5-2 A_2O process introduced to 7 WWTPs in Regional Sewerage , Tokyo

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Advanced wastewater treatment is essential to create favorable water environment and promote water recycling. Eutrophication of closed water areas is now emerging again as a problem. In Tokyo Bay, which is surrounded by the metropolitan Tokyo area, reduction of nutrient discharged from wastewater treatment plants is a challenge more significant than ever before.

The Tama River, the largest river in Tokyo, runs through Tokyo from west to east, flowing into Tokyo Bay. Since about half of the river flow in the middle of the course of the river is treated wastewater, quality of treated wastewater greatly affects the quality of the river water itself.

Starting with the introduction of A_2O (Anaerobic-Anoxic-Oxic) process to North Tama Ⅱ Wastewater Treatment Plant in the year 2000, Regional Sewerage Office, which controls the sewage system of Tama area, has adopted A_2O-based facilities in some line of all the 7 plants over the area by April 2004.

This paper describes the performance of these A_2O lines of 7 plants over several years, “measures taken against inferior performance ” and “desirable A_2O facilities.”

1. Outline of A_2O facilities and performance of 7 plants

A_2O facilities are designed according to “Japanese advanced treatment plant design manual” basically.

Figure 1 and Table 1 show 7 WWTPs location and the outline of operation of each plant in years from 2002 to 2004. Figure 2 and Table 2 show performance of treatment. The effluent standard for advanced treatment facilities is as follows: Nitrogen; 20 mg/L, Phosphorus; 1 mg/L.

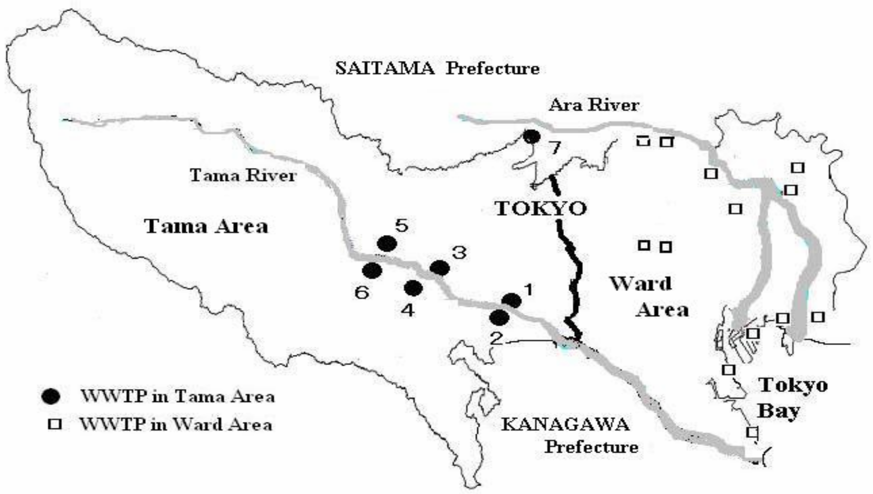

Figure 1 Wastewater Treatment Plant in Tama area

Table 1 Outline of operation of each WWTP

WWTP	Actual flow (m^3/d)	Anaerobic HRT(hr)	Anoxic HRT(hr)	Oxic HRT(hr)	Total HRT(hr)	Internal recycle ratio
1. North Tama Ⅰ *	21,000×2	1.5	6.1	9.4	17.0	0.8
2. South Tama	20,400×2	3.3	1.7	9.9	14.9	0.5
3. North Tama Ⅱ	16,400	1.8	2.2	9.8	13.8	0.5
4. Asakawa	14,600	1.5	4.9	9.3	15.7	1.0
5. Upstream Tama	48,900	1.4	4.8	7.7	13.9	0.7
6. Hachiouji	14,400	1.8	3.5	8.1	13.4	1.0
7. Kiyose	34,700	2.3	3.8	9.2	15.3	0.8

North Tama Ⅰ * Apr-04~Sep-04 Others Apr-03~Mar-04

Table 2 Performance (Annual average)

