Investigation Research on a Nitrification Promotion Type Anaerobic Anoxic Oxic Process

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(Purpose)

Receiving an announcement of a systematic classification designation with regard to an environmental standard for nitrogen and phosphorus in Hakata Bay, Fukuoka City worked out a "Master Plan for Advanced Treatment of Hakata Bay Specified Waters" jointly with the Fukuoka Prefectural Government in June 1998, under which Fukuoka City planned to establish an advanced treatment facility for removing nitrogen and phosphorus and also planned to introduce a "Nitrification Promotion Type Anaerobic Anoxic Oxic Process" (hereinafter referred to as "carrier-used A_2O Process") into which a nitrification carrier is inputted in the existing treatment facilities. Thus, they modified one series of the Tobu Wastewater Treatment Center and carried out an actual-size demonstration of this process since 2004. The purpose of this research aims to verify attainment of treatment water quality targets (annual average value) specified in the "Master Plan for Advanced Treatment of Hakata Bay Specified Waters" and to study facility designs and operation management methods. Meanwhile, this research was deliberated and evaluated by the "Committee for the Study of Advanced Sewage Treatment Technologies" established in Japan Institute of Wastewater Engineering Technology in 2006.

(Results)

(1) Nitrogen

1) Nitrification characteristics

We confirmed that NH_4-N density in an aerobic tank had become low, and in general, favorable nitrification reaction had been maintained. However, a shortage of nitrification existed in one point, and when we adjusted nitrification speed in the aerobic tank, we confirmed that nitrification speed had become comparatively low, and DO density in the aerobic tank had become particularly low. We considered it necessary to keep DO density to 3 mg／L or more to maintain the nitrification reaction in a good condition.

2) Denitrification speed

Removal of nitrogen in this method is mainly accomplished by denitrifying NOx-N which is supplied by circulating a nitrification solution of an anoxic tank. In this denitrification, almost complete denitrification was accomplished except when rainfall continued so long that the concentration of reaction tank inflow organic materials lowered.

We could quantify denitrification speed by analyzing changes in NOx-N density, and we derived the following denitrification expression of Fukuoka City's origin by adjusting the relationship with a CBOD-SS load with the use of the denitrification speed and taking an influence of a water temperature into account.

$$K_{DN,\ the\ whole} = 3.39 \times \exp^{(0.0535 \times T)} \times \text{CBOD} - \text{SS load} + 0.2$$

(2) Influence of CBOD／T-P ratio

Checking the relationship between the CBOD to T-P ratio and the T-P density of final sedimentation effluent, it was surmised that it is important to keep the CBOD／T-P ratio at around 20 or more to remove phosphorus stably. By first sedimentation bypass combination driving, the CBOD／T-P ratio rose from other experiment periods. Although there was a great deal of rainfall when first sedimentation bypass combination driving was conducted, we could remove phosphorus very well using a small amount of flocculants added.

(3) Achievement situation of processing target

Since the processing targeted value is an annual average value, we evaluated achievements using data of RUN5 to 9 of one year from July 2005 to June 2006 (41 data in total). With regard to all water quality items, values lower than the processing targeted value were obtained. From this fact, we can say that we could confirm a "proof of the achievement of processing target" by a true scale proof experiment.

(4) Design document and Driving management document

We made a plan of an institution design method and a driving management method in this process and gathered a plan of a design／a driving management document.

(Conclusion)

As a result of this research, we have obtained the following achievements.

- We could confirm that the treatment performance of the carrier-used A_2O Process was the one enough to cope with the advanced treatment of Fukuoka City.
- The establishment of the "a plan of a design／a driving management document" has enabled us to support a design／a driving management when this technology is introduced to the Wastewater Treatment Center of Fukuoka City.

When the carrier-used A_2O method is applied in each water treatment center including the Tobu Wastewater Treatment Center in the future, we hope that the "a plan of a design／a driving management document" will be effectively used, and we do expect that the results of this research will contribute to the promotion of advanced treatment in each wastewater treatment center and the water quality conservation of Hakata Bay.

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Researchers : Osamu Fujiki, Yoshiyasu Onoda, Toshiyuki Unishi, Susumu Kumano

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