Appendix B-3

Result of Concrete Neutralization Test

APPENDIX B-3 Result of Concrete Neutralization Test

B.3.1 Object of test

1) To understand the current status of the concrete of the facilities in the STP
2) To evaluate the durability and remaining life of the facilities
3) To clarify the necessity of the rehabilitation of the facilities

B.3.2 Facilities subject to the test

Table B.3.1 shows selected 9 facilities and the 10 points for the test. The facilities are the principle treatment unit process in the STP.

B.3.3 Method for the test and analysis

1) After the chipping the surface concrete, 1% phenolphthalein solution is splayed on the surface of the chipped concrete.
2) The depth from the surface to the boundary of the red discoloration is measured as layer of concrete neutralization
3) From the equation of time passed and neutralization depth shown below, co-efficient of neutralization (a) for each point of the facility is found by application of specific value of the depth (mm) and years after construction. With substituting the co-efficient (a) and concrete cover depth on the reinforcement in said equation, remaining durable life (t) is calculated.

$$h=a\times\sqrt{t}$$

h: neutralization depth
a: co-efficient
t: years after construction

B.3.4 Condition of examination

1) Concrete cover depth is assumed to be 40 mm from Snip

2) Years after construction is shown in the Table. A part of the facilities got the rehabilitation work in the past. (1998)

B.3.4 Result

1) Depth of neutralization is approximately 15mm averagely. Max is 45mm of digestion tank, while minimum is 6 mm of tanks in the outside.
2) Remaining life were calculated to be from 4 ~ 11 years. The value of 128.44, 503.75 years shall be neglected as incorrect. It means only they have sound concrete cover. Also the value of 0 years shall be neglected because its structure is brick wall as confirmed at the site.
3) Concrete condition is generally not good revealing lack of material and construction quality control.

B.3.5 Plan of rehabilitation in this project

1) Needs

From the test and observation, rehabilitation of concrete surface is urgently requested to prolong their life.

2) Rehabilitation extent

The neutralization has not reached to the reinforcement yet. Therefore surface rehabilitation is considered to be effective for rehabilitation.

3) Procedure

After surface chipping or blasted by water jet until reinforcement, the surface shall be treated by epoxy solution as a primer. No shrinking mortar shall be used for new concrete cover by plastering. This work shall be conducted under moderate climate to keep the quality of the concrete.

Table B-3-1 Concrete Neutralization Examination

No.	Facility	Location of inspection point	Observation	Period of operation (years)	Concrete cover (mm)	Depth of neutralization (mm)	Coefficient " a"	Remaining life
1	Inlet Chamber	Inside the cover (observation only)	Dirt, rust, humidity.	36	40	-	-	-
2	Inlet Pump Station	Internal wall of screen room	Chalking was confirmed on the surface broadly.	36	40	30	5	4
3	-ditto	External superstructure wall	Brick inside the finish mortar	36	40	40	6.7	0
4	Grit Chamber	External wall of channel	Calcification. Cracks.	36	40	30	5	4
5	Primary Sedimentation	Outer wall of tank	Dirt. (1998, rehabilitation made)	4	40	6	3	128.44
6	Aeration Tank	Wall of tank	Dirt. (1998, rehabilitation made)	4	40	15	7.5	11.11
7	Secondary Sedimentation	Outer wall of tank	Dirt. (1998, rehabilitation made)	4	40	6	3	128.44
8	Distribution Chamber	External wall of chamber	Dirt. (1998, rehabilitation made)	4	40	35	17.5	0.08
9	Sludge Thickener	Outer wall of tank	Dirt. (1998, rehabilitation made)	4	40	6	3	128.44
10	Digestion tank	External wall of tank	Dirt. (1998, rehabilitation made)	4	550	45	22.5	503.75
Average						13.9		

Notes

1) In 1998, rehabilitation was made for the part of facilities.
2) Depth of concrete cover follows the statement of SNIP(40mm cover). No specification on the drawing is confirmed.
3) Depth of concrete is investigated on the site by phenolphthalein method.
4) Outer cover (Brick wall) of the digestion tank is 500mm from the drawing. Inner structure is RC with thickness of 500mm.
5) Wall of super structure of pumping station is brick made finished by 10mm thick mortar surface.