WWTP	Nitrogen (mg/l)		Phosphorus(mg/l)	
	Influent*	Effluent	Influent*	Effluent
1. North Tama Ⅰ *	22.4	5.5	2.9	0.6
2. South Tama	27.9	9.0	4.3	0.4
3. North Tama Ⅱ	27.2	9.9	3.3	0.3
4. Asakawa	26.0	8.0	2.8	0.3
5. Upstream Tama	25.8	7.7	3.5	0.3
6. Hachiouji	31.4	9.2	3.3	1.1
7. Kiyose	27.0	8.3	2.7	0.4

North Tama Ⅰ * Apr-2004~Sep-2004 Others Apr-2003~Mar-2004

Influent* : Influent of reacter (Overflow of primary settling tank)

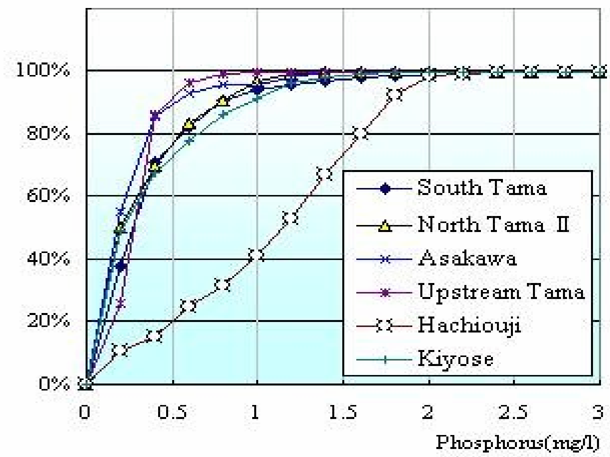

Figure 2 Cumulative frequency distribution (Phosphorus)

The performance of treatment indicates that the effluent nitrogen concentration is far below the standard , and in most cases over 90% of the effluent phosphorus satisfied the standard.

2. Situations where target effluent quality cannot be reached and countermeasures

2.1 When phosphorus concentration exceeds the target value of effluent

Phosphorus concentration of effluent exceeded 1 mg/L in the following three cases. The first case was when organic concentration (specifically acetic acid) in influent was low. (Table 3) As shown by Figure 3, phosphorus concentration in effluent was not stable at this time. The second case was when organic concentration in influent became low because of heavy rainfall. As shown by Figure 3, the quality of effluent deteriorated a little later than the heavy rainfall. The last case was when the inhibiting substances such as NO_3-N contained in factory effluent was high. It is Hachiouji wastewater treatment plant. In all of the above cases, phosphorus release in the anaerobic tank decreased, thus deteriorating the intake of phosphorus in the aerobic tank.

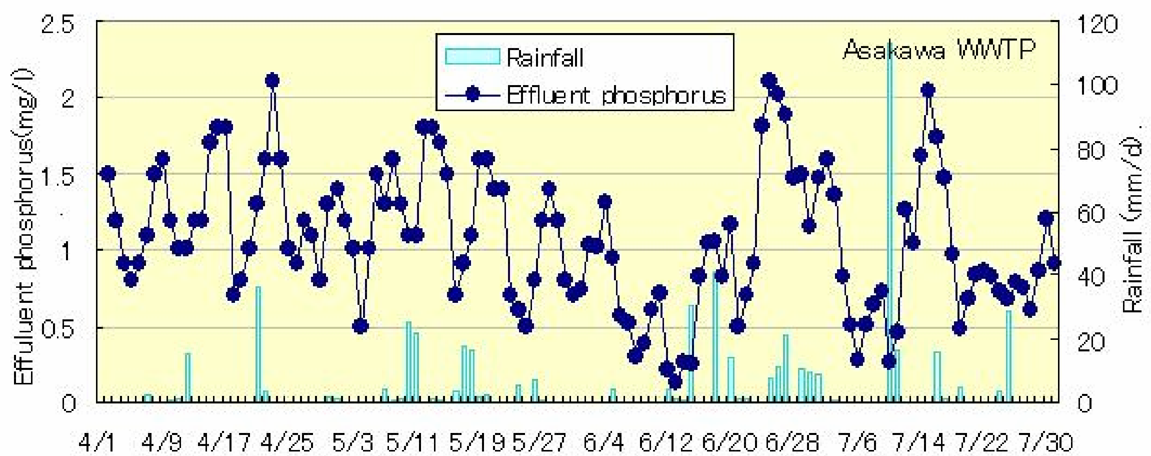

Figure 3 Effluent phosphorus in the year 2002

Table 3 Acetic Acid in infuent and Phosphorus effluent (in 2002)

