Challenge for Sustainable Sewage Management

The case of Yokohama City

Tokyo Development Learning Center

Japan Project Brief

Background and Objectives

The length of sewer pipes in Yokohama City is about 11,000km in total, equivalent to the distance between Yokohama City and New York City, USA. There are 11 wastewater treatment plants in the city that were constructed between 1962 and 1984, where about 1,500,000 m3 of sewage is treated per day. The sewage system has been contributing to improved sanitary conditions and water quality in rivers and streams, which is one important original objective of wastewater treatment. In addition, the city sewage system also addresses other sustainability challenges such as resource efficiency, reduction of greenhouse gas (GHG) emissions and disaster risk reduction.

The sewage system also faces sustainability challenges in terms of its service. Yokohama City is expected to update a large portion of its sewage infrastructure systems within the next 30 years. All of the 11 wastewater treatment plants in Yokohama and about half of the 71 pumping facilities were constructed more than 20 years ago (The national standard life period of a wastewater treatment plant is 50 years and that of a pumping station is 20 years). In fact, 2% of all the sewage pipes are more than 50 years old, 20% will be so in 15 years, and 75% in 30 years. Given that the national standard pipe-life period is 50 years, this rate of aging is serious. Aging sewage pipes and infrastructure not only directly affect the quality of sewage services but they also expose daily life and socio-economic activities in the city to danger, such as sink holes in roads due to damage to pipes, that need to be prevented. For sustainability of sound sewage services, the City of Yokohama identified five major activities to address the sustainability challenges in the mid-term business plan 2014 (FY2014-2017) (Table 1).

Table 1: Five major activities of Yokohama City

1. Maintain and rebuild sewage facilities strategically;
2. Prepare for earthquake and heavy rain disaster and reduce such risks;
   (1) New earthquake countermeasures incorporating disaster reduction;
   (2) New inundation countermeasures using internal water hazard map;
3. Create a good water environment;
4. Take initiatives for energy and global warming countermeasures;
5. Develop strategic promotional activities both domestically and overseas;
   (1) Developing international contribution activities making full use of Yokohama's experience;
   (2) Develop broad surveying and public relations activities.

Source: City of Yokohama. March 2015. Yokohama City's Sewage Management: Mid-term Business Plan 2014 (Summary) (in Japanese) http://www.city.yokohama.lg.jp/kankyo/gesui/keiei/keieikeikaku/2014gaiyouban.pdf

Project Overview

Advance Treatment Process for Further Improvement of Water Quality

The sewage system has been contributing to the improvement of public water quality. The sewage coverage rate increased from 85% in 1989 to 99.8% in 2013. No untreated wastewater flows into rivers, and river water quality has significantly improved. BOD values in major rivers in the city decreased 40 – 87% in 2013 from those in 1984. On the other hand, eutrophication in enclosed water bodies such as lakes and coastal waters still remains. To cope with this issue, Yokohama City introduced advanced treatment technology (Figure 1) to remove nitrate and phosphorus contributing to eutrophication. The number of treatment plants applies advanced treatment process increased from two in 1996 to eight in 2013. As the result, the removal rate of nitrogen and phosphorus increased (Figure 2).