Table B-3-2 Evaluation of rehabilitation need

No.	Facility	Remaining life	Description	Need for rehabilitation	Rehabilitation rank
1	Inlet Chamber	-	Test was not conducted because of safety measure, however from the observation condition of structure is deteriorated.	Necessary as soon as possible	Surface repairing
2	Inlet Pump Station screen room wall	4	From the chalking of the wall, urgent rehabilitation is necessary.	Necessary as soon as possible	Surface repairing
3	Inlet Pump Station superstructure wall	0	All the depth is already neutralizd.	Necessary as soon as possible	Surface repairing
4	Grit Chamber	4	To be abolished with the new construction of grit chamber.	No need	No need
5	Primary Sedimentation Tank	128.44	The structures rehabilitated in 1998 are in good condition. Since,No.1 tank was off rehabilitation in 1998, 1tank needs rehabilitation including reinforcement of the sub-	1 tank needs rehabilitation as soon as possible including sub-surface structure.	Surface repairing with reinforcement of the wall
6	Aeration Tank	11.11	This structure was rehabilitated in 1998, condition is not so good compared with sedimentation tank. Prolonging measure is necessary for further use.	Necessary as soon as possible	Surface repairing
7	Secondary Sedimentation Tank	128.44	The structures rehabilitated in 1998 are in good condition. Since,No.1,2 tanks were off rehabilitation in 1998, 2 of them need rehabilitation including reinforcement of the sub-surface wall.	2 tanks needs rehabilitation as soon as possible including sub-surface structure.	Surface repairing with reinforcement of the wall
8	Distribution Chamber	0.08	Although this was rehabilitated in 1998, surface condition is rather bad. Intense weathering is observed.	Necessary as soon as possible	Surface repairing
9	Sludge Thickener	128.44	The structures rehabilitated in 1998 are in good condition.	No need	No need
10	Digestion tank	503.75	Since the outer cover is thick, long remaininng life is calculated. But from the viewpoint of heat retaining functon, rehabilitation is necessary. Condition of the	Necessary as soon as possible	Surface repairing with reinforcement of the inside wall

1. Inlet chamber

The whole view

Observation

Figure B.3.1

2.Inlet pump station(1/2)

The whole view

Observation

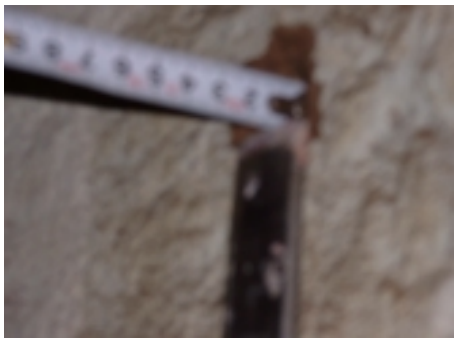

Figure B.3.2

2.Inlet pump station(2/2)

The whole view

Observation

Figure B.3.3

3.Inlet pump station (External wall)

The whole view

Observation

Figure B.3.4

4.Grit chamber

The whole view

Observation

Figure B.3.5

5.Primary sedimentation tank

The whole view

Observation

Figure B.3.6

6.Aeration tank

The whole view

Observation

Figure B.3.7

7. Secondary sedimentation tank

The whole view

Observation

Figure B.3.8

8.Distribution tank(secondary sedimentation tank)

The whole view

Observation

Figure B.3.9

9.Sludge Thickener

The whole view

Observation

Figure B.3.10

10. Digestion tank

The whole view

Observation

Figure B.3.11

Appendix B-4

Result of Sludge Coagulation Experiment

APPENDIX B-4 Result of Sludge coagulation experiment

B.4.1 Object of experiment

1) To confirm the characteristics of the sludge generated in the STP
2) To confirm the possibility of polymer supply for the mechanical thickening and dewatering
3) To clarify the proper type of polymer for this STP
4) To evaluate the practical use of mechanical thickener and dewatering

B.4.2 Sludge subject to the test

1) Raw sludge from primary sedimentation tank

Concentration is approximately 5 %, and black colored.

2) Waste sludge from secondary sedimentation tank

Concentration is approximately 0.2%, brown colored and it has good settling characteristics.

Note: Since digestion tank was not in operation because of mechanical breakdown, digested sludge was not possible to use in this experiment.

B.4.3 Material, method for the experiment

1) Coagulant

Two types of polymer were prepared for this experiment. They are J apanese and German product. German one is supplied to STP for sales sample from Almaty. Also Alum was prepared for preliminary confirmation of effectiveness of inorganic chemicals. Coagulant was dissolved in the tap water with the concentration of 2000 mg/l prior to the experiment.