WWTP	Acetic acid(mg/l) Influent	Phosphorus(mg/l) Effluent
1. North Tama Ⅰ	–	–
2. South Tama	19.0	0.5
3. North Tama Ⅱ *	38.0	0.3
4. Asakawa	9.0	0.8
5. Upstream Tama	11.0	0.3
6. Hachiouji	0.0	1.1
7. Kiyose	10.0	0.5

North Tama Ⅱ * Influent with a primary sludge

2.2 Countermeasures

The following measures were taken to cope with the cases in which treatment was considered difficult, and as a result, removal ratio was improved substantially. Table 4 and Figure 4 show a typical example.

① Operation management such as change of return sludge ratio or internal recycle ratio

② Measures against organic substances by the primary settling tank bypass operation or addition of primary sludge

③ Suspension of internal recycle and using a chemical dosage

Table 4 Performannce after the adoption of measures

WWTP	mesures	performance (%) before	after
1. North Tama Ⅰ	–	–	
2. South Tama	②	85	91
	② + ③		95
3. North Tama Ⅱ	① + ③	–	95
4. Asakawa	① + ②	64	95
5. Upstream Tama	②	–	97
6. Hachiouji	②	48	70
7. Kiyose	-	90	

Performance(%) : % of under 1mg/l (Phosphorus permit limit)

Period: 6months~one year (2002~2004)

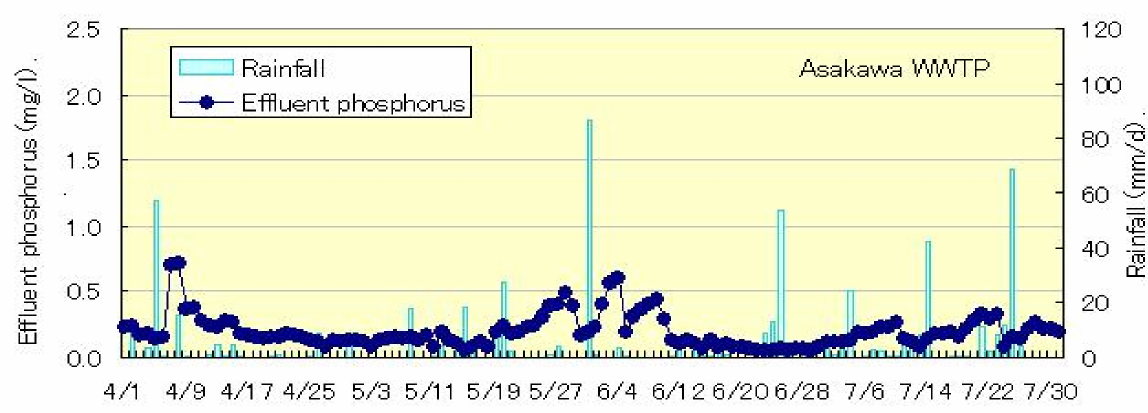

Figure 4 Effluent phosphorus in the year 2003

3. Conclusion

(1) The effluent nitrogen concentration was far below the standard, but the effluent phosphorus concentration was not stable.

(2) The cause of worse phosphorus removal was low influent organic concentration.

(3) The measures, change of return sludge ratio or internal recycle ratio, addition of organic substances, using a chemical dosage improved phosphorus removal.

4. Proposal for Desirable A_2O facilities

The investigation result of nitrification, denitrification, and phosphorus removal by each plant revealed that achieving the following is essential to operate A_2O facilities effectively.

(1) Facilities should be designed according to the actual conditions including water temperature and influent quality.

(2) Distribution of work among anaerobic tank, anoxic tank, and oxic tank must be flexible.

(3) Substantial water quality measuring equipment should be installed at site.

(4) Effect of operation of A_2O-based system on the centers as a whole including existing systems must be taken into consideration.