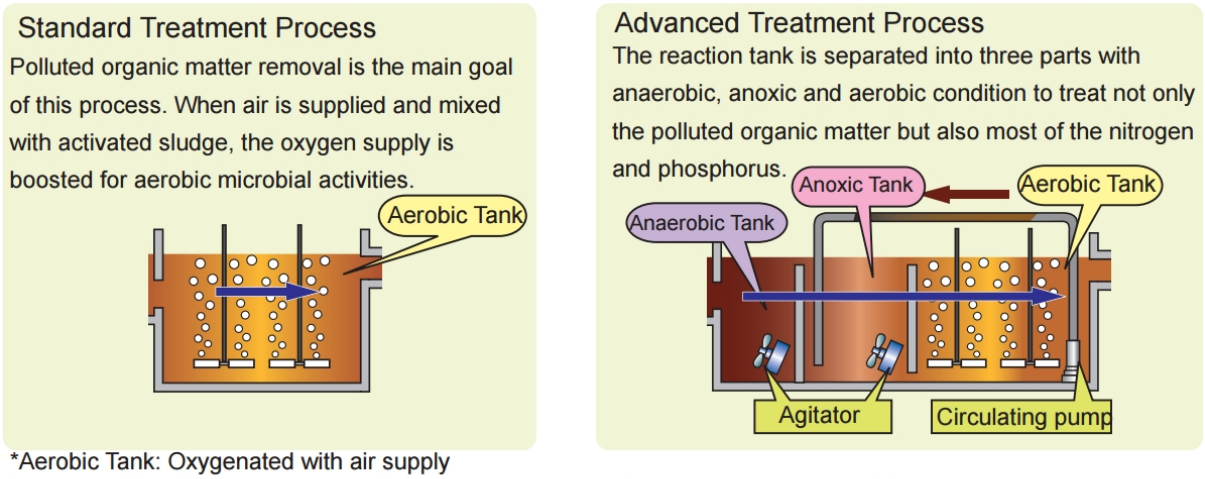

Figure 1: Comparison between standard treatment process and advanced treatment process

Source: Yokohama Environmental Planning Bureau. March 2016. Sewage Water Quality in Yokohama City. http://www.city.yokohama.lg.jp/kankyo/data/gesui/hakusho/swqinyc2016.pdf

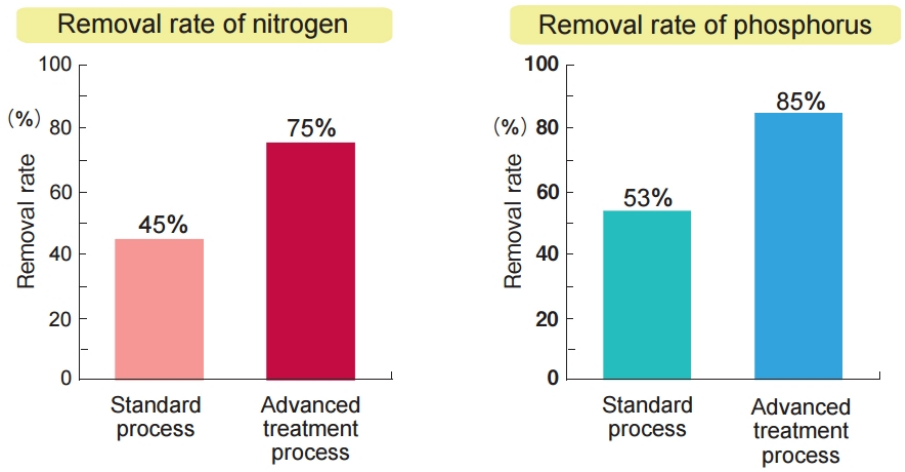

Figure 2: Removal rate of nitrogen and phosphorus by both standard and advanced treatment process

Source: Yokohama Environmental Planning Bureau. March 2016. Sewage Water Quality in Yokohama City. http://www.city.yokohama.lg.jp/kankyo/data/gesui/hakusho/swqinyc2016.pdf

Utilization of Reclaimed Water

Treated wastewater is utilized for various purposes in the city. Three wastewater treatment plants ozonize treated water while all the plants have facilities to filter wastewater by sand. Ozonized water is utilized for toilets, small artificial streams, and air conditioning systems (AC). On the other hand, sand filtered water is reclaimed for cleaning the wastewater treatment plants and toilets. The treated wastewater also generates revenue by being sold to clean drainage pipes and construction plants. Water quality of the reclaimed water complies with standards designated for different usage by the national government.

Table 2: Utilization of reclaimed water in Yokohama

Water Type	Purpose	Quantity Supplied (m^3/year)	Area Supplied
Ozonized	Small streams	3.5 million	Egawa stream, Iriegawa stream, Takinogawa stream, Futoo Minami Park stream and others
Ozonized	Toilet, AC Heating Source	251 thousand	Yokohama Arena, La Port Yokohama, Shin Yokohama Chuo Building and others,
Sand Filtered	Inside facilities	5.8 million	Wastewater Treatment Plants, Sludge Treatment Plants
Sand filtered	Drainage pipe cleaning	128 thousand	Recycled water is sold to Contracted Trading Company

Source: Yokohama Environmental Planning Bureau. March 2016. Sewage Water Quality in Yokohama City. http://www.city.yokohama.lg.jp/kankyo/data/gesui/hakusho/swqinyc2016.pdf

Utilization of Resources Generated from Sludge Treatment

The sludge generated from wastewater treatment process is also treated and recycled in Yokohama City. Sludge generated in eleven wastewater treatment plants is transported to two sludge treatment plants, and then subject to thickening, digestion, and dehydration processes. After the treatment, the weight of the sludge decreases by 400 times, and becomes an odorless, hygienic product (Figure 3). Gas generated during the digestion process is recovered as a source of energy and utilized for electricity generation and fuel for incineration in the treatment plants. In addition, the ash after incineration has been used as raw material for improved soil and cement.

