer of the filter

2) Keeping the filter clean tottaly

2-2 Improvement of O&M activity

1) Effective filter washing

2) Proper operation of the filter

3) Proper maintenance of the filter

2-3 Improvement of capacity

1) Monitoring capacity of the filter

2) Operation capacity of the filter

3) Maintenance capacity of the filter

2-4) Improvement of operating cost of the filter

1) Proper consumption of clear water use for filter washing

As the result of above, if possible achievement of the reduction of filter washing water volume

2) Degradation of filter sands is reduced, and protraction of a life of filter sands

As the result of above, replacement cost of filter sands is reduced in the future.

2. Method

2-1 Observation and check of the current condition of monitoring of the filter sand layer

1) Observation by eyes

1-1) Flatness of sand layer (Partial crater and/or buildup)

1-2) Cracks (Around walls, sand layer)

1-3) Mud balls and/or muddy layer

1-4) Fine sands

1-5) Algae growth

1-6) Escaped sand in the gully

1-7) Appearance of gravel

2) Observation by sampling the sands

2-1) Mud balls

2-2) Effective diameter

3) Check by measurement

3-1) Depth of sand layer

3-2) Difference of depth between right bank and left bank

2-2 Observation and check the current condition about operation during filtering

1) Water level in the filter

2) Difference of water level between right bank and left bank

3) Floating substances and/or submerged substances in the filter

4) Algae growth on the wall and/or effluent trough in the filter

5) Appearance of bubbles from the sand layer

6) Filter runtime

7) Water quality about turbidity and residual chlorine of filtered water and clarified water

2-3. Observation and check the current condition of operation during filter washing

1) Water level in the filter in start of air squaring and in start of rinsing

2) Uniform air bubbling condition by air squaring

3) Sufficient and adequate strength of air bubbling by air squaring

4) Uniform discharge of wash water from sand layer during combined wash by water and air

5) Uniform effluent of washed drainage during combined wash by water and air

6) Sand escape from the sand during combined wash by water and air

7) Uniform discharge of wash water from sand layer during backwash

8) Uniform effluent of washed drainage during backwashing

9) Washed drainage turbidity at start of combined wash process

10) Washed drainage turbidity at completion of backwash process

11) Backwash water flow rate

2-4.OJT by expert about filter refreshment to CP of H/Q and CP in model facility

Facility name	Date of OJT	Filter No.
Zagazig WTP	22/June/2008	No.5
	24/June/2008	No.2
	25/June/2008	No.6
	26/June/2008	No.1
	29/June/2008	No.3
	30/June/2008	No.6
Abbasa WTP	05/July/2008	No.2
	05/July/2008	No.5
	06/July/2008	No.1
	09/July/2008	No.4
	10/July/2008	No.6

Attendance of OJT about filter refreshment

Facility name	Date of OJT	H/Q CP team	Site CP team
Zagazig WTP	22/June/2008	Mr.Sharfi Ms.Heba	Mr.Mohamad (Plant manager) Mr.Ahmed (Lab. Manager) Mr.Sayed (Chemist) 2 operators
	24/June/2008	Mr.Sharfi Ms.Heba	Mr.Mohamad (Plant manager) Mr.Ahmed (Lab. Manager) Mr.Sayed (Chemist) 2 operators
	25/June/2008	Mr.Sharfi	Mr.Mohamad (Plant manager)

		Ms.Heba	Mr.Ahmed (Lab. Manager) Mr.Sayed (Chemist) 2 operators
	26/June/2008	Mr.Sharfi Ms.Heba	Mr.Mohamad (Plant manager) Mr.Ahmed (Lab. Manager) Mr.Sayed (Chemist) 2 operators
	29/June/2008	Mr.Sharfi Ms.Heba	Mr.Mohamad (Plant manager) Mr.Ahmed (Lab. Manager) Mr.Sayed (Chemist) 2 operators
	30/June/2008	Mr.Sharfi Ms.Heba	Mr.Mohamad (Plant manager) Mr.Ahmed (Lab. Manager) Mr.Sayed (Chemist) 2 operators
Abbasa WTP	05/July/2008	Mr.Sharfi Ms.Heba	Mr.Samir (Plant manager) Mr.Mansour (Lab.manager) Mr.Ismaiel (Technitian) Mr.Hosini (Technitian) 4 Operators
	05/July/2008	Mr.Sharfi Ms.Heba	Mr.Samir (Plant manager) Mr.Mansour (Lab.manager) Mr.Ismaiel (Technitian) Mr.Hosini (Technitian) 4 Operators
	06/July/2008	Mr.Sharfi Ms.Heba	Mr.Samir (Plant manager) Mr.Mansour (Lab.manager) Mr.Ismaiel (Technitian) Mr.Hosini (Technitian) 4 Operators
	09/July/2008	Mr.Sharfi Ms.Heba	Mr.Samir (Plant manager) Mr.Mansour (Lab.manager) Mr.Ismaiel (Technitian) Mr.Hosini (Technitian) 4 Operators
	10/July/2008	Mr.Sharfi Ms.Heba	Mr.Samir (Plant manager) Mr.Mansour (Lab.manager) Mr.Ismaiel (Technitian) Mr.Hosini (Technitian) 4 Operators

2-6. OJT about filter refreshment by CP of H/Q team to CP in model facility

Facility name	Date of OJT	Filter No.	Date of OJT	Filter No.
Zagazig WTP	10/Aug/2008	No.1	04/Aug/2008	No.4
	10/Sept/2008		26/Aug/2008	
	13/Sept/2008		20/Sept/2008	
	23/Sept/2008		07/Oct/2008	
	25/Sept/2008		08/Oct/2008	
	27/Sept/2008		12/Nov/2008	
	27/Sept/2008		07/Dec/2008	
	05/Oct/2008		03/Dec/2008	
	07/Oct/2008		15/Jan/2009	
	09/Oct/2008		07/Aug/2008	No.5
	16/Oct/2008		16/Aug/2008	
	25/Nov/2008		23/Sept/2008	
	23/Dec/2008		04/Oct/2008	
	09/Aug/2008	No.2	28/Oct/2008	
	06/Sept/2008		01/Dec/2008	
	12/Sept/2008		05/Dec/2008	
	17/Sept/2008		07/Jan/2009	
	21/Sept/2008		20/Jan/2009	
	22/Sept/2008		06/Aug/2008	No.6
	12/Dec/2008		28/Sept/2008	
	04/Jan/2009		09/Oct/2008	
	18/Jan/2009		22/Oct/2008	
	01/Aug/2008	No.3	18/Nov/2008	
	24/Aug/2008		04/Dec/2008	
	18/Sept/2008		13/Dec/2008	
	27/Sept/2008		25/Dec/2008	
	29/Sept/2008		13/Jan/2009	
	30/Oct/2008			
	01/Jan/2009			

Facility name	Date of OJT	Filter No.
Abbassa WTP	11/Nov/2008	No.7
	13/Nov/2008	No.8
	20/Nov/2008	No.9
	20/Nov/2008	No.10
	27/Nov/2008	No.11
	01/Dec/2008	No.12

Attendance of OJT by H/Q CP team about filter refreshment

Same CP of the plant attended at OJT activity by H/Q team as OJT activities by expert team.

Mr.Abd Allah has been come into H/Q CP team from 01/Sept/2008.

2-7 Achievements by OJT about filter refreshment as applying SOP to O&M activities on site

1) Filter refreshment activity has been conducted as one of the routine work of filter maintenance activity in WTP model facilities.
2) The filters are maintained in adequate condition as following.
   2-1) Filter sand layer is kept in clean condition without mud balls and muddy layers
   2-2) Additional activity: Periodical cleaning of wall surface in the filter is conducted.
      Wall surface in the filter is maintained in clean condition by periodical cleaning
3) The filter washing effectiveness can be evaluated and follow up approach can be supported as following
   3-1) Additional washing is conducted if necessary
   3-2) Degradation of filter sand can be judged by evaluation of filter refreshment results
3) By filter refreshment activity, the filters are operated in adequate condition as following additional affects
   3-1) Filter run time is almost maintained in set up time
   3-2) Filter washing is almost maintained in set up filter washing regime
4) By filter refreshment activity, the filters condition are monitored periodically as additional affects
   4-1) Operation condition of filtering
   4-2) Filter washing condition
   4-2) Sand layer condition
   4-3) Water quality about turbidity and residual chlorine of clarified water and filtered water
5) From above achievement, O&M capacity regarding for the filter equipment of H/Q CP team and model facility CP team has been improved as following
   5-1) Capacity to perform a monitoring of sand layer condition, filtering condition, filter washing condition and water quality in filtering process
      Objects to be monitored
      Points of evaluation with monitoring activities
      Judgment of unusual condition and criteria to be judged as unusual condition
      Monitoring frequency
   5-2) Capacities to perform maintenance activity about filter basin and filter sand
      Objects to perform a maintenance activity
      Procedures for a maintenance activity
      Point of a maintenance activity
      Items to be judged and judgment criteria about maintenance activity
      Maintenance frequency
   5-3) Capacities to perform adequate filter operation
      Limit of filter runtime
      Limit of filtering rate
      Adequate water level in the filter

      Rinsing procedures after filter washing
      Filter washing regime
   5-4) Capacities to perform analysis and evaluations of effectiveness of filter washing
      Procedures for analysis and evaluation
      Criteria for evaluation
   5-5) Capacities to perform a modification of filter washing regime
      Procedures for filter refreshment activities

2-8.Appendix

1) SOP documents regarding filter refreshment activity
2) Records for reference
3) Pictures

OJT Scenario :
Filter refreshment and optimum filter washing regime

Step-1.It is made to notice that the current condition of filter layer is not normal

1) Muddy layer of filter media surface
2) Mud balls
3) Unevenness of filter sand surface level
4) Unevenness of depth of filter sand layer
5) Dirtiness of inside wall of filter basin

Step-2. It is made to be consider why it became such condition

2-1. Filter run time is not controlled and managed

1) Current conditions

Filtration is continued until the water in a filter basin overflows

Allowable filter run time is not set up

The filter run time set up is not kept

2) Required knowledge

The clogging of the filter sand layer by too long filter run time

The maximum of filter run time

Effectiveness and its importance of filter washing

The effect component exerted on filter washing

Effective filter washing

The confirmation method that filter washing is effectiveness

Optimum filter washing regime

Effect of filtered water quality on filter run time

2-2, Filer washing operation is not controlled and managed

1) Current conditions

Inadequate filter washing operation

Inadequate filter washing regime

2) Required knowledge

Effectiveness and its importance of filter washing

The effect component exerted on filter washing

Effective filter washing

The confirmation method that filter washing is effectiveness

Optimum filter washing regime

2-3. Lack of filter layer maintenance implementation

1) Current condition

Nobody recognizes the dirty condition of filter layer as unusual

2) Required knowledge

The criteria which look at by the eyes and are judged to be dirty condition

2-4.A effectiveness of filter washing is not checked

1) Current condition

Nobody judges the effectiveness of filter washing

There are no criteria which judge that filter washing is effective

The antecedent basis of the current filter washing regime is not clear

2) Required knowledge

The confirmation method of the effectiveness of filter washing

Criteria to judge effectiveness of filter washing

The procedures to determine the optimum filter washing regime

Step-3, Activities which recovers a filter layer in the normal condition

3-1.Check of current condition of a filter layer and filter basin

1) Muddy layer of filter media surface
2) Mud balls
3) Unevenness of filter sand surface level
4) Unevenness of depth of filter sand layer
5) Dirtiness of inside wall of filter basin

3-2.Cofirmation of filter run time and filter washing regime in current condition

1) Measurement of filter back wash water flow rate, if possible

By portable ultrasonic flow meter or measurement of water revel in filter basin during back washing

Measure filtration area and Calculate back wash rate

2) Confirmation of specification of back wash pump and blower for air scouring

Calculate back wash rate and air scouring rate

3) Confirmation of during time of air scouring and back washing, including combined wash of air and water

4) Confirmation the filter washing operation by usual operation procedures in the plant

Measurement of during time of air scouring, combined wash and back washing

Confirmation of water level in a filter basin before start air scouring

Confirmation of usual rewashing procedures

5) Confirmation of the usual filter run time

3-3.Analysis and discussion about causes which resulted in the current condition

3-4.Analysis and discussion about recovery method

3-5.The proposal of recovery activities

Rapid Sand Filter in ZAGAZIG WTP

Filter dimension	**4.7** m			
	7.3 m			
Filtering are	**68.6** m2			
Backwash water Flow rate	**510** l/sec **0.5** m3/sec	Pump rated capacity	**590** l/sec	
(Measured by ultrasonic flowmeter)	**30** m3/min		**35.4** m3/min	
Backwash water Flow rate (Measured by differentia flowmeter)	**490** l/sec **0.5** m3/sec **30** m3/min			
Backwash rate	**0.44** m3/m2/min 73% of Japanese standard		**0.52** m3/m2/min 86% of Japanese standard	

Japanese standard of Backwash rate	**0.6** m3/m2/min (Wuthin the range of 0.6 to 0.9 m3/m2/min)
Backwash water Flow rate	**41.2** m3/min **686** l/sec
Backwash time	Wuthin the range of 4 to 6 min

Relation between backwash water flow rate and backwash rate

Filtering area 68.6 m2

Backwash flow rate (l/sec)	Backwash rate (m3/m2/min)
350	0.31
400	0.35
450	0.39
500	0.44
550	0.48
600	0.52

1) Change the backwash rate around 0.5-0.6 m3/m2/min, if possible
2) Implementation of filter washing and measure turbidity of back wash drainage at the end of washing
Change during time of air scouring, combined wash and back wash
3) Repeat 3 times above 2) and measure turbidity of wash drainage water
4) Observe surface condition of filter layer
5) Remove muddy layer and mud balls of filter layer and observe filter layer surface condition
6) Start filtering
7) Check the water quality of filtered water
8) Recovery activities for next filter
During times of filter washing should be changed as needed

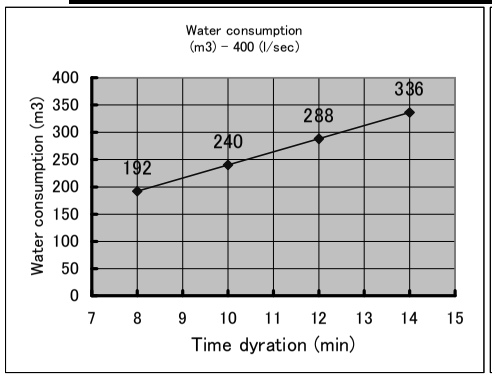
3-6.Data analysis of recovery activities of filters
Make graphs relation between filter back wash during time and turbidity of wash drainage water
Assess the appropriateness of washing regime

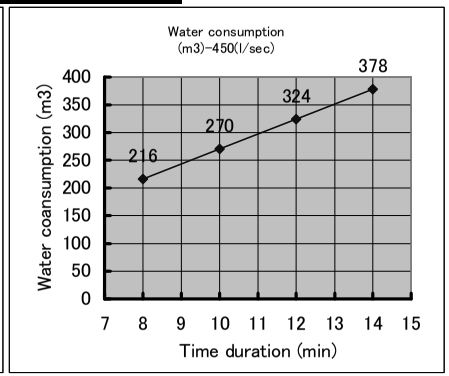
The followings will be known according to the above OJT activities
1) The present filter layer is unusual
2) Importance of filter washing works and filter washing frequency
3) How to check the condition of filter layer by observation
4) The sampling method of the filter wash drainage water during filter back wash
5) The assessment criteria of effectiveness of filter washing
6) The assessment procedures of effectiveness of filter washing
7) Importance of operator's role
8) Importance of taking record and record keeping of filter operation and filter washing
9) Procedures of filter refreshment
10) Check items for periodical inspection of filter layer

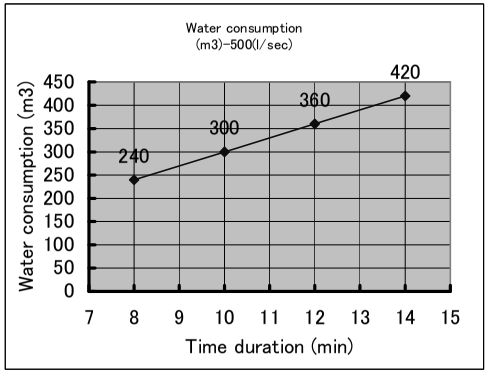
The expected improvement
1) Keeping normal condition of filter media
Prolongation of filter media life and decrease of additional supplying amount of filter sand
Water quality improvement of filtered water
Decrease in consumption of residual chlorine in a filtration process
Prolongation of filter run time
2) Optimum water consumption for filter washing
Decrease of additional supplying amount of filter sand

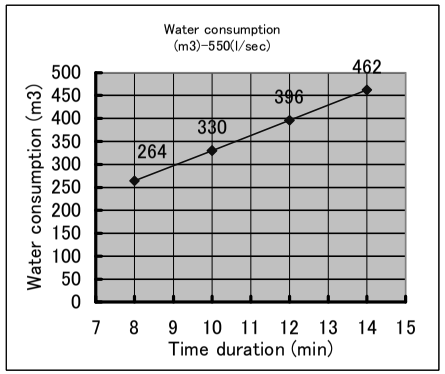
Water consumption in each filter washing

Backwash flow rate (l/sec)	Time duration (min)	Water consumption	(m3/min)
400	8	192	24
400	10	240	24
400	12	288	24
400	14	336	24
Backwash flow rate (l/sec)	Time duration (min)	Water consumption	(m3/min)
450	8	216	27
450	10	270	27
450	12	324	27
450	14	378	27
Backwash flow rate (l/sec)	Time duration (min)	Water consumption	(m3/min)
500	8	240	30
500	10	300	30
500	12	360	30
500	14	420	30
Backwash flow rate (l/sec)	Time duration (min)	Water consumption	(m3/min)
550	8	264	33
550	10	330	33
550	12	396	33
550	14	462	33









Evaluation of filter washing activity in WTP

1. Purpose

1-1 Evaluation of time frame for filter washing

Air scouring

Air scouring and backwashing

Backwashing

1-2 Evaluation of backwashing rate

2. Activities for test

2-1 Cleaning and initialization of existing filter by 4 times filter washing

2-2 Filter washing by time frame in current condition

2-3 Filter washing by modified time frame

It is estimated that backwashing step is not effective for filter washing cause of inadequate time frame for filter washing and/or inadequate backwashing rate.

Check 1: Effectiveness of air scouring

Check 2: Effectiveness of air/backswing

Backwashing flow rate in WTP of Sharkia is insufficient compared with Japanese standard rate (Approx.60-80%).

We have to find out the most effective point on air scouring and air/water washing.

Backwashing will be conducted as a function of rinse.