2) Filter

Two types of filter media were prepared. One is ordinary filter for the belt press, and the other is mesh belt that is made of fine steel textile.

3) Apparatus

Specific steel cylinder for the experiment and necessary appurtenances were used. (see the photo)

4) Method

120 seconds filtration in the cylinder after 60 seconds mixing with the coagulant by magnetic stirrer was made. After this step, thickened condition was observed, and filtrate /residue on the filter was examined.

5) Run number

20 run were planned , and 15 run were conducted from the observation.

B.4.4 Result

The result is shown in Table B.4.1. And the photo of the experiment is shown in Figure B.4.1~B.4.19

1) Cation polymer is indispensable for thickening the sludge.
2) Around 0.4% concentration of coagulant is recommended from the result for both of raw sludge and waste sludge. 0.2% is not enough for the thickening process.
3) Both product in German and J apan is almost equivalent with regard to performance.
4) Ordinary filter for belt press dewatering is effective enough when gravity belt filter type is adopted.

B.4.6 Conclusion

1) Sludge characteristics

Raw sludge is partially digested and thickened because of long detention time that is brought by method of operation.

Waste sludge is dark-brown colored and has characteristic of easy-sedimentation.

2) Supply of coagulant

It was confirmed that German product supply is already established through Almaty in Kazakhstan. The product shows the equivalent good performance to J apan product for coagulation. There will be no problem for chemical supply.

3) Suitable coagulant

J udging from the experience of using Alum for the thickening prior to the polymer use, cation polymer is the most suitable for this purpose.

4) Suitability of mechanical thickener and dewatering

No problem is found in this regard.

Table B-4-1 Site Astana STP

Date 2002/12/20 Waste sludge concentration 0.20 (%) Stirring 1st 120 rpm 60 sec Coagulant concentration 0.20 (%)

Raw sludge concentration 5.00 (%) 2nd rpm sec sludge volume 500 (ml)

Run No	Filter	Sludge	Polymer (cation)	Total fluid (ml)	Coagulant volume (ml)	Coagulant concentration to SS (%)	Condition after 120s filtration	Flock Dia. (mm)	Filtrate Vol. (ml)	Filtrate Transparency	Residue Vol. (ml)	Residue Condition	Evaluation
1	ordinary	Waste Sludge	–	500	0	0.00	Clogged. Sludge outflow.	–	270	bad	230	bad	bad
2	〃	〃	German	501	1	0.20	Clogged. Sludge outflow.	–	300	bad	201	bad	bad
3	〃	〃	German	502	2	0.40	Good	3	435	very good	67	usable	usable
4	〃	〃	Japan	501	1	0.20	Clogged. Sludge outflow.	–	400	very bad	101	very bad	bad
5	〃	〃	Japan	502	2	0.40	Good	3	430	very good	72	usable	very good
6	mesh belt	〃	–	500	0	0.00	All sludge outflow	–	475	bad	25	bad	bad
7	〃	〃	German	501	1	0.20	Good	3	440	usable	61	usable	usable
8	〃	〃	German	502	2	0.40	Better than run 7	3	445	**very good**	57	**very good**	**very good**
9	〃	〃	Japan	501	1	0.20	Omitted from the result of 7	–	–	–	–	–	–
10	〃	〃	Japan	502	2	0.40	Equivqlent to 8. Better than 7	3	440	**very good**	62	**very good**	**very good**
11	ordinary	Raw Sludge	–	500	0	0.00	Complete clogging	–	30	bad	470	bad	bad
12	〃	〃	German	525	25	0.20	Complete clogging	–	20	bad	505	bad	bad
13	〃	〃	German	550	50	0.40	Good	–	340	**very good**	210	**very good**	**very good**
14	〃	〃	Japan	525	25	0.20	Omitted from the result of 12	–	–	–	–	–	–
15	〃	〃	Japan	550	50	0.40	Good	–	340		210		
16	mesh belt	〃	–	500	0	0.00	Omitted from the result of 12	–	–	–	–	–	–
17	〃	〃	German	525	25	0.20	Omitted from the result of 12	–	–	–	–	–	–
18	〃	〃	German	550	50	0.40	Good	–	340	**very good**	210	**very good**	**very good**
19	〃	〃	Japan	525	25	0.20	Omitted from the result of 12	–	–	–	–	–	–
20	〃	〃	Japan	550	50	0.40	Good (Best)	–	355	**very good**	195	**very good**	**very good**