Asset Management

To cope with the aging sewage systems, a renewal plan has systematically been developed and executed in full consideration of the budget plan. The area where a sewage system was constructed before World War II was designated as the first phase renewal area, followed by a second phase renewal area where a sewage system was constructed from 1945 to 1970. To secure the budget for renewal of sewage infrastructure and continue to provide sound services, it was necessary to improve financial conditions. For example, a target was set to reduce the dependency rate on corporate bond to improve the financial basis for the sewage services. In addition, PFI was introduced to reduce the cost of recycling sludge. Daily management of systems has been strengthened to prolong the life of facilities and pipes, and a database of data and information on the sewage systems is being developed.

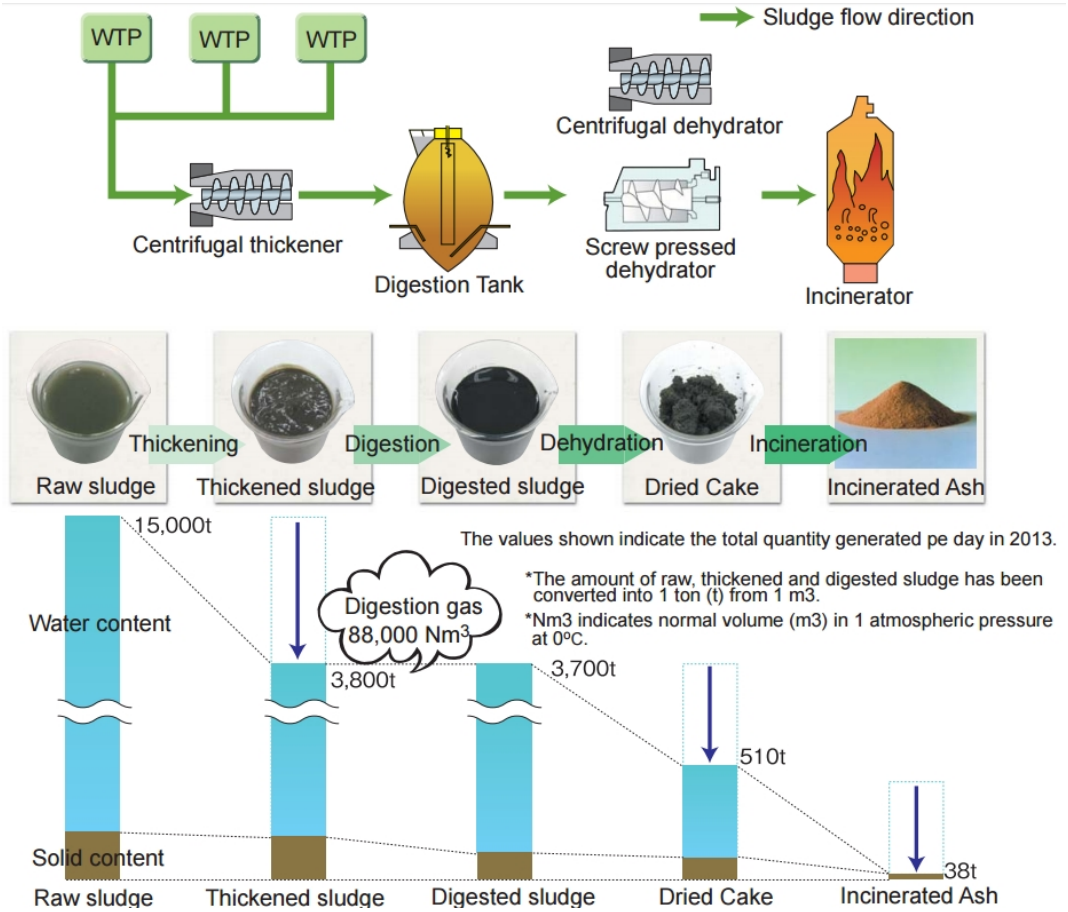

Figure 3: Decrease of sludge during the treatment process

Source: Yokohama Environmental Planning Bureau. March 2016. Sewage Water Quality in Yokohama City. http://www.city.yokohama.lg.jp/kankyo/data/gesui/hakusho/swqinyc2016.pdf