We will check the effectiveness of air souring and air/water washing

Time frame	Air scouring (min)	Air and water (min)	Backwashing (min)	Total backwashing (min)
Current pattern	**3**	**5**	**8**	**13**
Pattern 1	2	6	5	12
Pattern 2	1	7	5	12
Pattern 3	5	5	5	10
Pattern 4	5	6	5	11
Pattern 5	5	7	5	12

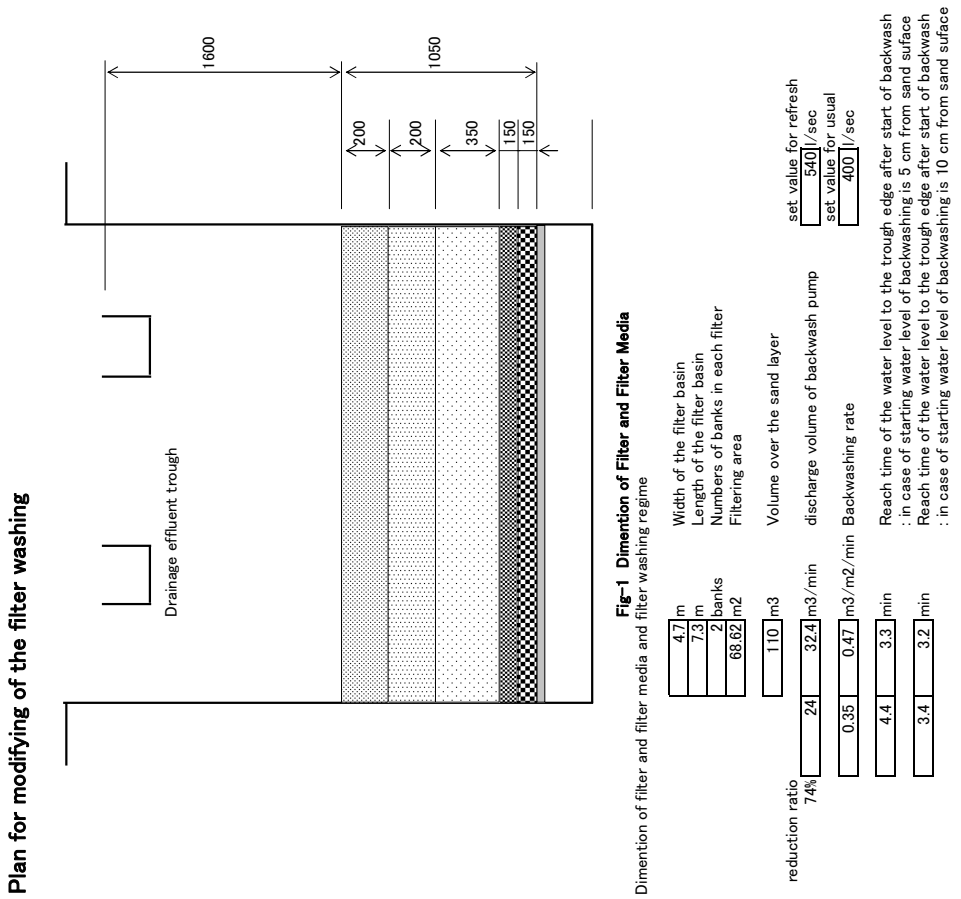
2-4 Measurement of backwashing water flow rate

2. Evaluation items

3-1 Measurement of turbidity of washed drainage water after completed of filter washing

3-2 Check of the flown sand in the washed drainage water

3-3 Check of the filter sand layer condition after completion of filter washing



Recording sheet for the test of filter washing pattern Plant name_____ (Date / / Recorded by)

Time frame	Air scouring (min)	Air and water (min)	Backwashing (min)	Total backwashing (min)	Turbidity of drainage water (NTU)	The flown sand in drainage water	Condition of filter media
Current pattern	**3**	**5**	**8**	**13**			
Pattern 1	2	6	5	12			
Pattern 2	1	7	5	12			
Pattern 3	5	5	5	10			
Pattern 4	5	6	5	11			
Pattern 5	5	7	5	12			

Comment for result

Time frame	Comment	Evaluation
Current pattern		
Pattern 1		
Pattern 2		
Pattern 3		
Pattern 4		
Pattern 5		

Filter & filter washing condition

Air scouring flow rate:_____m3/min (Nominal discharge volume of a blower)

Backwashing flow rate:_____m3/min (Reading of flow meter indicator)

Filtering area of unit filter:_____m2 (Calculated value from measured dimension: Width: m Length: m Number of basin:)

Backwashing rate:_____m3/m2/min (Backwashing flow rate/Filtering area of unit filter)

Air scouring rate:_____m3/m2/min (Air scouring flow rate/Filtering area of unit filter)

Numbers of filter: _____units

Evaluation of washing durattion time

Air scouring	Purpose 1	Break the clogging in the sand layer
	Purpose 2	Remove the dirty substances around sand grain and n the sand layer space in contact with sand each other
Air and water	Purpose 1	Remove the dirty substances around sand grain in contact with sand each other
	Purpose 2	Wash away the dirty water
Water backwash	Purpose 1	Rinse the filter sand with backwash water and flow away the dirty water in the filter

Required durtation time (Estimated values)

Air scouring	Minimum	3	min	(depend on the dirtiness degree of the filter media)
	Maximum	5	min	
Air and water	Minimum	3	min	(depend on the dimention between sand saufce and top of effluent trough)
	Maximum	5	min	(depend on the dirtiness degree of the filter media)
Backwashing	Minimum	3	min	(depend on the dirtiness degree of the filter media)
	Maximum	10	min	
Backwash rate	Minimum	0.3	m3/m2/min	(depend on the dimention between sand saufce and top of effluent trough)
	Maximum	0.5	m3/m2/min	(depend on the dirtiness degree of the filter media)
Flitering duration time (Filter washing frequency)	Normal	24	hours	(In case of single filter layer)
	Maximum	48	hours	

Plan 1

filter media	clean	Rank of cleanness	Clean Midium Dirty
media depth	1000	mm or around this	
backwash rate	0.35	m3/m2/min or around this	
Dimention	1500	mm or around this	dimention between sand saufce and top of effluent trough

Air scouring	3	min
Air and water	5	min
backwashing	5	min

Plan 2

filter media	Midium	Rank of cleanness	
media depth	1000	mm or around this	
backwash rate	0.4	m3/m2/min or around this	
Dimention	1500	mm or around this	dimention between sand saufce and top of effluent trough

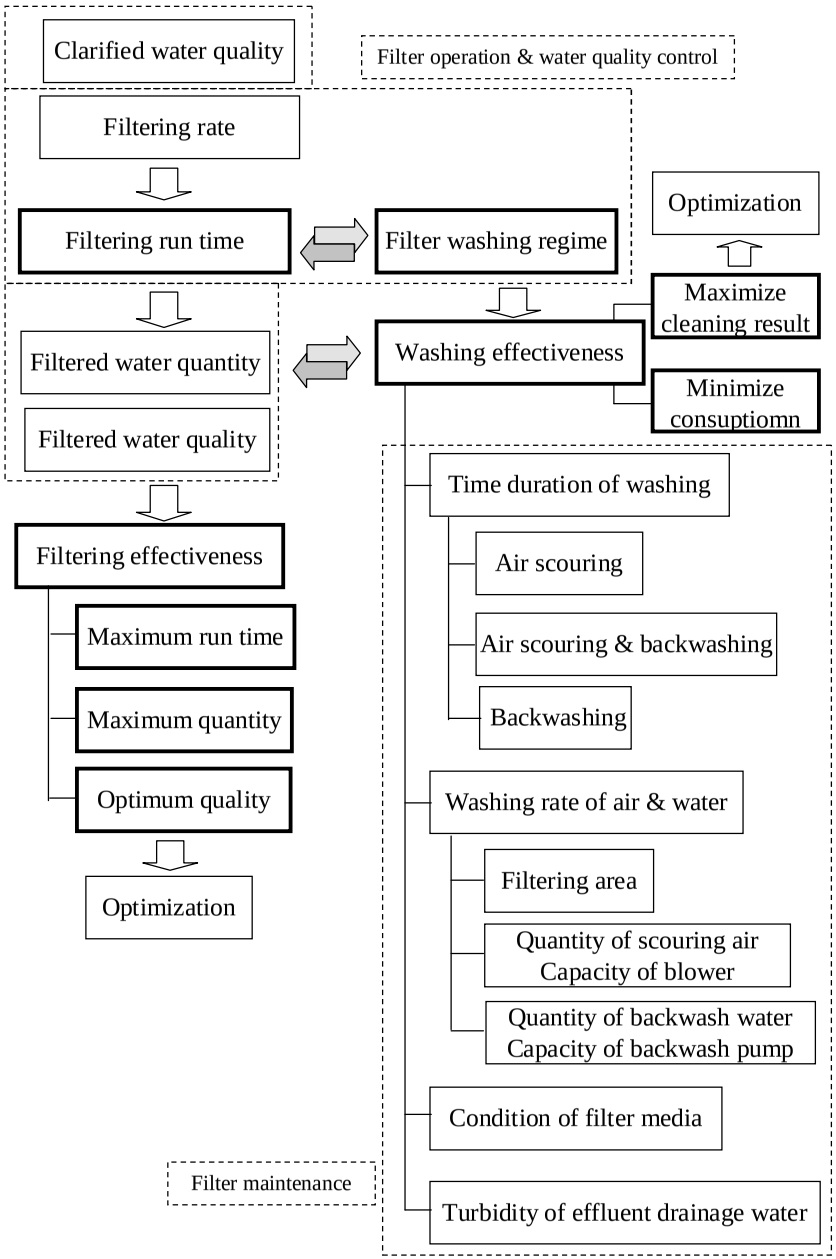
Air scouring	5	min
Air and water	5	min
backwashing	5	min

Plan 3

filter media	Dirty	Rank of cleanness	
media depth	1000	mm or around this	
backwash rate	0.45	m3/m2/min or around this	
Dimention	1500	mm or around this	dimention between sand saufce and top of effluent trough

Air scouring	5	min
Air and water	5	min
backwashing	5	min

Mian scheme of O&M and water quality control for the Filtering process



Estimated reduction volume of filter washing water in ZAGAZIG water treatment plant

		Before modification	After modification
Filter washing regime	Air acouring	3 min	5 min
	Air and backwash	5 min	5 min
	backwashing	8 min	5 min
	Dischaege volume of backwashing pump	475 l/sec	530 l/sec
Backwashing rate	Filtering area 69 m2	0.41 m3/m2/min	0.46 m3/m2/min
Water consumption	per one filter per once washing	370.5 m3	318.0 m3
Difference between before and after modification	per once washing per one filter	53 m3/filter/washing	
Filter run time	per one filter	24 hr	36 hr
Frequency of filter washing in a week	per one filter	7 times	5 times
Total quantity of water consumption in a week	per one filter	2,593.5 m3/filter	1,484.0 m3/filter
Difference between before and after modification	per one week per one filter	1109.5 m3/week/filter	
Water reduction quantity in a day	per one filter	158.5 m3/day/filter	
total reduction of water consumption in a day	Number of the filter 6 filters per all filter	951.0 m3/day/6 filters	
total reduction of water consumption in a month	Number of the filter : 6 filters	28,530.0 m3/month/6 filters	

Results of assessment the current condition and the filter refreshment

Trial operation period **From 24/June/2008 to 2/July/2008**

ZAGAZIG WTP

	Current	assessment	modify
Time duration of washing	3 min	too short	5 min
Air scouring & backwashing	5 min	enough	5 min
Backwashing	8 min	too long	5min

	measured	rate	modify
Washing rate of air & water	69 m2		
Filtering area	(nominal capacity) 4100 m3/hr	1.0 (m3/m2/min)	for refreshment 530 l/sec 0.46 (m3/m2/min)
Quantity of scouring air Capacity of blower	400 l/sec	0.35 (m3/m2/min)	
Quantity of backwash water Capacity of backwash pump			

	Water level in the working filter
Condition of filter media	(Before refreshment)
	muddy surface much difference between both banks many mud balls
	(After refreshment)
	slight muddy slight difference between both banks few mud balls

	At the end of filter washing
Turbidity of effluent drainage water	Before refreshment / After refreshment
	approx.30 NTU / 15 NTU or less

Procedures for refreshment of the dirty filter 01/July/2008 rev .0

Refreshment of the filter is one of the recovery activities for depression of the filter.
The filter repeats filtering operation and filter washing operation periodically.
Above 2 operations are the basic functions of the filter.
The filter media is a key part in the filtering system for above 2 basic functions.
Refreshment of the filter is activity to restore the filter media in dirty or clogging condition.

1. Purpose: Restore the function of the filtering
   1-1.Clean up the sand layer by removing the dirty layer on the sand surface
   1-2.Remove the mud balls on the sand surface
   1-3.Clean up the sand grain
   1-4.Arise the mud balls in the filter layer
2. Procedures
   2-1.Preparations prior to refreshment activities
      1) Confirm the current operation condition of filtering and filter washing
         1-1) Filter run time
            24 hours, more than 24 hours, more than 36 hours, more than 48 hours
            Periodical washing or not (in case of 'not', what is a trigger of filer washing?)
            Can not be clarified (no records)
         1-2) Filter washing regime
            Air scouring duration time and air flow rate
            Simultaneous washing duration time air scouring and backwashing
            Backwashing duration time
         1-3) Formation of filter media and installation history
            Size of each filter media as design
            Depth of each filter media as design
            Depth of each filter media as current condition
            Date of replacing (whole or partially) or newly laying
         1-4) Structure and system of under drain
            Pipe structure or channel structure
            Type of collecting water nozzle
         1-5) Dimension of the filter and shape of the filter
            Filtering area
            Dimension from sand surface up to top of effluent trough
            Split bank type or non split bank type
            Numbers of the effluent trough for each bank
            Evenness of installed level of top regarding the all effluent toughs in the filter
         1-6) Filter washing quantity of air and backwash water
            Quantity of air or nominal discharge capacity of blower
            Quantity of backwashing water as flow rate (l/sec) and integral water volume of each washing (m3)

            Calculated backwashing rate (m3/m2/min)
            Calculated air scouring rate (m3/m2/min)
         1-5) Turbidity of washed effluent drainage water
            Take a sample after combined washing
            Take a sample after 2 min from start of backwashing (stop of air scouring)
            Take a sample after 2 min from above
            Take a sample after 1 min from above
            Note: In case of split bank type filter, Take samples from both banks at a time.
      2) Visual observation of the filter sand layer
         2-1) Dirtiness of sand layer before filter washing and after filter washing
         2-2) Appearance of mud balls on the filter sand surface before filter washing and after filter washing
            Check point
               Muddy layer thickness
               Amount of mud balls and size of mud balls
               Wall side condition of muddy layer

         2-3) Flatness of the whole area of filter sand surface before filter washing and after filter washing
            Check point
               Difference of the level of sand surface and confirmation of big different parts
               Location of the above and area of the above
               Craters of the sand surface and location of the craters
               Location of the above and area of the above
               Partial build up of the sand surface and location of the build up location
               Location of the above and area of the above
         2-4) Cracks on the whole area of filter sand surface especially parts of beside walls
            Check point
               Location of cracks
               Numbers of cracks
               Size of cracks
   2-2.Decide the backwash rate and the filter washing regime for refreshment filter washing
      1) Decide the backwashing rate and the filter washing regime
         1-1) Assessment of the current backwashing rate and set the backwashing flow rate for refreshment filter washing
            Backwashing rate for refreshment of the filter was required around 0.47 (m3/m2/min) according to our trial activities.
            Procedures of assessment and setting are following;
               1. Confirm the current backwashing rate.
               2. Change the backwash water flow rate to required backwash rate if necessary.
               3. If capacity of backwash pump is not enough for above flow rate, set to maximum flow rate of pump capacity.

1-2) Assessment of the current filter washing regime and setting the filter washing regime for refreshment filter washing

Under above condition of backwash rate, duration time for combined washing is required more than 5 min according to our trials.

And the drainage water started flowing out from effluent trough after about 3 min of start of combined washing and this continues the flowing out for about 2 min.

Air scouring duration time is 5 min and backwashing duration time is 5min according to our trials.

Procedures of assessment and setting are following of tentative filter washing regime;

1. Confirm the current filter washing regime
2. Change the current filter washing regime if necessary.

Recommendation washing regime according to our trial experiences;

For dirty and medium class filter

Air scouring	5 min
Combined wash	5 min
backwash	5 min

For very dirty filter combined wash and backwash duration time will be added 2 min.

Dirty conditions are classified as following 4 kinds of condition as tentative:

Class 1 Very dirty : Deep muddy layer and big size of mud balls
- Muddy layer depth: 0.5 cm or more
- Mud ball size: diameter 5 cm or more
- Muddy area: approximately 90 % or more of filter area

Class 2 Dirty : Shallow muddy layer and medium of mud balls
- Muddy layer depth: 0.5 cm or less around 0.3 cm
- Mud ball size: diameter: 5 cm or less around 3 cm
- Muddy area: approximately 70 % or more of filter area

Class 3 Medium : Shallow and partial muddy layer and small size of mud balls
- Muddy layer depth: 0.5cm or less around 0.2 cm
- Mud ball size: diameter: 3 cm or less around 1 cm
- Muddy area: approximately 30 % or less of filter area

Class 4 Clean : No muddy layer and no mud balls

2-3.Trial operation of filter refreshment

1) Preparations

1-1) Plan and schedule of trial operation

1-2) Arrangement of the operator, the chemist, and the supervisor

Following arrangement is required for trial before start the trial;

The operator	: 1 Operation of the filter
The chemist	: 2 Taking samples and water analysis
The supervisor	: 1 Supervising the trial operation totally
Assistant for supervisor	: 2 Assist the supervisor and taking records

1-3) Preparation of instruments and tools

Stop watch

Sampling bottles and sampling dipper

Turbidity meter

1-4) Preparation of recording sheets

2) Procedures for trial operation

2-1) Adjust a backwash flow rate to the preset value prior to starting of trial operation

2-2) Set the water level in the filter to be tested to the starting level of air scouring

Starting water level for air scouring: 5 cm or less from sand surface

2-3) Start air scouring and continue it according to the time duration schedule

2-4) Backwashing start beside the air scouring after 5 min from starting of air scouring

2-5) Stop the air scouring after 5 min from starting of the backwashing continue the backwashing according to the time duration schedule

Take a water sample of wash drainage from effluent water just before stop the air scouring.

2-6) Take a sample of wash drainage water from effluent water at every 2 min during backwashing and 1 min before finishing the backwashing.