Sludge sample

Figure B.4.1

Run No2

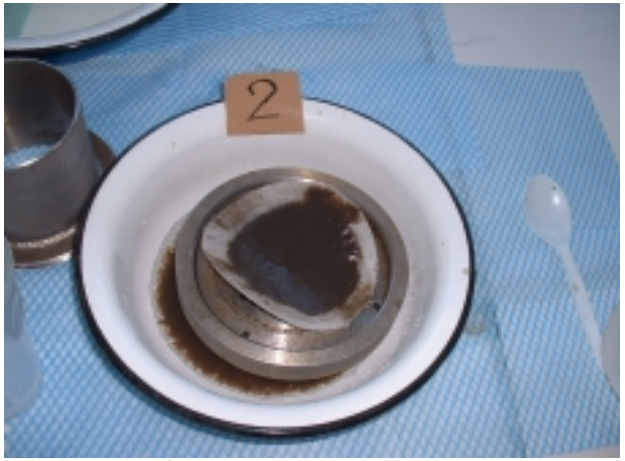

Figure B.4.2

Run No3

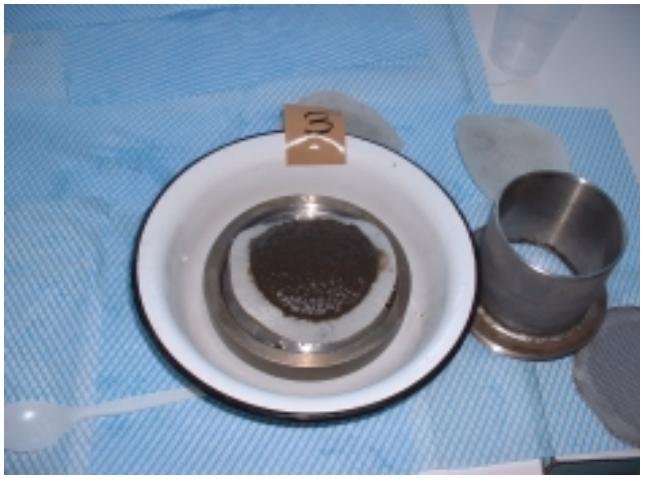

Figure B.4.3

Run No4

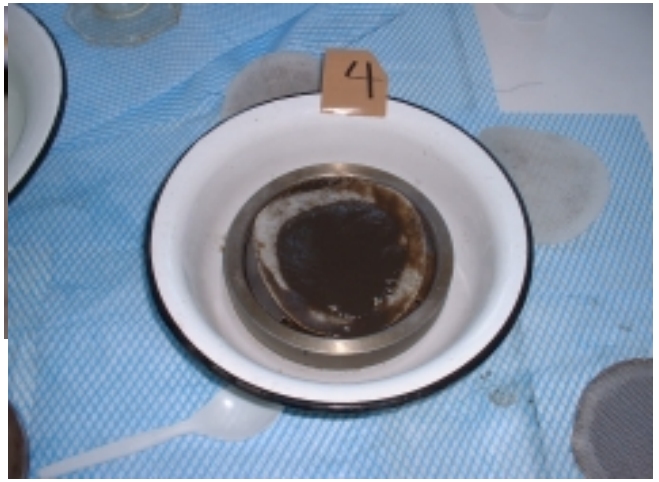

Figure B.4.4

Run No5

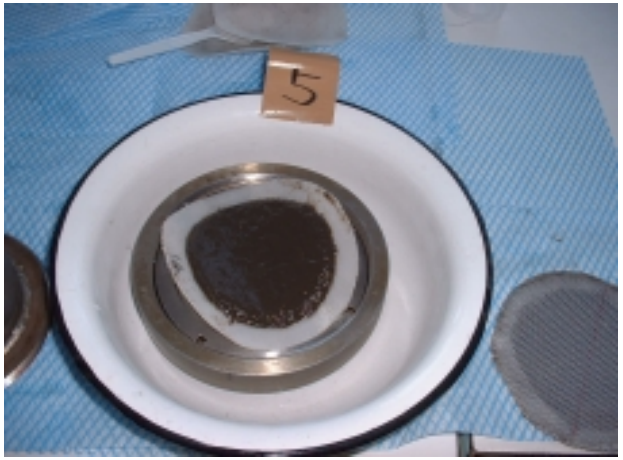

Figure B.4.5

Run No6

Figure B.4.6

Run No7

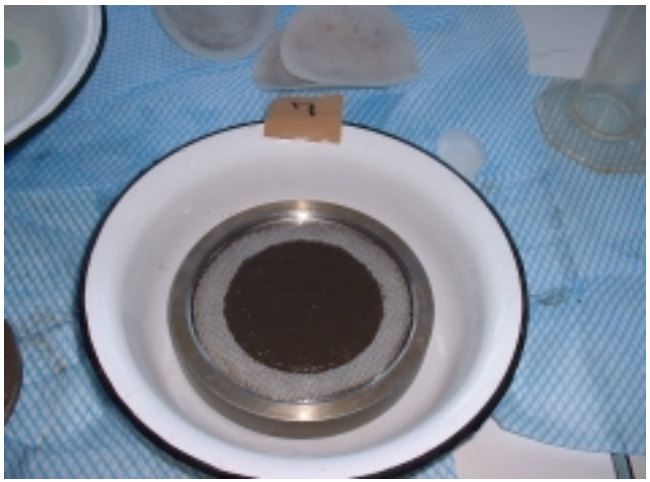

Figure B.4.7

Run No8

Figure B.4.8

Run No10

Figure B.4.9

Run No12

Figure B.4.10

Run No13

Figure B.4.11

Run No15