Project Impacts

Economic Impact:

The city is trying to reduce the heavy dependence on corporate bonds and achieved the target identified in the mid-term plan of 2007. A new target has been set for the current mid-term plan. If the plan is properly implemented, it is expected to improve the financial situation of sewage management for the city. Resource recovery measures can reduce the cost of treatment and increase revenue by the sale of recycle materials. For further financial improvement, private sector involvement in sewage management is also extended for cost reduction. There has also been opportunities to export experience and technology of Yokohama's sewage system. The city is now collaborating with local companies in Yokohama to export waste water treatment technology to Batam City in Indonesia under a project by the Japan International Cooperation Agency. This will also benefit the economy of Yokohama.

Social Impact:

The sewage system in Yokohama contributes to the improvement of sanitation in the city. In addition, small streams where ozonized reclaimed water is used provide excellent waterfront and leisure space for citizens (Figure 4). In addition, the efforts of Yokohama City to pursue sustainability for sewage systems contributes to serve as inundation mitigation during floods.

Figure 4: Re-treated water in Egawa Stream

Environmental Impact:

Water quality in rivers, streams and coastal waters in Yokohama has improved due to its sewage system. BOD values in the main rivers of the city saw a 40% to 86% decrease in 2013 compared with those in 1989[1], which indicates that water quality of rivers has improved. Improved water quality also resulted in the increase of diversity of fish in the main rivers. Studies showed that fishes such as killifish, salmon and freshwater minnows returned (Figure 5).

About 20% of GHG emissions from business and services operated by the City of Yokohama comes from sewage management[2]. Energy recovery from wastewater and sludge treatment process contributes to a reduction of GHG emissions, together with efforts on energy saving in sewage management overall.

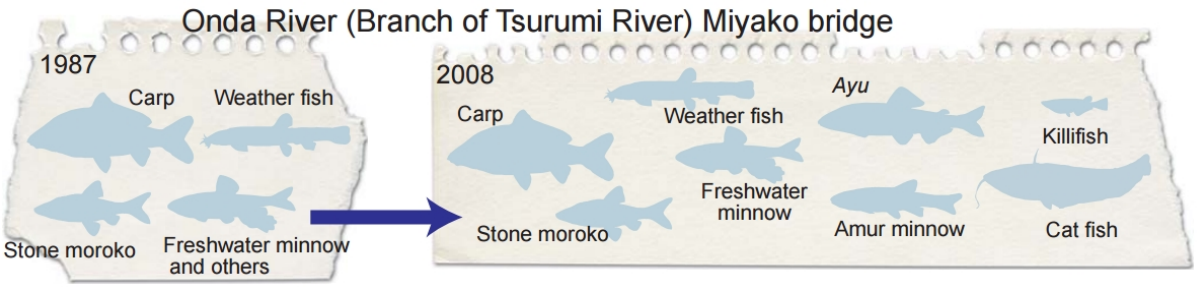

Figure 5: Variation in fish species

Source: Yokohama Environmental Planning Bureau. March 2016. Sewage Water Quality in Yokohama City. http://www.city.yokohama.lg.jp/kankyo/data/gesui/hakusho/swqinyc2016.pdf

Lessons Learned

Challenge:

The sewage system in Yokohama City plays various roles to improve the environment and amenities in the city. One of the biggest challenges of the city's sewage system is how to finance the sewage services. In light of an aging society, revenue from services is expect to be reduced gradually, and solid implementation of a financial plan is critically important.

Opportunity:

Using its own experiences, Yokohama City is very active in international cooperation. The city received over 2,400 trainees from developing nations to study technology and management of water and wastewater public works. In addition, under a technical assistance project funded by JICA, the city sent expertise to developing nations to teach their experiences to counterparts overseas. These kinds of activities are good examples of making full use of their experiences in order to increase visibility on the international stage and also contribute to human capacity development of water experts in the city.

[1] Yokohama Environmental Planning Bureau. March 2016. Water Quality of Sewage in Yokohama (in Japanese). http://www.city.yokohama.lg.jp/kankyo/data/gesui/hakusho/h26suishitsudemiru.pdf

[2] City of Yokohama. March 2015. Yokohama City's Sewage Management: Mid-term Business Plan 2014 (Summary) (in Japanese) http://www.city.yokohama.lg.jp/kankyo/gesui/keiei/keieikeikaku/2014gaiyouban.pdf

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