2-7) Stop the backwashing according to the time duration schedule

2-8) Measure the turbidity of samples

2-9) Down the water level up to lower than sand surface level

2-10) Confirm the surface condition of the filter sand layer

2-11) Remove the muddy layer and mud balls on the sand surface as needed

2-12) Assess the data from records of turbidity of wash drainage water

2-13) Wash the filter again depend on results of sand surface condition after washing and assessment results

2-14) Repeat the procedures of above 2-2)-2-12) and wash again if necessary

2-15) Refreshment of the filter should be completed according to following results;

Turbidity of wash drainage water: Approximately around 10 (NTU)

Surface condition of filter sand layer: No muddy layer and no mud balls

3) Procedures for assessment of data on turbidity of wash drainage water

3-1) Make graphs regarding relation between turbidity and washing duration time

3-2) Make graphs regarding relation between turbidity reduction removal and washing duration time

3-3) Observe the condition of filter sand layer according to the check list described above.

Note

Sand surface level is important for functions of filtering and filter washing.

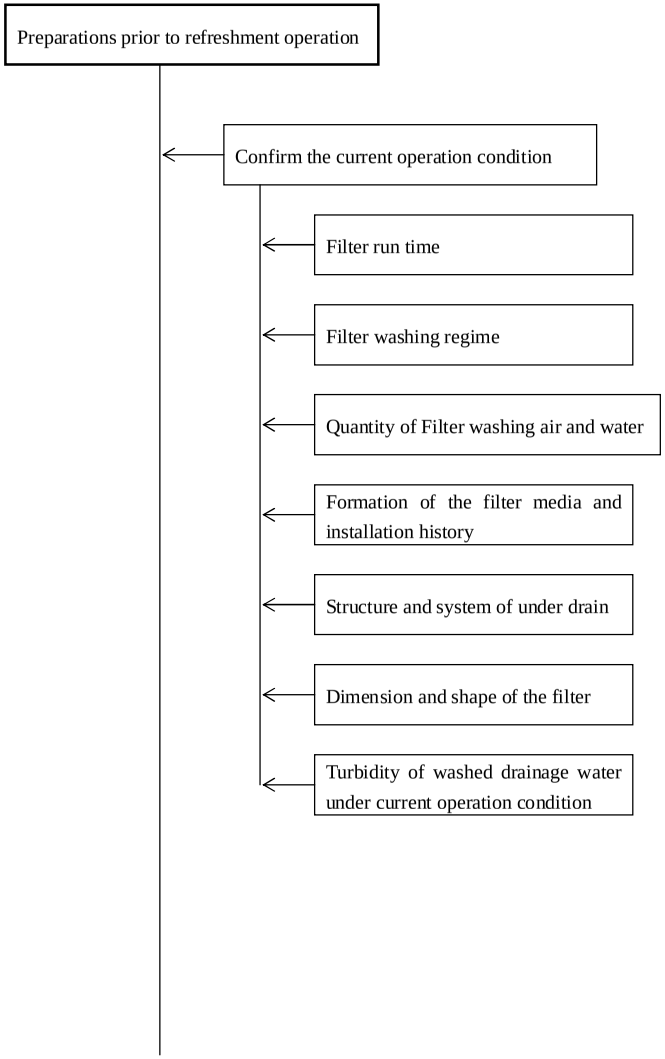
Make sure the sand surface level and if difference level between both banks of the filter is found, sand level should be adjusted to be same level in both banks.

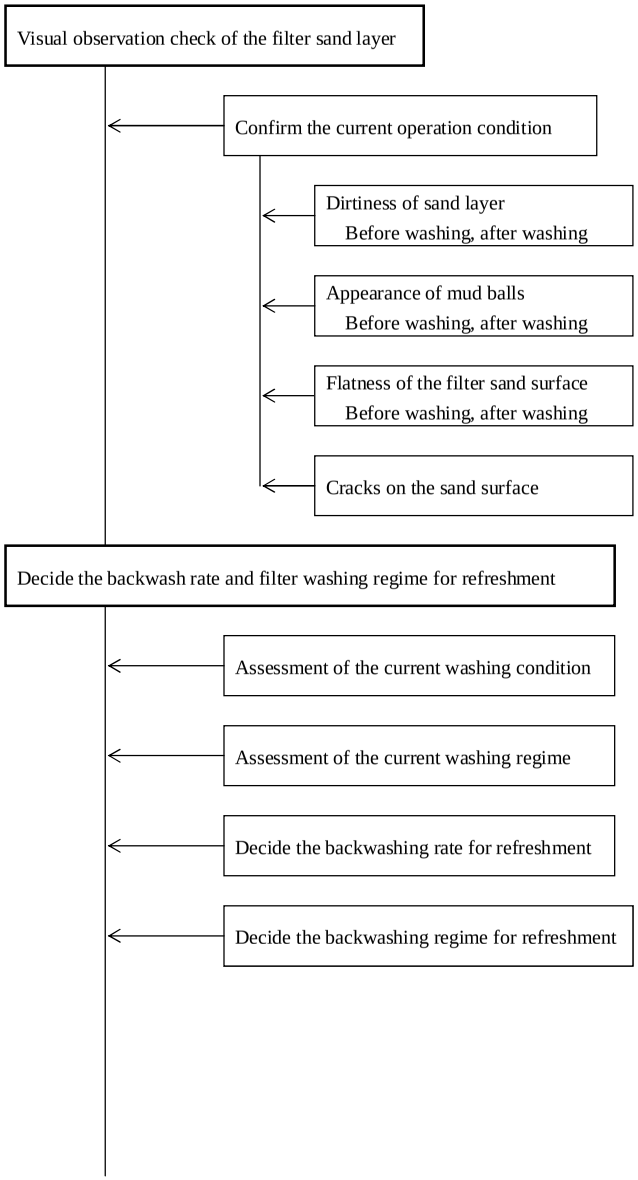
If this difference will be left itself, filtering rate and filter washing effectiveness can not be kept even. Washing effectiveness to deeper sand bank will be weaker than shallower bank.

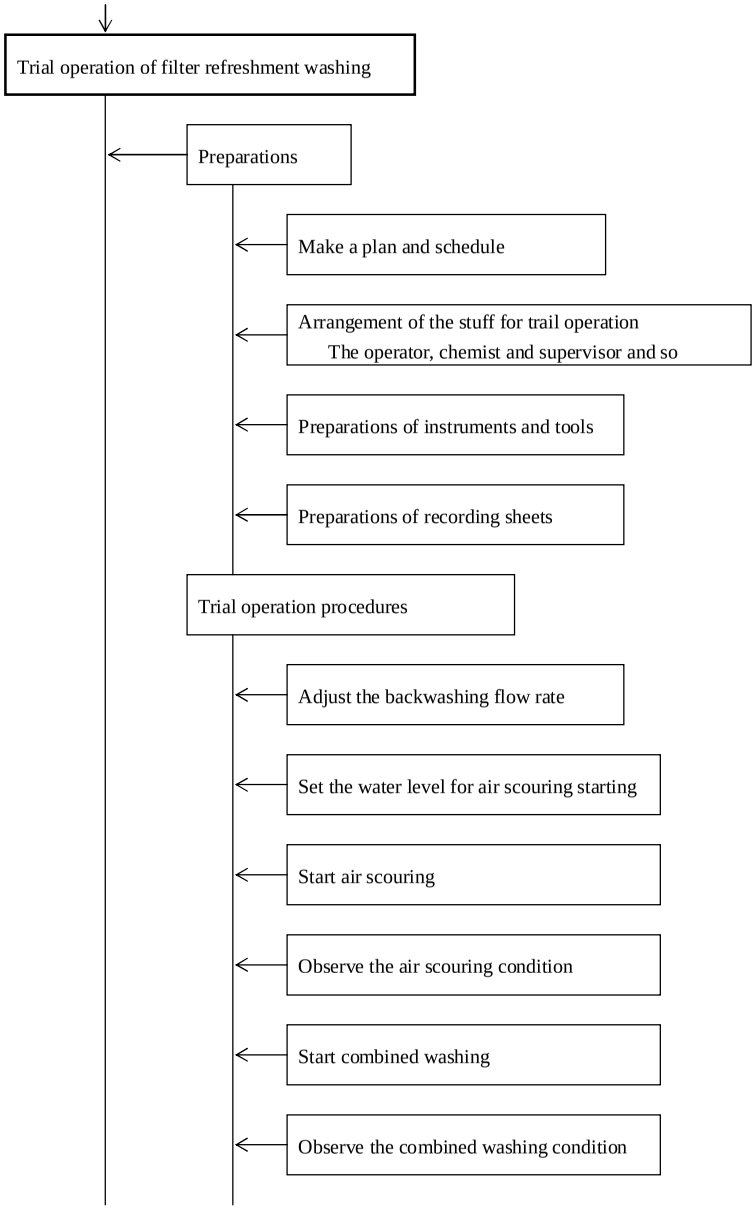
As the results one of the banks will be dirty more and more than another bank.

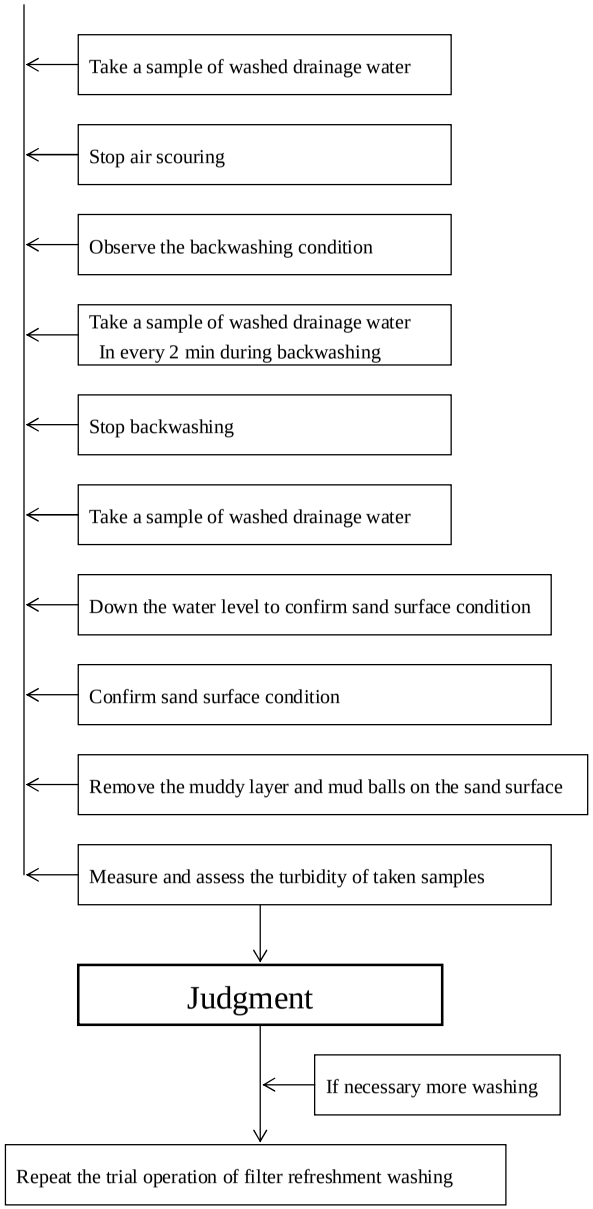
Flow chart for Procedures for refreshment of the dirty filter

01/July/2008 rev .0

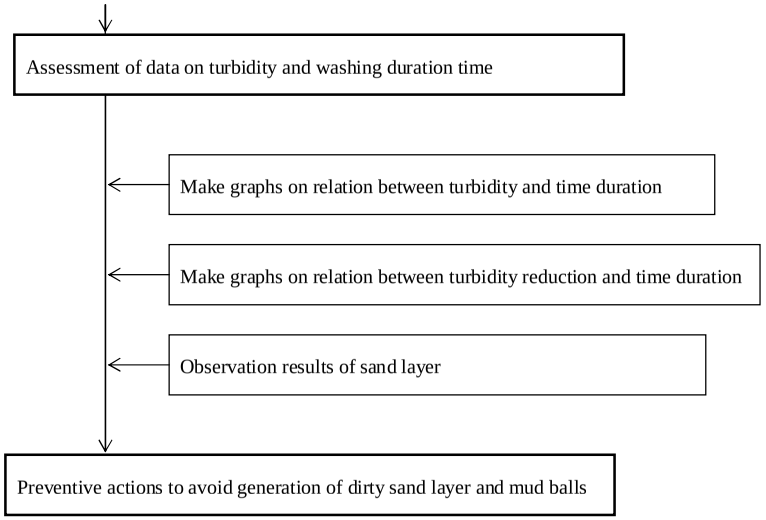



Visual observation check of the filter sand layer
Confirm the current operation condition
Dirtiness of sand layer
Before washing, after washing
Appearance of mud balls
Before washing, after washing
Flatness of the filter sand surface
Before washing, after washing
Cracks on the sand surface
Decide the backwash rate and filter washing regime for refreshment
Assessment of the current washing condition
Assessment of the current washing regime
Decide the backwashing rate for refreshment
Decide the backwashing regime for refreshment


Trial operation of filter refreshment washing
Preparations
Make a plan and schedule
Arrangement of the stuff for trail operation
The operator, chemist and supervisor and so
Preparations of instruments and tools
Preparations of recording sheets
Trial operation procedures
Adjust the backwashing flow rate
Set the water level for air scouring starting
Start air scouring
Observe the air scouring condition
Start combined washing
Observe the combined washing condition


Take a sample of washed drainage water
Stop air scouring
Observe the backwashing condition
Take a sample of washed drainage water
In every 2 min during backwashing
Stop backwashing
Take a sample of washed drainage water
Down the water level to confirm sand surface condition
Confirm sand surface condition
Remove the muddy layer and mud balls on the sand surface
Measure and assess the turbidity of taken samples
Judgment
If necessary more washing
Repeat the trial operation of filter refreshment washing

4/5


Assessment of data on turbidity and washing duration time
Make graphs on relation between turbidity and time duration
Make graphs on relation between turbidity reduction and time duration
Observation results of sand layer
Preventive actions to avoid generation of dirty sand layer and mud balls

5/5

Operation procedures of filter washing and drainage water sampling

1. Stop the raw water flow to the filter by close the raw water valve and open the drainage valve. Outlet water valve is still opened.
   Filtered water still flow into the ground reservoir.
2. Wait several minutes until water level goes down up to 10 cm over the sand surface level in the filter.
3. Close the outlet valve and confirm the water level is approx. 1cm over the sand surface. Filtered water stopped flowing into the ground reservoir.
   If water level is still high, adjust the water level by open the outlet valve again.
4. Start the blower for air washing and open the air washing valve.
5. Air washing duration time is 5 min.
6. After 5 min from start blower, start backwashing pump and open the backwash valve.
7. Air washing and backwashing duration time is 5 min.
8. After 5 min from start backwashing pump, close the air washing valve and stop the blower.
9. Continue backwashing for 5 min after stop the blower.
10. After 5 min of backwashing, close the backwash valve and stop the backwash pump.
    Before stop the backwash pump, take a sample of wash drainage water from effluent rough once a week.
11. Measure the turbidity of sampled water in the laboratory.
    And make sure that turbidity is less than 10 NTU.
12. Make sure the sand surface once a week after complete the filter washing by letting down the water level.
    And if you find out the mud balls or other foreign matters remove them.
13. After complete the filter washing, close the drainage valve, open the raw water valve and open the
    pre-filtering valve. Pre-filtering duration time is approx.10 min.
14. After pre-filtering is completed, close the pre-filtering valve and open the outlet valve. Filtering is started.

Key point

Air washing	:	5 min
Air washing and backwashing	:	5 min
Backwashing	:	5min
Frequency of taking sample of wash drainage water	:	Once a week
Measuring of turbidity of wash drainage water	:	Once a week
Check the sand surface condition	:	Once a week

Procedures for performance test of filter washing

1. Purpose
   1-1.Confirmation of performance of current filter washing
   1-2.Finding out adequate during time for washing process of filter washing
2. Methodology
   2-1.Observation of condition of filter sand layer at stop period of filtering
      1) Dirtiness of sand layer
      2) With or without of mud balls and amount of mud balls
      3) Difference of water level of both banks of the filter
   2-2.Taking samples of washed drainage water and measuring of turbidity
      1) Frequency of the sample
         1st sampling : After 5 min simultaneous washing of air/backwashing
         2nd sampling: After 2 min of start of backwashing
         3rd sampling: After 4 min of start of backwashing
         4th sampling: After 6 min of start of backwashing
         5th sampling: After 8 min of start of backwashing
      2) Location of sampling: Effluent water from drainage trough
   Note: Filter washing shall be done repeatedly if turbidity will not be reached less than 10 NTU at time point of 8 min after backwashing.
   2-3.Evaluation of measured records
      1) Making relation graph between the duration time and turbidity of drainage water
      2) Evaluation of reduction degree on turbidity of drainage water

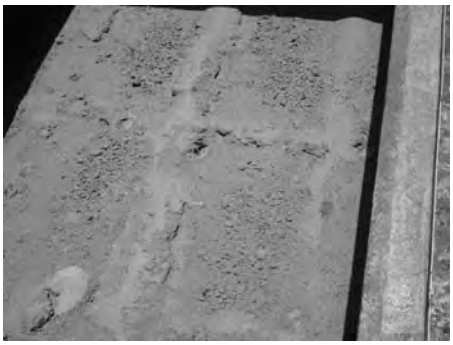
Refreshment of No.5 Filter in ZAGAZIG WTP (1/2)

1)

Sand layer after 1st washing: Big amount of muddy layer and mud balls

2)

Removal of muddy layer and mud balls



3)

Sand layer after 2nd washing: Big amount of muddy layer and mud balls

4)

Wash drainage water during backwashing in 3rd washing: after 2 min start of backwashing

Refreshment of No.5 Filter in ZAGAZIG WTP (2/2)

5)

Sand layer after 3rd washing: Big amount of muddy layer and mud balls

6)

Sand layer after removal of muddy layer and mud balls

7)

Sand layer after 4th washing: Reduced amount of muddy layer and mud balls

8)

Check the sand layer by excavating sand layer

3.8 Summary Report of Residual Chlorine Control in “WTPs” (Action S6)

Summary of OJT activity about residual chlorine control In water treatment process

1. Purpose of OJT about residual chlorine control in water treatment plant

Improvement of implementation capacity regarding operation and control of chlorination process

2. Target of achievement by OJT activity

2-1 Improvement of stability of residual chlorine concentration of treated water

1) Stable residual chlorine concentration of clarified water

2) Stable residual chlorine concentration of filtered water

3) Stable residual chlorine concentration of transmission water

2-2 Improvement of O&M activity

1) Effective chlorine dosing

2) Proper chlorine dosing rate

3) Routine work of water quality analysis about residual chlorine by proper frequency

4) Effective utilizing of water quality analysis record about residual chlorine

5) Control activity about residual chlorine with control target of treated water

6) Supplying of safety water with high reliability to the network

2-3 Improvement of O&M capacity

1) Capacity to monitor residual chlorine of treated water

2) Capacity to control the chlorinator to demanded flow rate of chlorine

3) Capacity to set up and modify a required dosing rate of chlorine

2-4) Improvement of operating cost of the filter

1) Proper consumption of chlorine

As the result of above, if possible achievement of the reduction of chlorine consumption weight