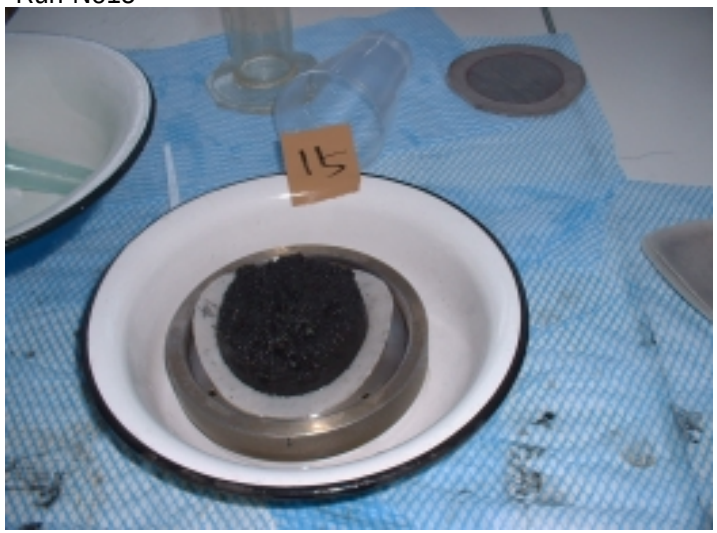

Figure B.4.12

Run No18

Figure B.4.13

Run No20

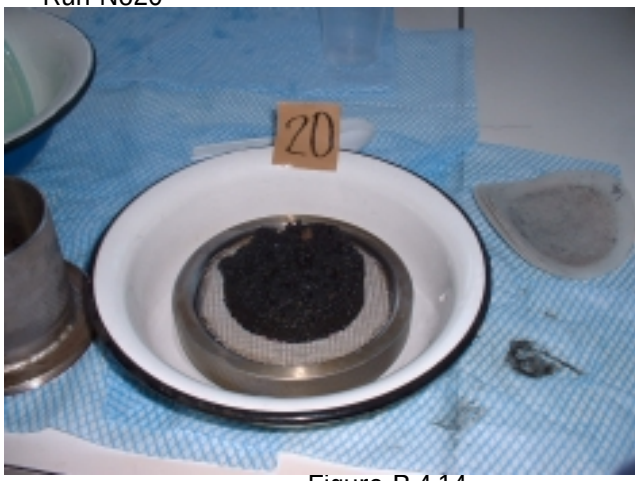

Figure B.4.14

Run1 to 3 waste sludge

Figure B.4.15

Run4 to 6 waste sludge

Figure B.4.16

Run7,8,10 waste sludge

Figure B.4.13

Run11,12,13 raw sludge

Figure B.4.13

Run15,18,20 raw sudge

Figure B.4.13

Appendix B-5

Results of Water and Sludge Quality Analysis

Refer to Appendix C-2

APPENDIX B-5 Result of Water and Sludge Quality Analysis

Refer to APPENDIX C-2