# Study of Energy Efficiency of a Sludge Treatment System

| Year of research | 2009～2010 | Research of resource and energy in sustainability |
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**(Background)**

Despite the public's demand for reduction of greenhouse effect gases from sewage systems, sewage systems consume about 0.7% of all electric power consumed in Japan, and from the perspective of greenhouse effect gas emissions (converted to $CO_2$), about half is generated by electric power production. A high percentage of this is consumed to drive pumps and blowers in water treatment systems, but it is impossible to ignore that consumed by sludge treatment, so energy conservation measures are an urgent challenge.

**(Goals and contents of the research)**

The principal goal of this research is to clarify the energy efficiency of the overall flow in sludge treatment systems. A variety of sludge treatment process cases were set and the capacities of these processes were calculated. The impacts of the fluctuation of specification values (sludge concentration, recovery rate) on the facility capacities of each process were studied based on the results of calculations of capacity.

(1) Organizing the study specifications

1) Treated water: the object of the study was the conventional activated sludge process treating 100,000$m^3$/day of influent water.

2) Sludge treatment process: objects of the study were thickening→digestion (with/without) →dewatering →incineration.

3) Design specifications were categorized according to information from documents regarding the moisture content and recovery rate in the solid balance calculation for the thickening process, digestion process, and dewatering process (with digestion/without digestion).

(2) Sludge treatment process capacity calculation (study case setting basic guideline)

- Perspective encompassing the entire sludge treatment system
- Perspective of the impact of each unit process on the overall sludge treatment system

Cases based on the above basic guideline were categorized from I to IV, to set a total of 23 types of cases and the capacities for all cases were calculated.

(3) Sensitivity analysis of the sludge concentration and recovery rate

Based on the results of the capacity calculations in (2), the impacts of fluctuation of specification values (sludge concentration, recovery rate) were considered with regard to [1] recycle flow and solids quantity of the sludge treatment process, [2] facility and equipment capacity of each process, and [3] facility and equipment operating time of each process.

(4) Research achievements

1) Preparing sludge treatment process capacity calculation sheets

Major treatment methods from the four sludge treatment processes of thickening, digestion, dewatering, and incineration were selected and combined to create support tools which can be used to calculate capacity, calculate solids balance, and perform general studies of equipment scale or number of units.

2) Sensitivity analysis of sludge concentration and recovery rate

[1] Regarding recycle flow and quantity of solids of the sludge treatment process

· If efforts are made to improve the sludge recovery rate, the quantity of recycle flow solids could be lowered to less than 10% of the solids in the treatment plant inflow.

· Fluctuation of the digestion rate had no impact on the rise or fall of the recycle flow and recycled solids.

[2] Facility and equipment capacity of each process

· Decline of the performance of the thickening process in the sludge treatment process severely impacted the digestion tank and incineration furnace capacities.

[3] Facility and equipment operating time of each process

· The operating time of principal equipment in the sludge treatment process was approximately 18 hours/day.

· The operating rate of the incineration furnace was estimated as approximately 50% to 60%.

(5) Future developments

From the perspective of greenhouse effect gas emissions, it is assumed that it will be necessary to survey greenhouse effect gas emissions and trial calculate costs for each case which was set.

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| Key words | Sludge treatment system, greenhouse effect gas, sensitivity analysis, energy efficiency |
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