2. Method

2-1 Confirmation and check of the current condition of residual chlorine control

1) Confirmation by records of water quality analysis about break-point and residual chlorine

1-1) Frequency of analysis in a day and water sampling method

1-2) Validity and availability of recorded values

1-3) Utilizing of analysis records to the plant operation

2) Confirmation of knowledge of laboratory staffs about residual chlorine control

2-1) Kind of residual chlorine and feature of each

2-2) Residual chlorine to be maintained in usual operation of WTP

2-3) Residual chlorine concentration to be kept of transmission water from WTP

2-4) Assessment of consumption of residual chlorine in the water treatment process

2-5) Treatment targets about residual chlorine in the water treatment process

2-6) Residual chlorine concentration to be kept of transmission water at final tap in the network

2-7) Regulations or law about residual chlorine in Egypt

2-8) Letters or documents on above regulations or law

3) Confirmation of current operation about control of dosing flow rate by chlorinator

3-1) Communication between laboratory team and operation team
3-2) Procedures for control operation of chlorinator when chlorine dosing flow rate should be changed
3-3) Utilizing of records of raw water flow rate to control of the chlorine dosing flow rate
3-4) Procedures to calculation of dosing flow rate of chlorine
3-5) Frequency of change of chlorine dosing flow rate in a day
3-6) Procedures for control of residual chlorine concentration in the water treatment process
3-7) Use of break-point test results for set-up of pre-chlorine dosing rate
3-8) Consumption of residual chlorine in water treatment process

2-2 Lectures about control procedures for residual chlorine in water treatment process

1) Importance of free residual chlorine and effectiveness over disinfection of potable water
2) Necessity of water analysis about not only total residual chlorine but free residual chlorine
3) Criteria of residual chlorine concentration of potable water by WHO guideline
4) Necessity of control activity of residual chlorine concentration in water treatment process
5) Achievements by control activity of residual chlorine concentration in water treatment process
6) Functions of pre-chlorine dosing and post-chlorine dosing
7) Relation between pre-chlorine dosing rate and post-chlorine dosing rate
8) Required activities to control of residual chlorine concentration in water treatment process
9) Required records to control of residual chlorine concentration in water treatment process
10) Procedures for control of residual chlorine in water treatment process

2-3. OJT about residual chlorine control

1) Set-up the treatment targets of residual chlorine about clarified water, filtered water and transmission water
2) Taking records of residual chlorine under operation condition in the current for 5 days
3) Taking records of raw water flow rate for 5 days
4) Analysis about 5-days records of operation
   Differences between the target treatment value and actual records
   Study about variation of residual chlorine concentration in 5 days
   Study about differences between residual chlorine of clarified water and filtered water
   Study about relation between beak-point test results, pre-chlorine dosing rate and residual chlorine of clarified water
   Calculation of consumption of residual chlorine in treatment process
   Study about causes of found differences
6) Focusing to required reviews about modification of current operation conditions
7) Implementation of operation under condition of reviewed operation and taking of records for 5days
8) Same as above 4) to 7)
9) Setting the criteria for winter season about control of residual chlorine

2-4.OJT by expert about residual chlorine control to CP of H/Q and CP in model facility

Facility name	Date of OJT	OJT
Abbassa WTP	12/Oct/008	Lecture to H/Q CP from expert
	13/Oct/008	Lecture to H/Q CP from expert
	14/Oct/008	Investigation about current condition
	28/Oct/008	Lecture to site CP from H/Q CP
	29/Oct/2008	Data collection start
	18/Jan/2009	Data analysis
Zagazig WTP	16/Oct/2008	Investigation about current condition
	25/Oct/008	Lecture to site CP from H/Q CP
	27/Nov/2008	Data collection start
	18/Jan/2009	Data analysis
	20/Jan/2009	Data analysis
	21/Jan/2009	Data analysis
	22/Jan/2009	Issue of request letter to the manager

Attendance of OJT about residual chlorine control

Facility name	Date of OJT	H/Q CP team	Site CP team
Abbassa WTP	12/Oct/2008	Mr.Sharfi Ms.Heba Mr.Abd Allah	
	13/Oct/2008	Mr.Sharfi Ms.Heba Mr.Abd Allah	
	14/Oct/2008	Mr.Sharfi Ms.Heba Mr.Abd Allah	Mr.Mohamad (Plant manager) Mr.Ahmed (Lab. Manager) Mr.Sayed (Chemist) Mr.Ismaiel (Technitian) Mr.Hosini (Technitian)
	28/Oct/2008	Mr.Sharfi Ms.Heba Mr.Abd Allah	Mr.Mohamad (Plant manager) Mr.Ahmed (Lab. Manager) Mr.Sayed (Chemist)
	29/Oct/2008	Mr.Sharfi Ms.Heba Mr.Abd Allah	Mr.Mohamad (Plant manager) Mr.Ahmed (Lab. Manager) Mr.Sayed (Chemist) 2 operators
	18-21/Jan/2009	Mr.Sharfi Ms.Heba	

		Mr.Abd Allah	
Abbasa WTP	16/Oct/2008	Mr.Sharfi Ms.Heba Mr.Abd Allah	Mr.Mohamad (Plant manager) Mr.Ahmed (Lab. Manager) Mr.Sayed (Chemist) 3 chemists
	25/Oct/2008	Mr.Sharfi Ms.Heba Mr.Abd Allah	Mr.Mohamad (Plant manager) Mr.Ahmed (Lab. Manager) Mr.Sayed (Chemist) 3 chemists
	27/Nov/2008	Mr.Sharfi Ms.Heba Mr.Abd Allah	Mr.Mohamad (Plant manager) Mr.Ahmed (Lab. Manager) Mr.Sayed (Chemist) 3 chemists
	18-21/July/2008	Mr.Sharfi Ms.Heba Mr.Abd Allah	Mr.Mohamad (Plant manager)
	22/Jan/2008	Mr.Sharfi Ms.Heba Mr.Abd Allah	

2-5 Achievements by OJT about residual chlorine control as applying SOP to O&M activities on site

1) Water quality analysis about residual chlorine in treatment process has been conducted as one of the routine work of monitoring activity in WTP model facilities.
2) From October-2008, residual chlorine to monitor has been changed to free residual chlorine from total residual chlorine in WTP model facilities.
3) By control activity of residual chlorine, residual chlorine of clarified water and filtered water has been in stable condition. However, both concentrations of residual chlorine are still in slightly high condition.
4) By control activities of residual chlorine, operation on control of chlorine flow rate was improved as reliable adjustment handling of the chlorinator.
   While residual chlorine control was not performed, when a raw water flow rate was changed, the chlorine dosing flow rate was not changed into a considerable amount in many cases.
5) From above achievement, O&M capacity regarding for the residual chlorine control of H/Q CP team and model facility CP team has been improved as following
   5-1) Capacity to associate the following three factors when monitoring is carried out
      Residual chlorine concentration of clarified water, filtered water and transmission water
      Set value of dosing flow rate of chlorinator
      Raw water flow rate
   5-2) Capacities to perform a calculation of required chlorine dosing flow rate
   5-3) Capacity to set a proper dosing rate of chlorine based on collected records
   5-4) Capacity to modify a dosing rate of chlorine based on collected records

5-5) Capacity to consider required dosing rate according to seasonal change of chlorine demand

5-6) Capacity to consider that residual chlorine concentration is proper or not based on collected records.

5-7) Capacities to perform analysis and evaluations of effectiveness of chlorine dosing

2-8.Appendix

1) SOP documents regarding residual chlorine control activity

2) Records for reference

OJT scenario

Theme: Control procedures for control of free chlorine residual in WTP

1. Confirmation of current operation condition on water quality analysis and facility operation

What is a value of residual chlorine in potable water? (Minimum requirement)

Is above value free chlorine residual?

What kind of treated water as sample water do you measure usually?

Where each sample is taken?

How many times do you measure the residual chlorine?

How to control the residual chlorine?

Is current procedure of monitoring and control of residual chlorine proper?

What is the object of control of residual chlorine?

What is the object of break point of raw water?

For what is the break point measured result utilized?

Is measurement of the residual chlorine carried out with free residual chlorine?

How is the dosing rate of pre-chlorine decided?

How is the dosing rate of post-chlorine decided?

What is the control target value of residual chlorine of transmission water?

What is the basis of above target value?

What is the control target value of residual chlorine of clarified water (inlet water to filter)?

What is the basis of above target value?

What is the control target value of residual chlorine of filtered water?

What is the basis of above target value?

What is the current issues regarding residual chlorine control

What do you think residual chlorine control should be performed?

１. Doesn’t the current control method of residual chlorine need to be change

What is the reason for not changing the current control method?

Suppose it changed a control method, how does it change?

２. The explanation for understanding the meaning of common control activity

３. The explanation for understanding the meaning of residual chlorine control activity

４. Required data for setting up the control target value of residual chlorine

５. Making the procedures and flow chart for residual chlorine control

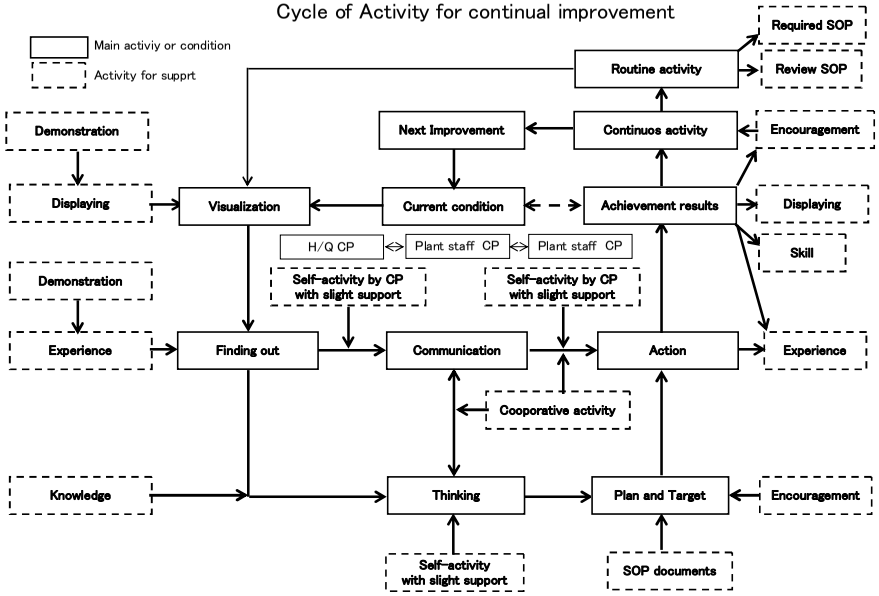
６. The utilization method of data required for residual chlorine control

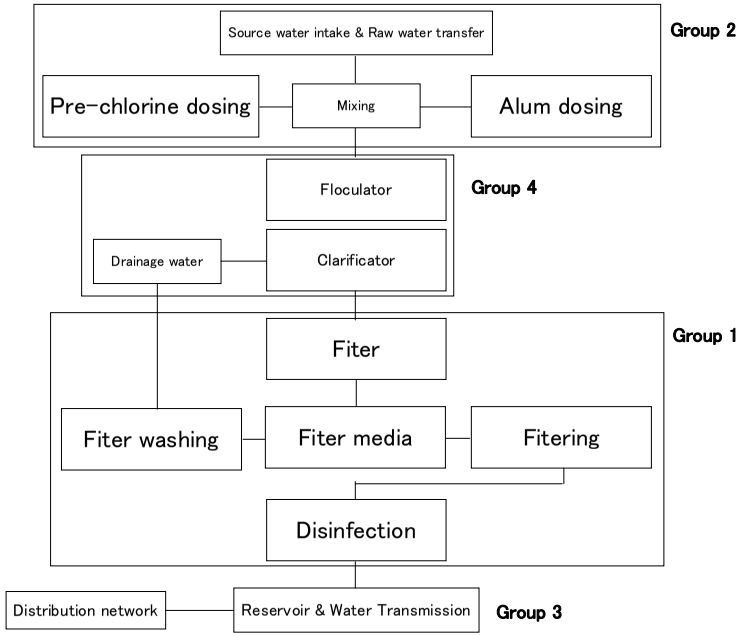
７. Trial activity of residual chlorine control according to the flow chart

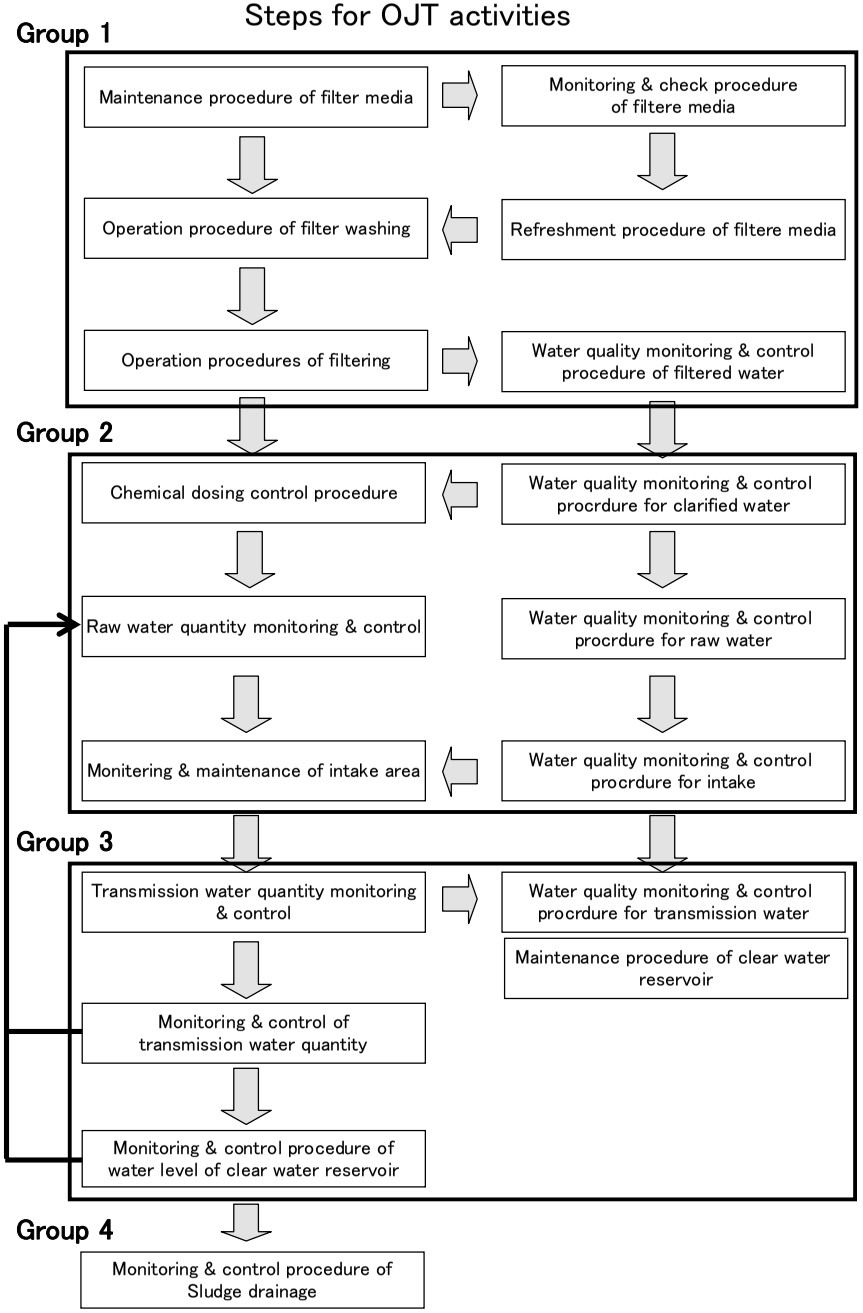
８. Take a record of trial activity result and analyze the record.

Control target and dosing rate of chlorine should be changed if necessary.

９. Repeat the above mentions (3 to 9) if necessary and review SOP (flow chart)


Cycle of Activity for continual improvement
Main activiy or condition
Activity for supprt
Required SOP
Routine activity
Review SOP
Demonstration
Next Improvement
Continuos activity
Encouragement
Displaying
Visualization
Current condition
Achievement results
Displaying
H/Q CP
Plant staff CP
Plant staff CP
Skill
Demonstration
Self-activity by CP with slight support
Self-activity by CP with slight support
Experience
Finding out
Communication
Action
Experience
Cooporative activity
Knowledge
Thinking
Plan and Target
Encouragement
Self-activity with slight support
SOP documents


Source water intake & Raw water transfer
Group 2
Pre-chlorine dosing
Mixing
Alum dosing
Floculator
Group 4
Drainage water
Clarificator
Group 1
Fiter
Fiter washing
Fiter media
Fitering
Disinfection
Distribution network
Reservoir & Water Transmission
Group 3


Steps for OJT activities
Group 1
Maintenance procedure of filter media
Monitoring & check procedure of filtere media
Operation procedure of filter washing
Refreshment procedure of filtere media
Operation procedures of filtering
Water quality monitoring & control procedure of filtered water
Group 2
Chemical dosing control procedure
Water quality monitoring & control procrdure for clarified water
Raw water quantity monitoring & control
Water quality monitoring & control procrdure for raw water
Monitering & maintenance of intake area
Water quality monitoring & control procrdure for intake
Group 3
Transmission water quantity monitoring & control
Water quality monitoring & control procrdure for transmission water
Maintenance procedure of clear water reservoir
Monitoring & control of transmission water quantity
Monitoring & control procedure of water level of clear water reservoir
Group 4
Monitoring & control procedure of Sludge drainage

Control of free residual chlorine in the water treatment plant

Ammonia is contained usually in canal water in Egypt. The combination of chlorine and ammonia produced inactive disinfection than chlorine alone. However, a combined chlorine and ammonia residual is not as effective as a free –chlorine residual. Free residual chlorine involves the application of chlorine to water to produce- -either directly or by first destroying any naturally present ammonia- - a free available chlorine residual and to maintain this residual chlorine through part or all of the water treatment plant and distribution system

Free available residual forms have higher oxidation potential than combined available chlorine forms and more effective as disinfectants. The absence of free available chlorine residual indicates the absence of satisfactory disinfectant. It is the responsibility of the water supplier to ensure that treatment plant is suitably equipped to maintain adequately disinfected water.

Related factors for free residual chlorine control are shown in following table.

