Development of Next-generation Wastewater Treatment Technology Using New Biological Reaction

(Research of FY 2017-2021)

1.PURPOSE

This study aims to develop wastewater treatment technology using a new biological reaction. The new system is expected to be more energy-saving, cost-saving, and energy-recyclable than conventional technologies. We extract prospective technologies by a bibliographic survey, grasp the R&D trend through a questionnaire to private companies, and carry out a feasibility study by bench-scale experiments.

2.OUTCOMES OF THIS YEAR

Based on the result of the journal investigation carried out the previous year, we selected two technologies of "microbial battery" and "normal temperature ANAMMOX" as targets of study.

This year, we reviewed five academic journals and seminar proceedings of Japan Annual Technical Conference on Sewerage to list up research papers relating to the selected two technologies.

Besides, we had questionnaires to domestic private companies that carry out R&D of related technologies.

(1) **Microbial battery**(target companies:10, valid responses:7)

Most experiments conducted by private companies were sequential and lab scales with a treatment capacity of 3m^3/d at the maximum.

Many of them treated high organic concentration factory wastewater or artificial wastewater as raw water. Only two experiments handled municipal sewage.

Figure 1 describes the results of four experiments answering both COD and power output in the survey. It shows higher COD of raw water tends to generate more electricity. Wastewater having as much organic matter concentration as municipal wastewater was considered to generate electricity about 0.01-0.1W/m^2.

As for the removability of organic matters, municipal wastewater showed BOD of 80mg/L and COD of 150mg/L in raw water and BOD of 20mg/L and COD of 90mg/L in the treated effluent. Therefore, the microbial battery was considered to have less removability of organic matters than the conventional activated sludge process.

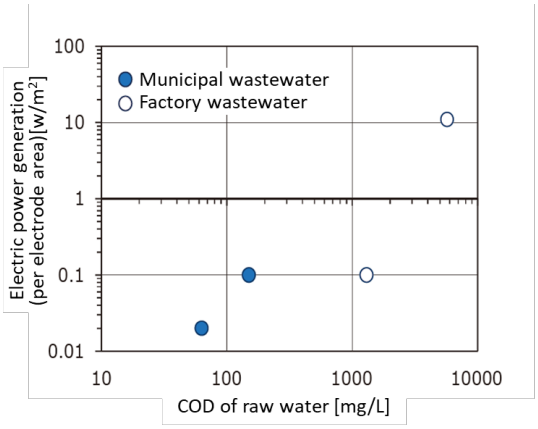

Figure 1: Relationship between raw water COD and power generation output for microbial battery

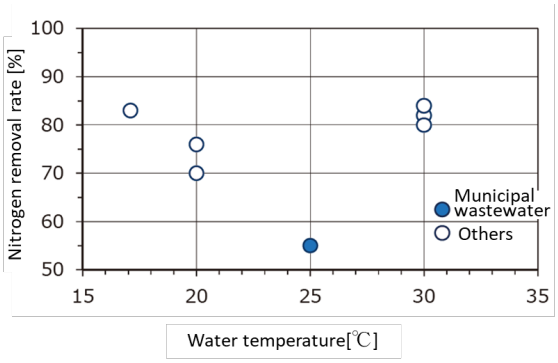

Figure 2: Relationship between water temperature and nitrogen removal rate for normal temperature ANAMMOX

(2) **Normal temperature ANAMMOX** (target companies:15, valid responses:9)

Most experiments were sequential and carried out at the lab scale. Their treatment capacity was 100L/d or less, 24m3/d at maximum. Most of them used raw water of high nitrogen concentration, and two experiments were conducted using municipal wastewater.

Figure 2 shows the seven cases that answered both water temperature and nitrogen removal rates in the survey. When using wastewater with highly concentrated nitrogen, nitrogen removal rates were about 80% at a water temperature of 30℃, and 70-80% at 20℃ or less. As for municipal wastewater, the nitrogen removal rate was 55% at a water temperature of 25℃, which tended to be lower than the other examples and modified Ludzack-Ettinger process, which is about 65-70%. However, nitrogen removal was considered to be possible.

3.CONCLUSION

AS a result of the questionnaires to domestic companies, a current R&D trend shows microbial battery and normal temperature ANAMMOX both have applicability to wastewater treatment as new technology. On the other hand, there are some issues with practical application. The microbial battery needs enhancement of its power generation performance and removability of organic matter. More findings for normal temperature ANAMMOX are required for nitrogen removability at a water temperature of below 20℃.

The R&D on microbial battery and normal temperature ANAMMOX will go on at the collaboration with domestic companies and universities for practical application.

Keywords: Microbial battery, Normal temperature ANAMMOX