Factor	Object water	Explanation
Free available residual chlorine of distribution water	Drinking water from WTP to the network	Control target of this free residual chlorine shall be defined based on residual chlorine consumption in the network. Residual chlorine criterion, that is more than 0.5 mg/l as free residual, shall be kept all the time at final and farthest tap in the network. In SHAPWASCO, control target range of free residual chlorine will be 1.5-2.0mg/l. Control target point of free residual chlorine will be changed according to situation of each plant such as length of network pipes. Control target of free residual chlorine will also be changed according to seasonal change of water quality.
Free residual chlorine of the water after post-chlorine dosing	Inlet water to clear water reservoir	Free residual chlorine of transmission water can be controlled by post-chlorine dosing into the filtered water. After post chlorine dosing free residual chlorine of process water cannot be controlled by facility. Free residual chlorine of transmission water will be estimated according to consumption amount of free residual chlorine in clear water reservoir.
Free residual chlorine of filtered water	Filtered water	Free residual chlorine of filtered water is related to free residual chlorine of clarified water and filter media condition. Free residual chlorine should be remained in filtered water to ensure avoiding growth of algae and bacteria.
Free residual chlorine of clarified water	Outlet water from sedimentation basin to filter	Free residual chlorine of clarified water is related to residual chlorine of filtered water and filter media condition. Free residual chlorine should be remained consumption amount or more in filter to ensure avoiding growth of algae and bacteria.
Break point value	Raw water	Free residual chlorine is formed by adding pre-chlorine beyond break point. Break point indicates chlorine demand amount for raw water.

Factor	Object water	Explanation
Pre-chlorine dosing	Raw water	Free residual chlorine of clarified water can be controlled by adjusting of pre-chlorine dosing rate according to estimation of consumption of free residual chlorine in coagulation and sedimentation process based on break point test results of raw water.
Post-chlorine dosing	Filtered water	Free residual chlorine of transmission water can be controlled by adjusting of post-chlorine dosing. free residual chlorine of process water cannot be controlled by facility after post chlorine dosing. Free residual chlorine of transmission water will be estimated according to consumption amount of free residual chlorine in clear water reservoir.

In Egypt, generally free residual chlorine is controlled by adjustment of pre-chlorine dosing rate and post chlorine dosing rate in water treatment plant.

Pre-chlorine dosing rate should be defined based on control target of free residual chlorine concentration of clarified water. And control target of free residual chlorine concentration of clarified water should be set based on following factors;

1) Chlorine demand for raw water (Measured value of break point)
2) Control target of free residual chlorine concentration of filtered water
3) Estimated consumption amount of free residual chlorine in sedimentation basin by evaporation

Post-chlorine dosing rate should be defined based on following factors;

1) Free residual chlorine concentration of filtered water
2) Control target of free residual chlorine concentration of transmission water

And each of above mention will be affected following factors+

Affect factors to 1)

1) Free residual concentration of clarified water
2) Estimated consumption amount of free residual chlorine concentration of through filter

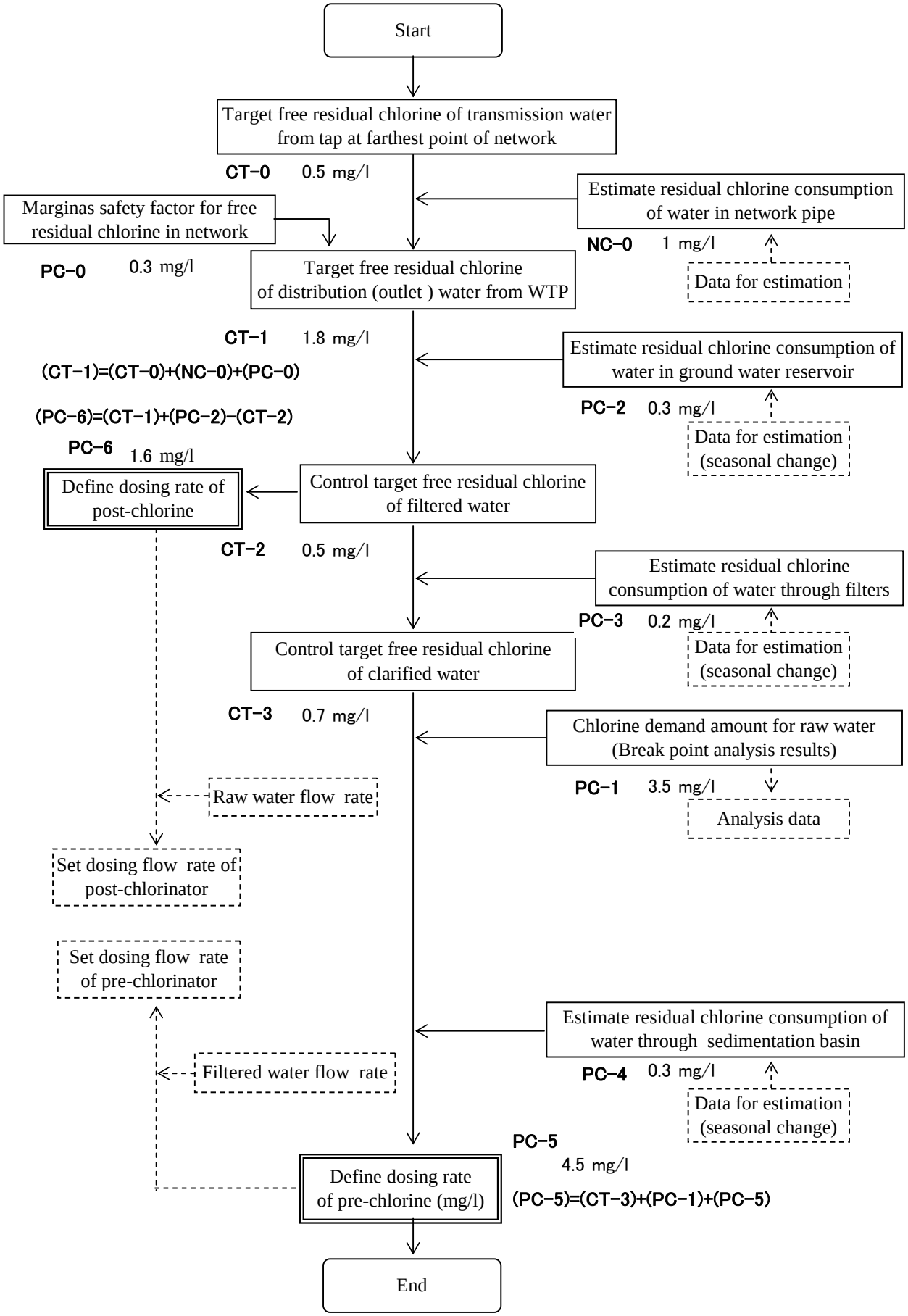
Affect factors to 2)

1) Consumption amount of free residual chlorine through clear water reservoir
2) Consumption amount of free residual chlorine through network pipes
3) Free residual chlorine concentration .of network water from farthest point tap of network

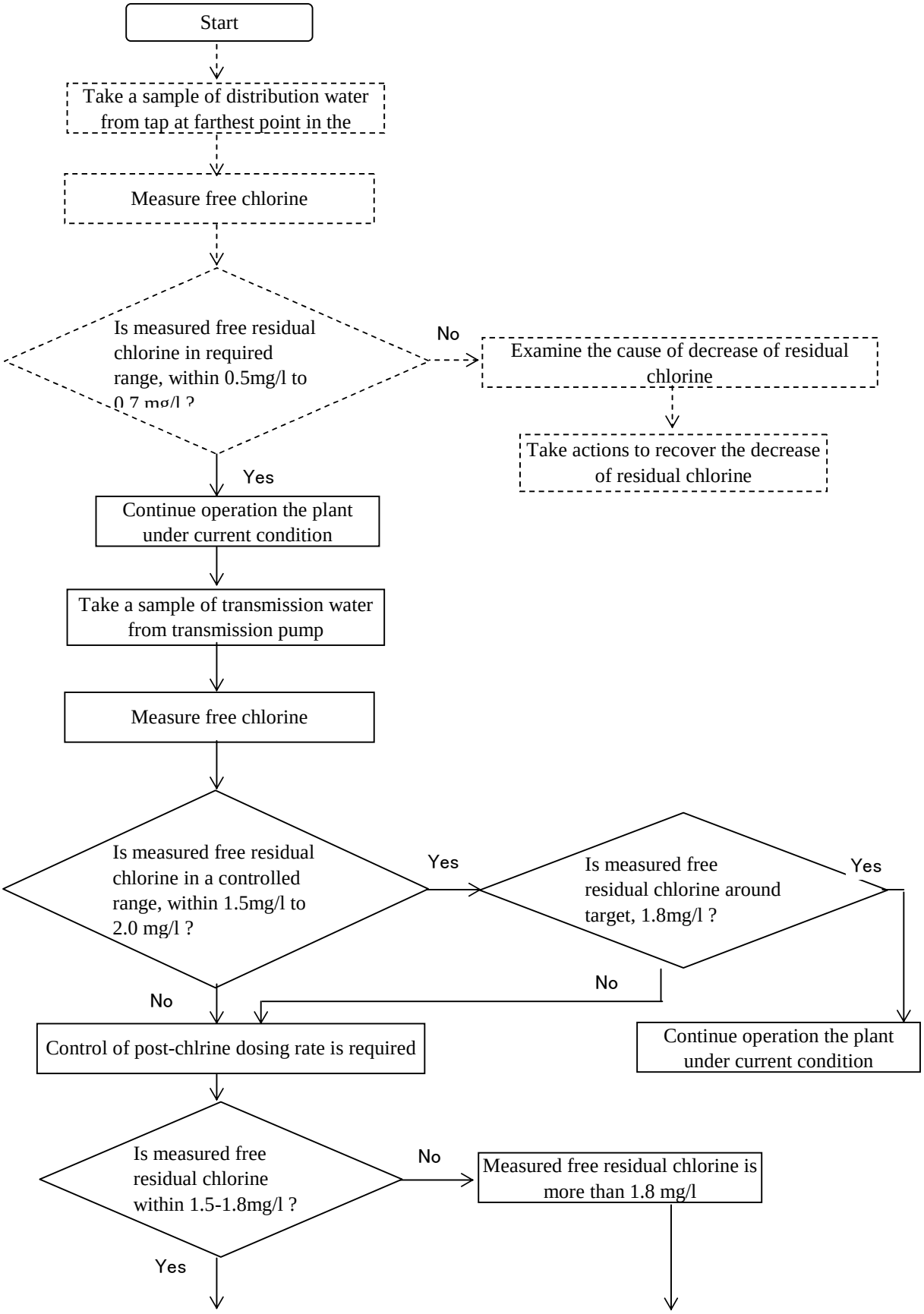
According to above mentions, procedures for setting of chlorine dosing rate and procedures for residual chlorine control are described as flow chart in following pages.

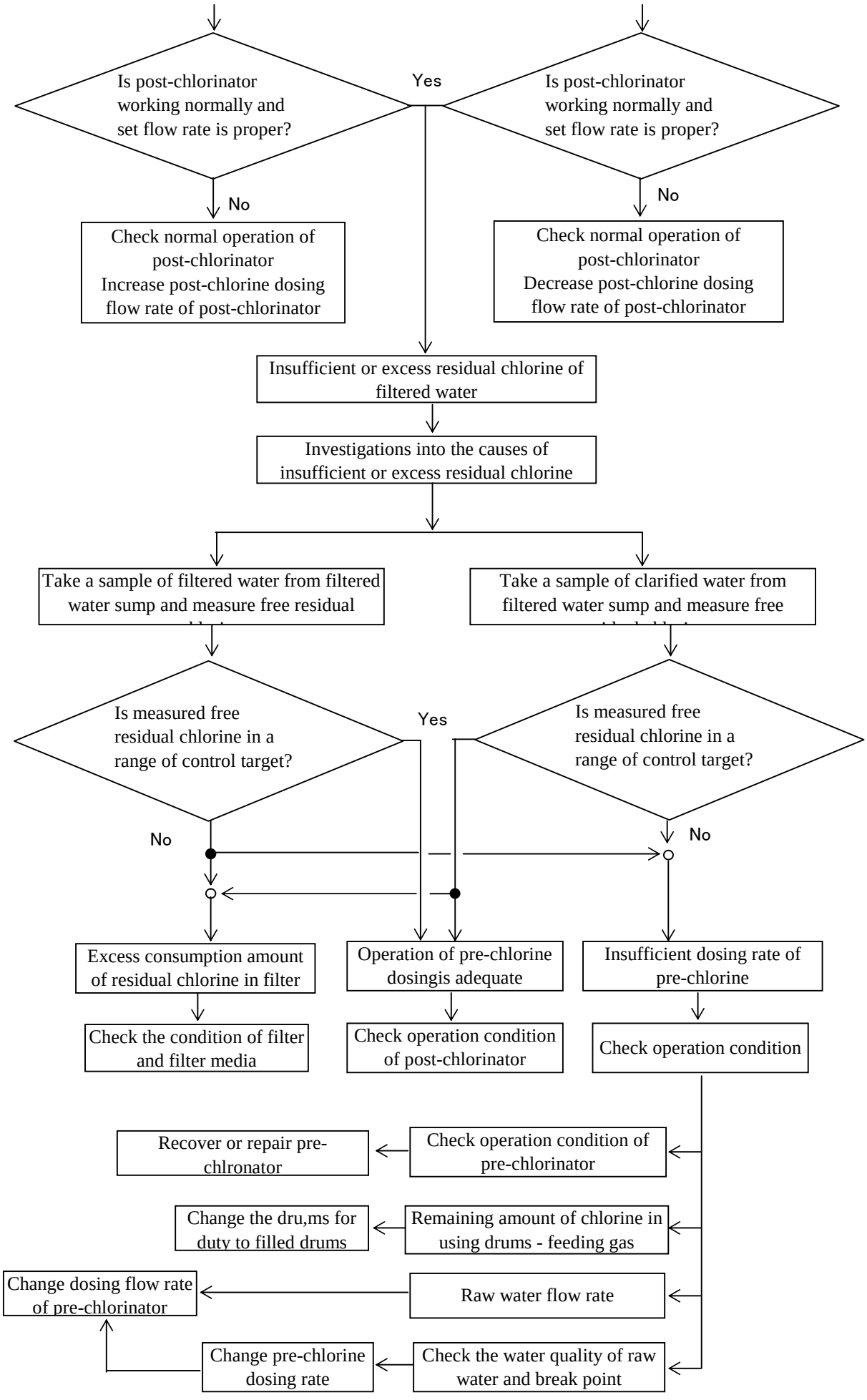
And explanation documents on break point also attached to this document.

Flow-1 Procedures for chlorine dosing rate setting in WTP



Flow-2　Procedures for residual chlorine control in water treatment plant




Is post-chlorinator working normally and set flow rate is proper?
Yes
Is post-chlorinator working normally and set flow rate is proper?
No
No
Check normal operation of post-chlorinator Increase post-chlorine dosing flow rate of post-chlorinator
Check normal operation of post-chlorinator Decrease post-chlorine dosing flow rate of post-chlorinator
Insufficient or excess residual chlorine of filtered water
Investigations into the causes of insufficient or excess residual chlorine
Take a sample of filtered water from filtered water sump and measure free residual
Take a sample of clarified water from filtered water sump and measure free
Is measured free residual chlorine in a range of control target?
Yes
Is measured free residual chlorine in a range of control target?
No
No
Excess consumption amount of residual chlorine in filter
Operation of pre-chlorine dosingis adequate
Insufficient dosing rate of pre-chlorine
Check the condition of filter and filter media
Check operation condition of post-chlorinator
Check operation condition
Recover or repair pre-chlronator
Check operation condition of pre-chlorinator
Change the dru,ms for duty to filled drums
Remaining amount of chlorine in using drums - feeding gas
Change dosing flow rate of pre-chlorinator
Raw water flow rate
Change pre-chlorine dosing rate
Check the water quality of raw water and break point

Criteria for residual chlorine control

Control target

CT-0 Control Target of free residual chlorine of distribution water from tap at farthest point of network
CT-1 Control target of free residual chlorine concentration of distribution water from WTP
CT-2 Control target of free residual chlorine concentration of filtered water
CT-3 Control target of free residual chlorine concentration of clarified water

Process condition

PC-0 Margine as safety factor for free residual chlorine in network
PC-1 Chlorine demand for raw water (Break point)
PC-2 Consumption amount of free residual chlorine in reservoir
PC-3 Consumption amount of free residual chlorine in filtering process
PC-4 Consumption amount of free residual chlorine in sedimentation
PC-5 Pre-chlorine dosing rate
PC-6 Post-chlorine dosing rate
PC-7 Time delay of appearance of chlorine dosing affect to filter water
PC-8 Time delay of appearance of chlorine dosing affect to clarified water
PC-9 Time delay of appearance of chlorine dosing affect to reservoir outlet water

Network condition

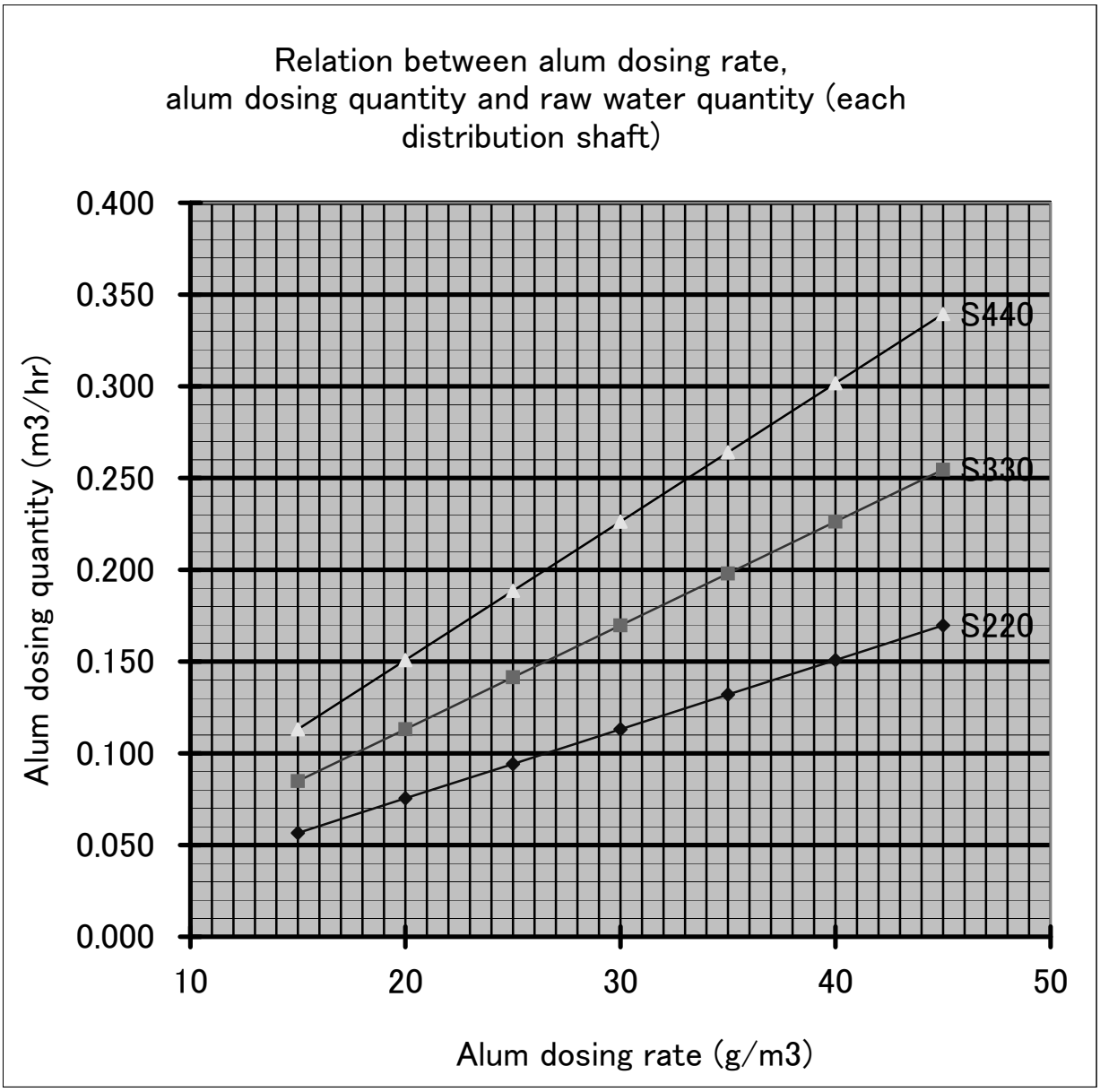
NC-0 Consumption amount of free residual chlorine in network

Alum dosing as 20 % diluted solution of LAS

Raw water flow rate	Q	l/sec	
Dosing rate of alum (as LAS)	A	g/m3	
Dosing flow rate of alum (as LAS)	S	l/hr	
Concentration of alum solution	c	%	20
Density of LAS	d	kg/l	1.05

S(m3/hr) = Q (l/sec) × 60 × 60 × 1/1000 × A (g/m3) × 1/d (kg/l) ×100/20 × 1/1000 × 1/1000

A	S220	S330	S440	S650	S700	S750	S800	S850	S900	S950	S1000
15	0.057	0.085	0.113	0.167	0.180	0.193	0.206	0.219	0.231	0.244	0.257
20	0.075	0.113	0.151	0.223	0.240	0.257	0.274	0.291	0.309	0.326	0.343
25	0.094	0.141	0.189	0.279	0.300	0.321	0.343	0.364	0.386	0.407	0.429
30	0.113	0.170	0.226	0.334	0.360	0.386	0.411	0.437	0.463	0.489	0.514
35	0.132	0.198	0.264	0.390	0.420	0.450	0.480	0.510	0.540	0.570	0.600
40	0.151	0.226	0.302	0.446	0.480	0.514	0.549	0.583	0.617	0.651	0.686
45	0.170	0.255	0.339	0.501	0.540	0.579	0.617	0.656	0.694	0.733	0.771

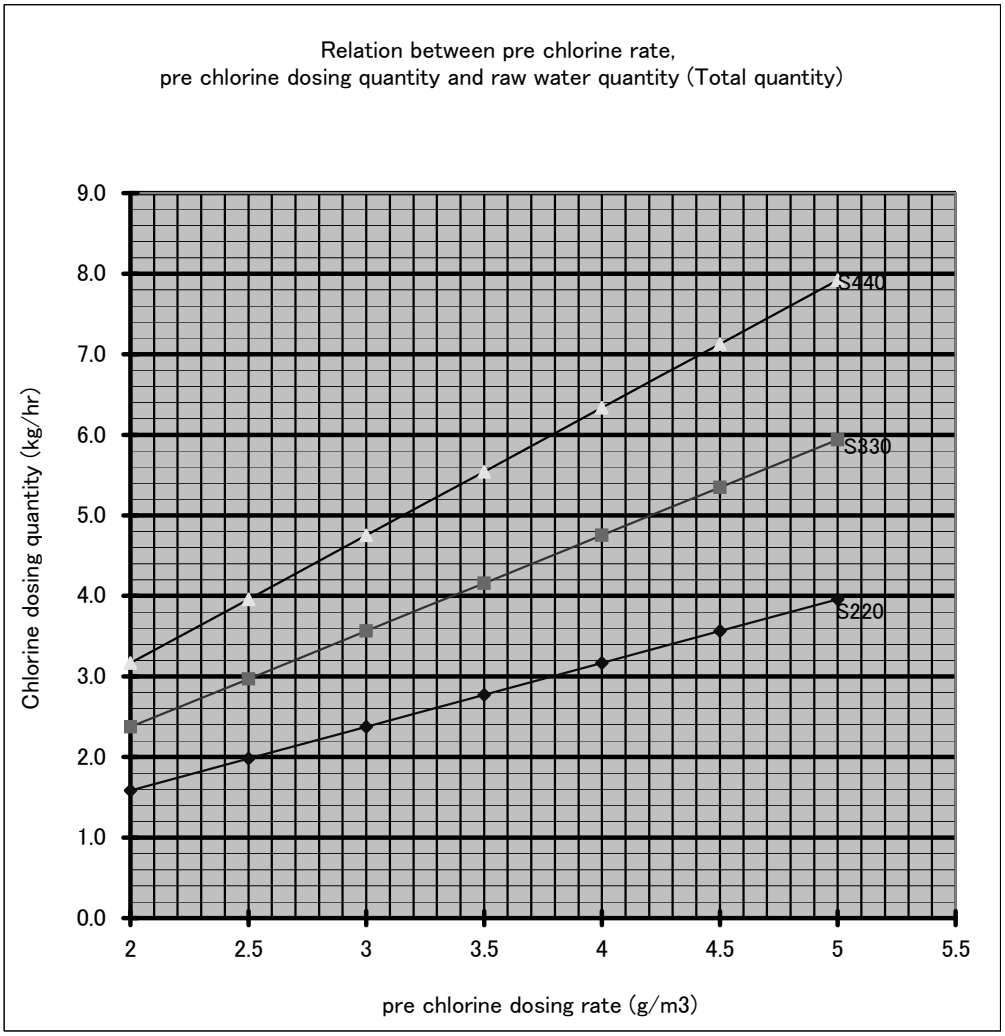


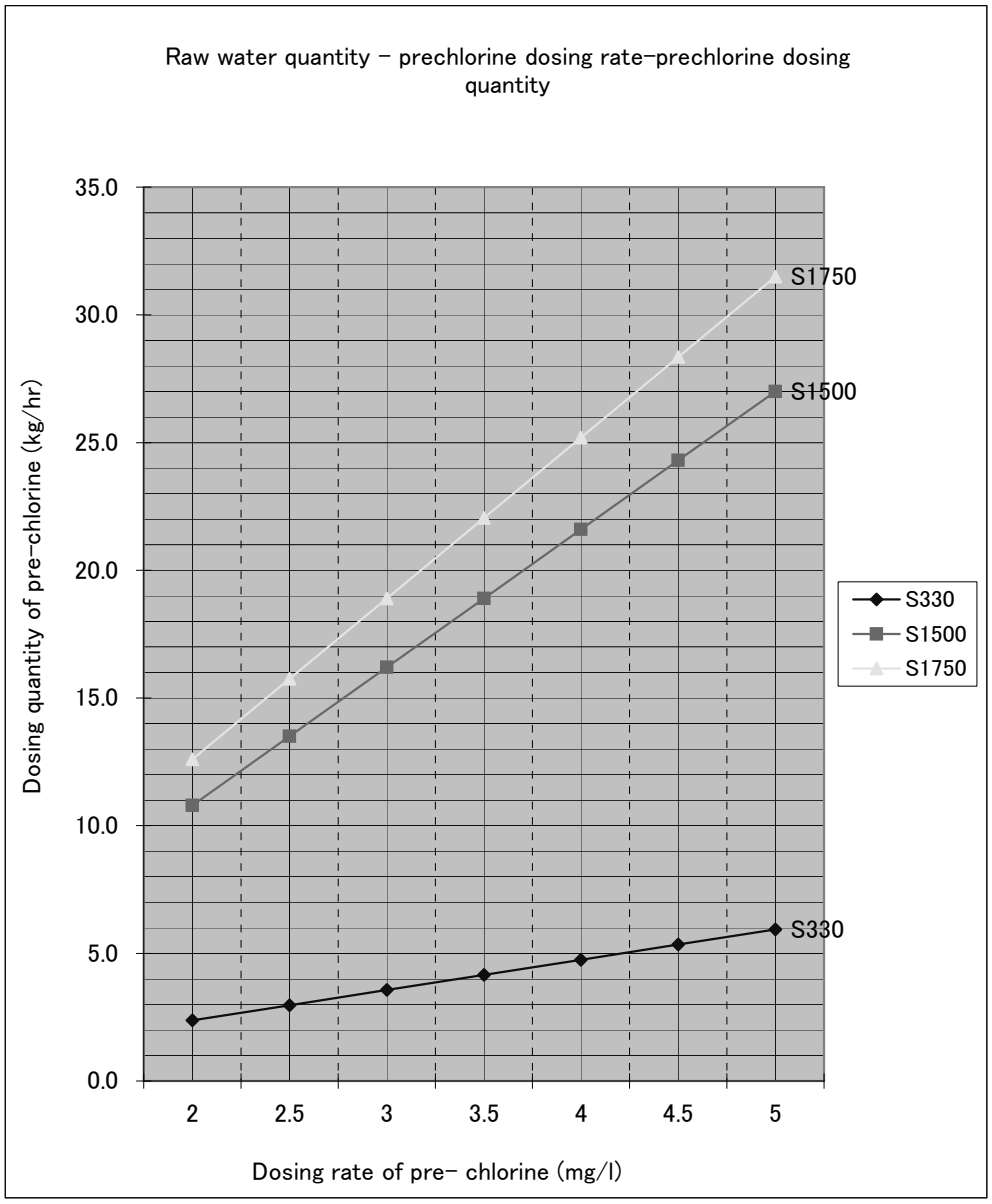
Pre-chlorine dosing

Raw water flow rate	Q	l/sec
Dosing rate of pre-chlorine	A	g/m3
Dosing flow rate of pre-chlorine	S	kg/hr

S(kg/hr) = Q (l/sec) × 60 × 60 × 1/1000 × A (g/m3) × 1/1000

	S220	S330	S440	S1400	S1500	S1550	S1600	S1650	S1700	S1750
2	1.6	2.4	3.2	10.1	10.8	11.2	11.5	11.9	12.2	12.6
2.5	2.0	3.0	4.0	12.6	13.5	14.0	14.4	14.9	15.3	15.8
3	2.4	3.6	4.8	15.1	16.2	16.7	17.3	17.8	18.4	18.9
3.5	2.8	4.2	5.5	17.6	18.9	19.5	20.2	20.8	21.4	22.1
4	3.2	4.8	6.3	20.2	21.6	22.3	23.0	23.8	24.5	25.2
4.5	3.6	5.3	7.1	22.7	24.3	25.1	25.9	26.7	27.5	28.4
5	4.0	5.9	7.9	25.2	27.0	27.9	28.8	29.7	30.6	31.5



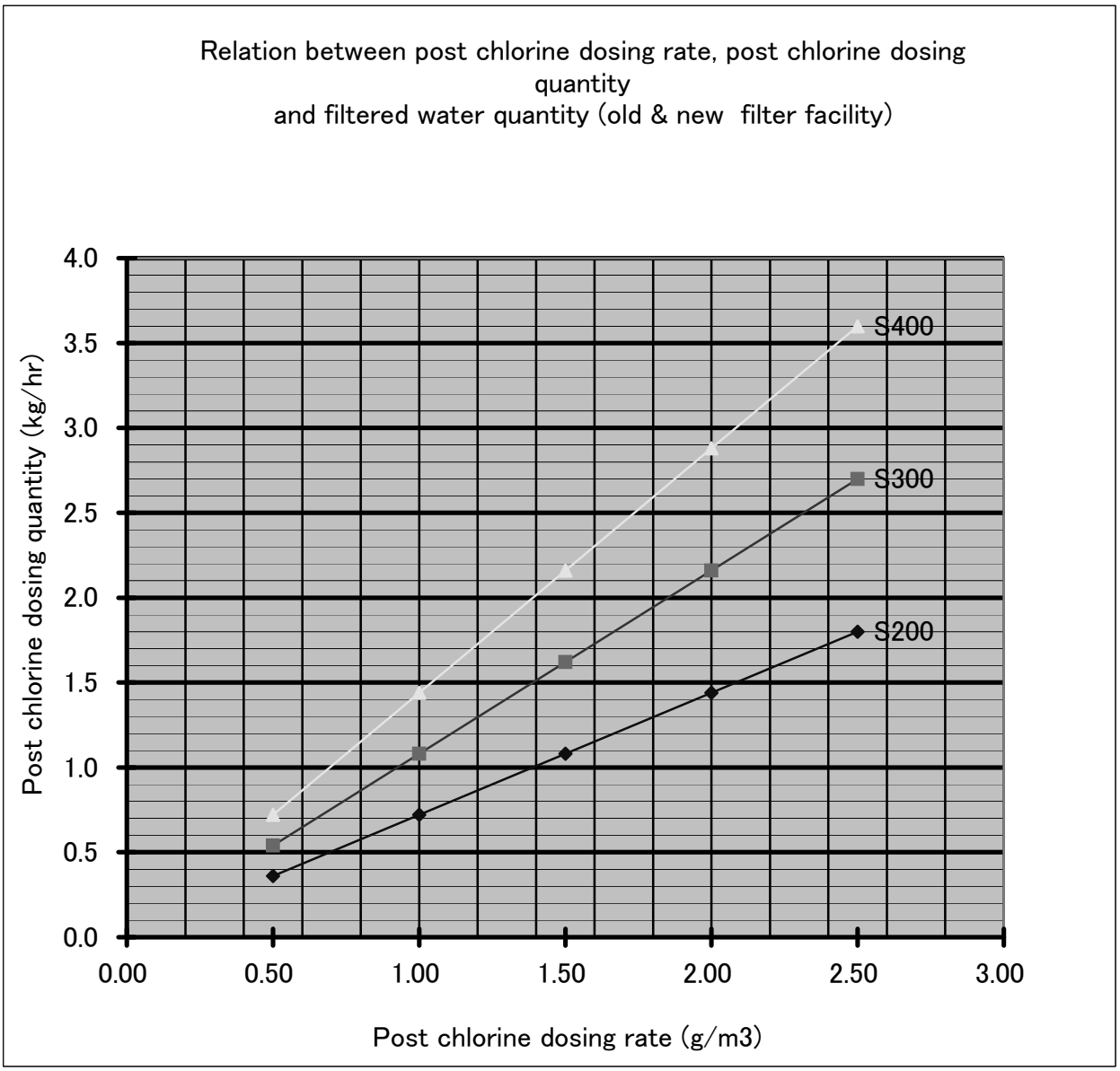

Raw water quantity – prechlorine dosing rate–prechlorine dosing quantity
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
Dosing quantity of pre–chlorine (kg/hr)
2
2.5
3
3.5
4
4.5
5
Dosing rate of pre– chlorine (mg/l)
S1750
S1500
S330
S330
S1500
S1750

Post chlorine dosing

Filltered water flow rate	S	l/sec
Dosing rate of post-chlorine	c	%
Dosing flow rate of pre-chlorine	d	kg/l

$$S(kg/hr) = Q\ (l/sec) \times 60 \times 60 \times 1/1000 \times A\ (g/m3) \times 1/1000$$

	S200	S300	S400	S650	S700	S750	S800	S850	S900	S950	S1000
0.50	0.4	0.5	0.7	1.2	1.3	1.35	1.44	1.53	1.62	1.71	1.80
1.00	0.7	1.1	1.4	2.3	2.5	2.70	2.88	3.06	3.24	3.42	3.60
1.50	1.1	1.6	2.2	3.5	3.8	4.05	4.32	4.59	4.86	5.13	5.40
2.00	1.4	2.2	2.9	4.7	5.0	5.40	5.76	6.12	6.48	6.84	7.20
2.50	1.8	2.7	3.6	5.9	6.3	6.75	7.20	7.65	8.10	8.55	9.00

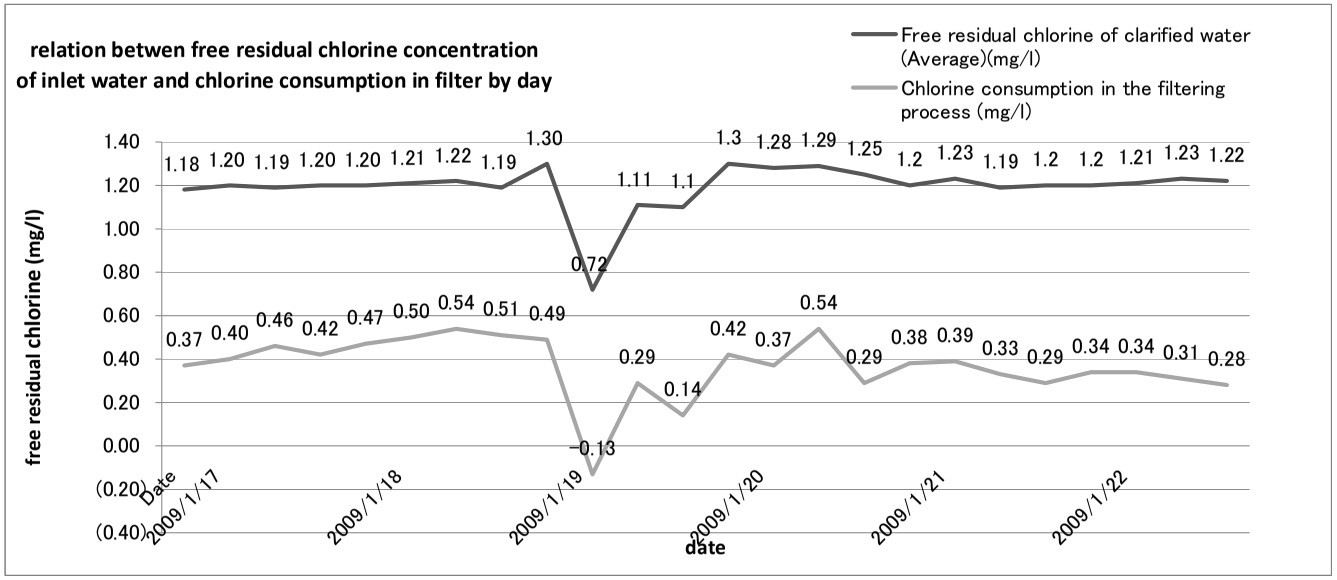


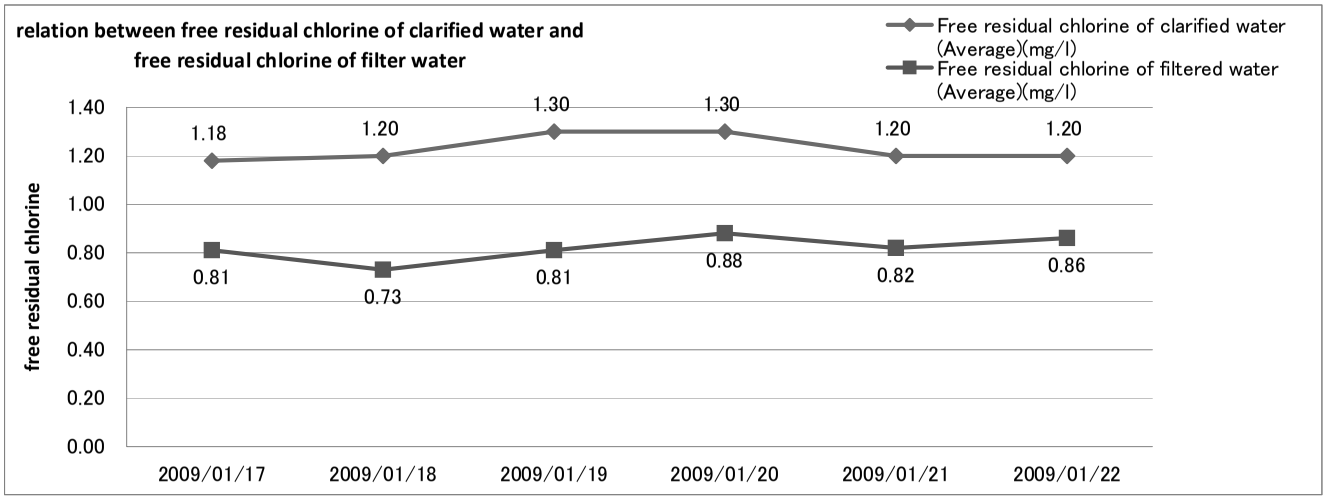
RECORD IN ZAGAZIG WTP

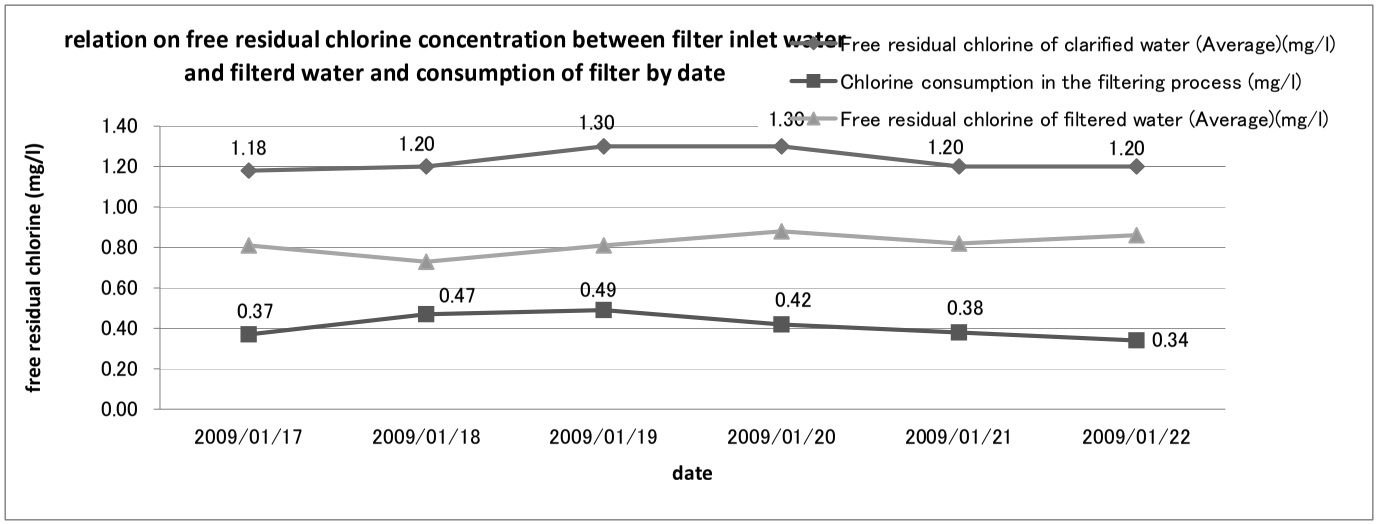
ChLorine , Raw Water and Treated Water Production JAN 2009

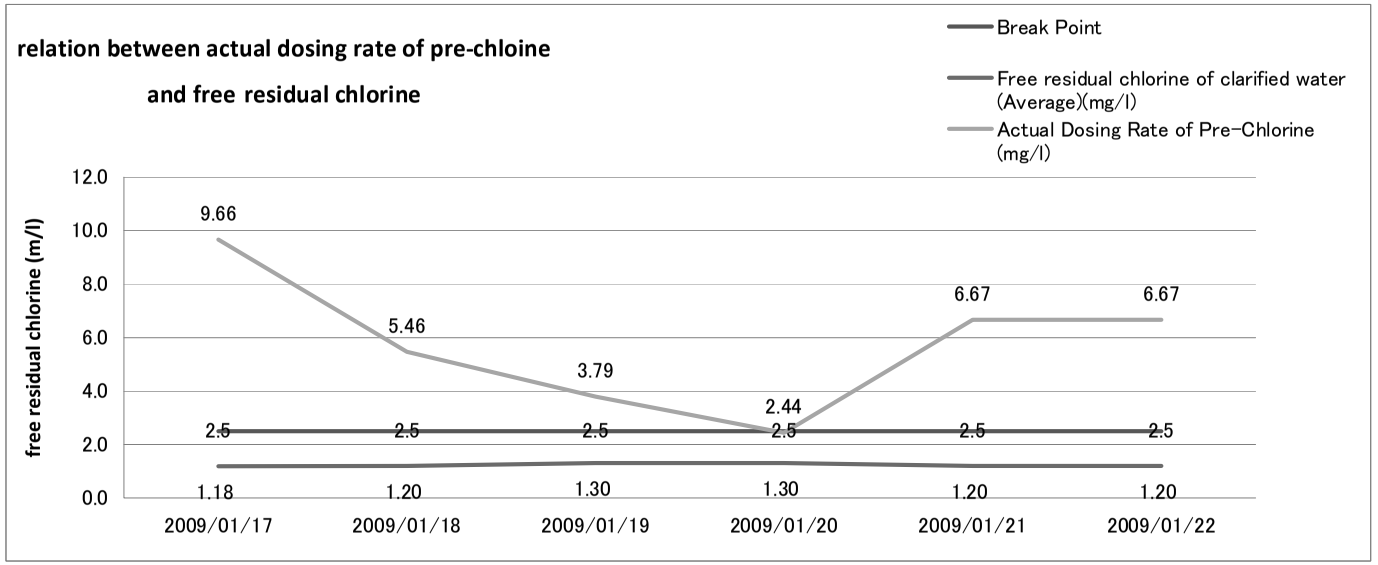
Date	Time	Break Point	Pre-chlorine Dosing (mg/l)	Post	Raw Water Quantity (lit/sec.)	Treated Water Quantity (lit/sec.)	Pre-chlorine Dosing Quantity (kg/hr.)	Free residual chlorine of clarified water (Average)(mg/l)	Free residual chlorine of filtered water (Average)(mg/l)	Post chlorine Dosing Quantity (kg/hr.)	Free Residual Chlorine of Transmission water at Plant
2009/1/17	9:00:00	2.5	3.5	1.0	230	240	8	1.18	0.81	1.5	1.8
	11:00:00	2.5	3.5	1.0	455	430	6	1.20	0.80	1.2	1.7
	13:00:00	2.5	3.5	1.0	445	400	8	1.19	0.73	1.9	1.75
	15:00:00	2.5	3.5	1.0	470	400	8	1.20	0.78	1.9	1.76
2009/1/18	9:00:00	2.5	3.5	1.0	305	430	6	1.20	0.73	1.3	1.73
	11:00:00	2.5	3.5	1.0	525	430	6	1.21	0.71	1.7	1.7
	13:00:00	2.5	3.5	1.0	520	425	9	1.22	0.68	3.6	1.72
	15:00:00	2.5	3.5	1.0	520	425	9	1.19	0.68	3.6	1.8
2009/1/19	9:00:00	2.5	3.5	1.0	440	410	6	1.30	0.81	1.5	1.8
	11:00:00	2.5	3.5	1.0	440	435	6	0.72	0.85	1.5	1.7
	13:00:00	2.5	3.5	1.0	440	409	6	1.11	0.82	1.5	1.72
	15:00:00	2.5	3.5	1.0	440	410	6	1.1	0.96	1.5	1.9
2009/1/20	17:00:00	2.5	3.5	1.0	235	180	8	1.3	0.88	1.3	1.9
	19:00:00	2.5	3.5	1.0	435	420	8	1.28	0.91	2.8	1.87
	21:00:00	2.5	3.5	1.0	440	410	8	1.29	0.75	2.8	1.8
	23:00:00	2.5	3.5	1.0	475	415	8	1.25	0.96	2.6	2
2009/1/21	1:00:00	2.5	3.5	1.0	455	190	4	1.2	0.82	1.6	1.9
	3:00:00	2.5	3.5	1.0	460	405	8	1.23	0.84	1.9	1.86
	5:00:00	2.5	3.5	1.0	455	410	10	1.19	0.86	1.4	187
	7:00:00	2.5	3.5	1.0	430	410	10	1.2	0.91	1.4	1.9
2009/1/22	9:00:00	2.5	3.5	1.0	250	450	6	1.2	0.86	1.7	1.9
	11:00:00	2.5	3.5	1.0	445	450	11	1.21	0.87	3.7	1.93
	13:00:00	2.5	3.5	1.0	445	450	9	1.23	0.92	2.4	1.95
	15:00:00	2.5	3.5	1.0	410	420	8	1.22	0.94	2.8	2
2009/1/23	9:00:00				220	220	6			1.7	
	11:00:00				420	415	10			1.8	
	13:00:00				410	405	10			1.8	
	15:00:00				400	395	10			1.8	

Date	Chlorine consumption in the filtering process (mg/l)	Actual Dosing Rate of Pre-Chlorine (mg/l)	Chlorine consumption in the caogulation and sedimentation	Actual Dosing Rate of Post-Chlorine (mg/l)
23-Dec-08	0.37	9.66	8.48	1.74
	0.40	3.66	2.46	0.78
	0.46	4.99	3.80	1.32
	0.42	4.73	3.53	1.32
24-Dec-08	0.47	5.46	4.26	0.84
	0.50	3.17	1.96	1.10
	0.54	4.81	3.59	2.35
	0.51	4.81	3.62	2.35
25-Dec-08	0.49	3.79	2.49	1.02
	-0.13	3.79	3.07	0.96
	0.29	3.79	2.68	1.02
	0.14	3.79	2.69	1.02
26-Dec-08	0.42	2.44	1.14	1.90
	0.37	4.83	3.55	1.92
	0.54	6.11	4.82	1.90
	0.29	6.46	5.21	1.76
27-Dec-08	0.38	6.67	5.47	0.99
	0.39	6.87	5.64	1.17
	0.33	5.62	4.43	0.86
	0.29	5.42	4.22	0.93
28-Dec-08	0.34	6.67	5.47	1.05
	0.34	6.87	5.66	2.28
	0.31	5.62	4.39	1.48
	0.28	5.42	4.20	1.85


relation betwen free residual chlorine concentration of inlet water and chlorine consumption in filter by day
Free residual chlorine of clarified water (Average)(mg/l)
Chlorine consumption in the filtering process (mg/l)
free residual chlorine (mg/l)
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
(0.20)
(0.40)
1.18 1.20 1.19 1.20 1.20 1.21 1.22 1.19 1.30 0.72 1.11 1.1 1.3 1.28 1.29 1.25 1.2 1.23 1.19 1.2 1.2 1.21 1.23 1.22
0.37 0.40 0.46 0.42 0.47 0.50 0.54 0.51 0.49 -0.13 0.29 0.14 0.42 0.37 0.54 0.29 0.38 0.39 0.33 0.29 0.34 0.34 0.31 0.28
Date
2009/1/17
2009/1/18
2009/1/19
2009/1/20
2009/1/21
2009/1/22
date


relation between free residual chlorine of clarified water and free residual chlorine of filter water
Free residual chlorine of clarified water (Average)(mg/l)
Free residual chlorine of filtered water (Average)(mg/l)
free residual chlorine
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
1.18 1.20 1.30 1.30 1.20 1.20
0.81 0.73 0.81 0.88 0.82 0.86
2009/01/17
2009/01/18
2009/01/19
2009/01/20
2009/01/21
2009/01/22

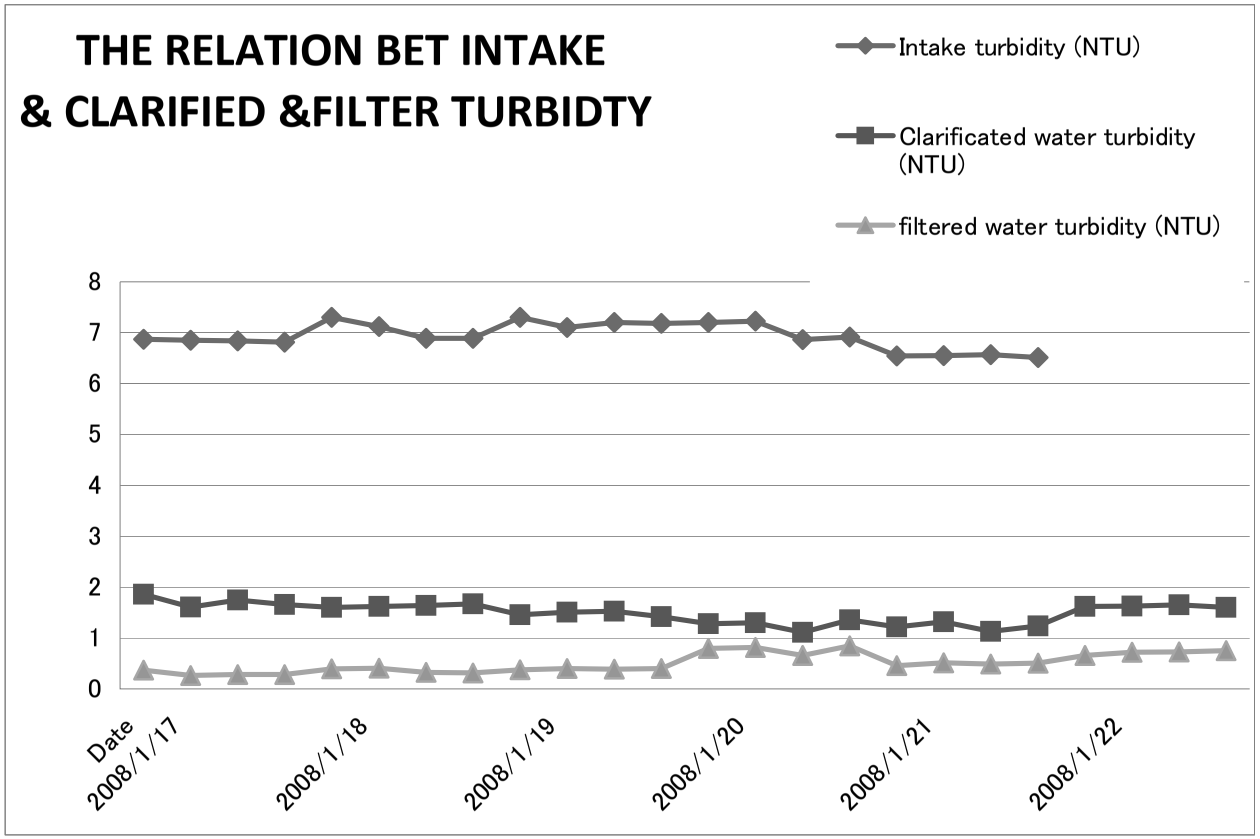

relation on free residual chlorine concentration between filter inlet water and filterd water and consumption of filter by date
Free residual chlorine of clarified water (Average)(mg/l)
Chlorine consumption in the filtering process (mg/l)
Free residual chlorine of filtered water (Average)(mg/l)
free residual chlorine (mg/l)
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
1.18
1.20
1.30
1.30
1.20
1.20
0.37
0.47
0.49
0.42
0.38
0.34
2009/01/17
2009/01/18
2009/01/19
2009/01/20
2009/01/21
2009/01/22
date


relation between actual dosing rate of pre-chloine and free residual chlorine
Break Point
Free residual chlorine of clarified water (Average)(mg/l)
Actual Dosing Rate of Pre-Chlorine (mg/l)
free residual chlorine (m/l)
12.0
10.0
8.0
6.0
4.0
2.0
0.0
9.66
5.46
3.79
2.44
6.67
6.67
2.5
2.5
2.5
2.5
2.5
2.5
1.18
1.20
1.30
1.30
1.20
1.20
2009/01/17
2009/01/18
2009/01/19
2009/01/20
2009/01/21
2009/01/22

RECORD IN ZAGAZIG WTP

Alum&turbidity , Raw Water and Treated Water Production in JAN 2009

Date	Time	Raw Water Quantity (lit/sec.)	Treated Water Quantity (lit/sec.)	liquid Alum dosing rate (mg/l)	Alum dosing quantity (l/hr)	Intake turbidity (NTU)	Clarificated water turbidity (NTU)	filtered water turbidity (NTU)	Transmassio n water turbidity (NTU)
2008/1/17	9:00:00	230	220	26	1.2	7	1.86	0.372	0.342
	11:00:00	455	230	26	1.2	7	1.61	0.267	0.298
	13:00:00	445	400	26	2	7	1.75	0.281	0.318
	15:00:00	470	400	26	2	7	1.66	0.285	0.364
2008/1/18	9:00:00	305	240	26	0.9	6.87	1.6	0.396	0.325
	11:00:00	525	450	26	2.1	6.85	1.62	0.41	0.348
	13:00:00	520	390	26	2.1	6.84	1.64	0.324	0.352
	15:00:00	520	420	26	2	6.81	1.67	0.316	0.319
2008/1/19	9:00:00	440	215	26	2	7.3	1.46	0.38	0.31
	11:00:00	440	215	26	2	7.12	1.51	0.4	0.36
	13:00:00	440	215	26	2	6.89	1.53	0.39	0.28
	15:00:00	440,235	215	26	2	6.89	1.42	0.4	0.321
2008/1/20	9:00:00	235	245	26	0.9	7.3	1.28	0.8	0.38
	11:00:00	435	415	26	2	7.1	1.3	0.82	0.36
	13:00:00	440	420	26	2	7.2	1.11	0.66	0.31
	15:00:00	475	415	26	2.1	7.18	1.36	0.85	0.46
2008/1/21	9:00:00	455	405	26	2.1	7.2	1.22	0.458	0.362
	11:00:00	460	405	26	2.1	7.23	1.32	0.516	0.389
	13:00:00	455	395	26	2.1	6.86	1.13	0.493	0.364
	15:00:00	430	400	26	1.9	6.91	1.24	0.512	0.4
2008/1/22	9:00:00	250	250	26	1	6.54	1.62	0.663	0.751
	11:00:00	445	440	26	2	6.55	1.63	0.721	0.764
	13:00:00	445	415	26	2	6.57	1.65	0.732	0.782
	15:00:00	410	375	26	1.18	6.51	1.6	0.756	0.781
2008/1/24	9:00:00	220	220		0.9				
	11:00:00	420	415		2.1				
	13:00:00	410	405		2.14				
	15:00:00	400	390		2				

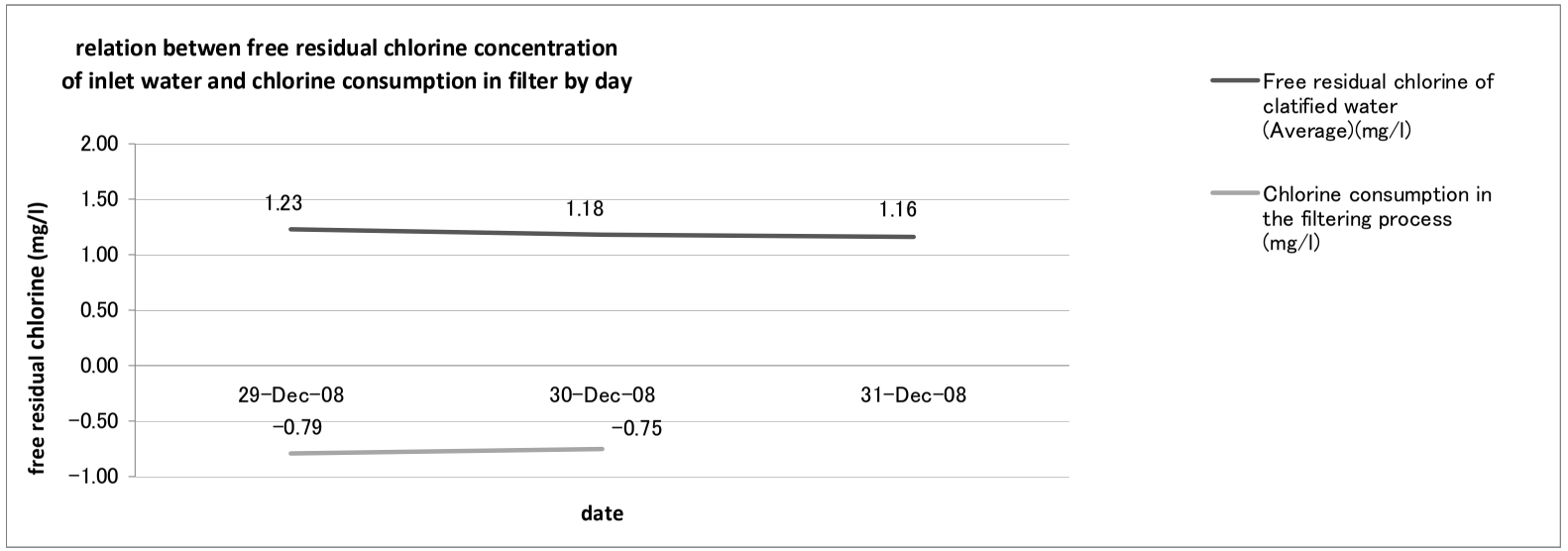

THE RELATION BET INTAKE
& CLARIFIED &FILTER TURBIDTY
Intake turbidity (NTU)
Clarificated water turbidity (NTU)
filtered water turbidity (NTU)
8
7
6
5
4
3
2
1
0
Date
2008/1/17
2008/1/18
2008/1/19
2008/1/20
2008/1/21
2008/1/22

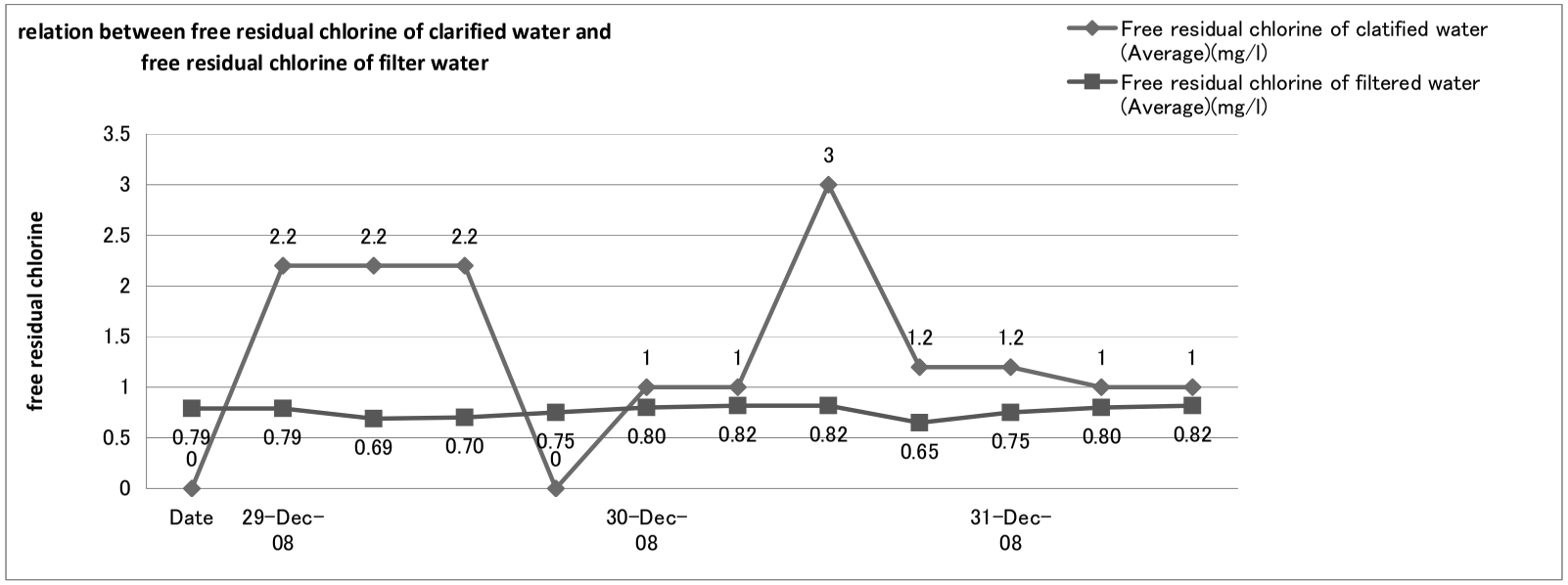
RECORD IN ZAGAZIG WTP

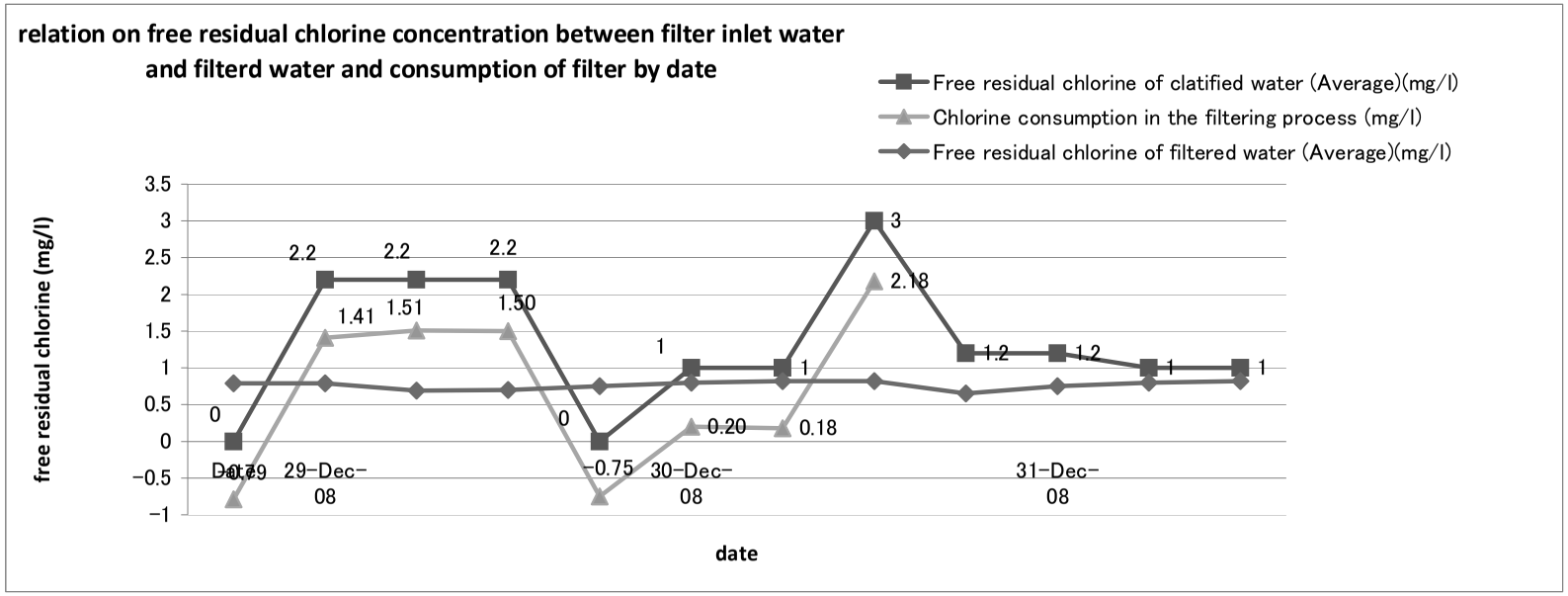
Alum&turbidity , Raw Water and Treated Water Production IN DEC 2008

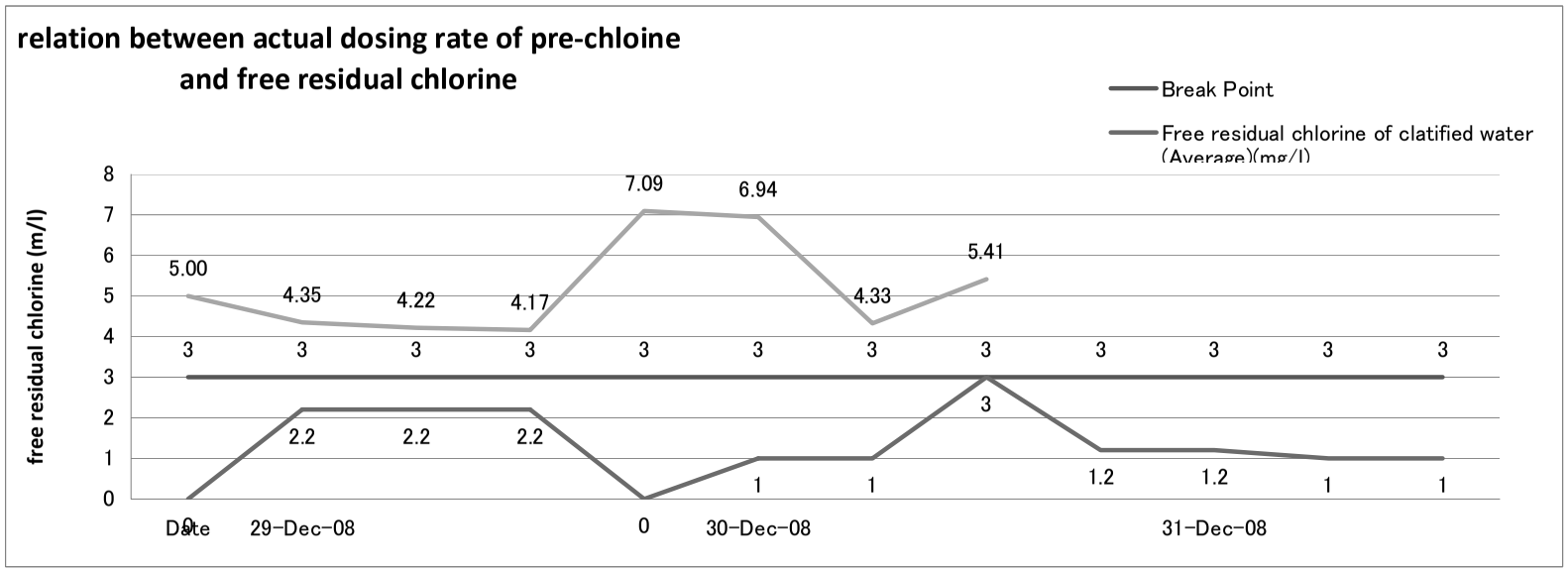
Date	Time	Break Point	Pre-chlorine Dosing (mg/l)	Post	Raw Water Quantity (lit/sec.)	Treated Water Quantity (lit/sec.)	Pre-chlorine Dosing Quantity (kg/hr.)	Free residual chlorine of clatified water (Average)(mg/l)	Free residual chlorine of filtered water (Average)(mg/l)	Post chlorine Dosing Quantity (kg/hr.)	Free Residual Chlorine of Transmission water at Plant
29-Dec-08	9:00:00	3	4	1.0	250	260	4.5	1.23	0.79	0	1.7
	11:00:00	3	4	1.0	415	410	6.5	1.22	0.79	2.2	1.7
	13:00:00	3	4	1.0	395	365	6	1.22	0.69	2.2	1.6
	15:00:00	3	4	1.0	400	380	6	1.21	0.70	2.2	1.65
30-Dec-08	9:00:00	3	4	1.0	235	266	6	1.18	0.75	0	1.65
	11:00:00	3	4	1.0	240	230	6	1.12	0.80	1	1.7
	13:00:00	3	4	1.0	385	355	6	1.19	0.82	1	1.7
	15:00:00	3	4	1.0	385	345	7.5	1.19	0.82	3	1.7
31-Dec-08	9:00:00	3	4	1.0	385	315	6	1.16	0.65	1.2	1.6
	11:00:00	3	4	1.0	385	315	6	1.18	0.75	1.2	1.68
	13:00:00	3	4	1.0	380	380	6	1.2	0.80	1	1.7
	15:00:00	3	4	1.0	380	350	6	1.21	0.82	1	1.70

Date	Chlorine consumption in the filtering process (mg/l)	Actual Dosing Rate of Pre-Chlorine (mg/l)	Chlorine consumption in the caogulation and sedimentation process (mg/l)	Actual Dosing Rate of Post-Chlorine (mg/l)
29-Dec-08	-0.79	5.00	5.00	0.00
	1.41	4.35	2.15	1.49
30-Dec-08	1.51	4.22	2.02	1.67
	1.50	4.17	1.97	1.61
31-Dec-08	-0.75	7.09	7.09	0.00
	0.20	6.94	5.94	1.21
04-Dec-08	0.18	4.33	3.33	0.78
	2.18	5.41	2.41	2.42


relation betwen free residual chlorine concentration
of inlet water and chlorine consumption in filter by day
free residual chlorine (mg/l)
2.00
1.50
1.00
0.50
0.00
-0.50
-1.00
1.23
1.18
1.16
-0.79
-0.75
29-Dec-08
30-Dec-08
31-Dec-08
date
Free residual chlorine of clatified water (Average)(mg/l)
Chlorine consumption in the filtering process (mg/l)


relation between free residual chlorine of clarified water and
free residual chlorine of filter water
free residual chlorine
3.5
3
2.5
2
1.5
1
0.5
0
Free residual chlorine of clatified water (Average)(mg/l)
Free residual chlorine of filtered water (Average)(mg/l)
0
2.2
2.2
2.2
0
1
1
3
1.2
1.2
1
1
0.79
0.79
0.69
0.70
0.75
0.80
0.82
0.82
0.65
0.75
0.80
0.82
Date
29-Dec-08
30-Dec-08
31-Dec-08


relation on free residual chlorine concentration between filter inlet water and filterd water and consumption of filter by date
Free residual chlorine of clatified water (Average)(mg/l)
Chlorine consumption in the filtering process (mg/l)
Free residual chlorine of filtered water (Average)(mg/l)
free residual chlorine (mg/l)
3.5
3
2.5
2
1.5
1
0.5
0
−0.5
−1
2.2
2.2
2.2
1.41
1.51
1.50
0
0
−0.75
1
1
3
2.18
0.20
0.18
1.2
1.2
1
1
0
Date
29-Dec-08
30-Dec-08
31-Dec-08
date


relation between actual dosing rate of pre-chloine and free residual chlorine
Break Point
Free residual chlorine of clatified water (Average)(mg/l)
free residual chlorine (m/l)
8
7
6
5
4
3
2
1
0
5.00
4.35
4.22
4.17
7.09
6.94
4.33
5.41
3
3
3
3
3
3
3
3
3
3
3
3
2.2
2.2
2.2
0
1
1
3
1.2
1.2
1
1
0
Date
29-Dec-08
30-Dec-08
31-Dec-08

RECORD IN ZAGAZIG WTP									
Alum&turbidity , Raw Water and Treated Water Production IN DEC 2008									
Date	Time	Raw Water Quantity (lit/sec.)	Treated Water Quantity (lit/sec.)	liquid Alum dosing rate (mg/l)	Alum dosing quantity (l/hr)	Intake turbidity (NTU)	Clarificated water turbidity (NTU)	filtered water turbidity (NTU)	Transmassion water turbidity (NTU)
29-Dec-08	9:00:00 AM	250	260	25	1	10.8	1.35	0.65	0.3
	11:00:00 AM	415	410	25	1.9	10.5	1.34	0.6	0.29
	1:00:00 PM	395	365	25	1.7	10.5	1.32	0.6	0.29
	3:00:00 PM	400	380	25	1.6	10.8	1.31	0.53	0.28
30-Dec-08	9:00:00 AM	235	266	25	1.5	6.9	1.42	0.4	0.281
	11:00:00 AM	240	230	25	1.2	6.66	1.4	0.38	0.28
	1:00:00 PM	385	355	25	1.4	6.65	1.38	0.38	0.276
	3:00:00 PM	385	345	25	1.4	6.64	1.38	0.36	0.27
31-Dec-08	9:00:00 AM	385	315	25	1.6	6.8	1.45	0.53	0.3
	11:00:00 AM	385	315	25	1.6	7.1	1.42	0.5	0.32
	1:00:00 PM	380	380	25	1.5	7.1	1.4	0.48	0.3
	3:00:00 PM	380	350	25	1.5	7.11	1.38	0.45	0.3