Investigation research on a nitrification advanced type anaerobic non-oxygen-aerobic method (Part II)

Whole term	2004.4 ～ 2006.12	

(Purpose)

Based on a notification pertaining to the designation of nitrogen／phosphorus environmental standards for Hakata Bay, Fukuoka City formulated the "Hakata bay specification water area advanced processing master plan" (joint activity with Fukuoka Prefecture) in October 1998. The city is thus planning the establishment of advance sewage treatment facilities for the simultaneous elimination of nitrogen and phosphorus and planning the introduction of the "Anaerobic-Anoxic-Oxic to Promote Nitrification Process" (hereinafter the "Carrier Use A2O Process"), which invests nitrification carriers for existing treatment facilities. Consequently, an actual-size demonstration of this process has been carried out through modification of one series of the Tobu Wastewater Treatment Center since FY2004. This project aims to verify attainment of treatment water quality targets (annual average value) that are established in the Basic Plan for Advanced Sewage Treatment in Specific Water Areas of Hakata Bay and to study facility designs and operation management methods. It should be mentioned that the project is being discussed and evaluated by a "Committee for the Study of Advanced Sewage Treatment Technologies" that has been established within the Japan Institute of Wastewater Engineering Technology.

(Results)

The following is a report of expertise obtained through experimentation in FY2005 (primarily from June 2005 to march 2006).

1. Nitrogen

(1) Nitrification, denitrification

It was confirmed that NH_4-N density within the aerobic tank was low and that, in general, favorable nitrification was maintained. However, insufficient nitrification was seen at one point ; it was confirmed that, when adjusting the nitrification speed within the aerobic tank, the nitrification speed fell to a relatively low value and DO density of the aerobic tank reached a particularly low value. It is thought necessary to keep DO density at 3 ㎎／ℓ or higher in order to favorably maintain nitrification. Moreover, although complete denitrification was largely achieved when variation per day of NOx-N density in the anoxic tank was adjusted, complete nitrification did not occur during the winter. It is thought that the failure to achieve complete denitrification may be due to a lack of organic matter.

(2) Relationship between CBOD-SS load and denitrification speed

Calculations of denitrification speed resulting from changes in NOx-N density within the anoxic tank revealed that denitrification speed increased the higher the CBOD-SS load, which was a finding that matched standard knowledge. It also revealed that denitrification speed was greater in the front half of the anoxic tank than in the rear half of the tank, even under the same CBOD-SS load conditions, and that the impact of CBOD-SS load was more striking in the front half.

(3) Effects of methanol addition and denitrification promotion

When adjusting the effect that methanol addition has on denitrification speed, it was found that while denitrification speed increased due to the addition of methanol (except in times when methanol addition was temporarily interrupted), the degree of increase was slightly high.

2. Phosphorus

(1) Phosphorus density in the reaction tank

It was confirmed that the period in which the period of effective biological phosphorus removal grew when PO_4-P density within the reaction tank was adjusted, and that phosphorus removal could be favorably achieved.

(2) Impact of organic acid and return sludge NOx-N density

Favorable phosphorus elimination could be achieved irrelevant of organic acid density and return sludge NOx-N density when the relationship between organic acid density, return sludge NOx-N density, and final sedimentation effluent T-P density was adjusted. However, in two case examples, phosphorus elimination worsened. It is thought that these cases where due to high NOx-N density (6 to 7 ㎎/ℓ) in return sludge and to a relatively low CBOD to T-P ratio.

(3) Impact of the CBOD to T-P ratio

When adjusting 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 to T-P ratio at around 20 or more in order to achieve stable phosphorus elimination.

3. BOD and COD_{Mn}

When adjusting the variation per day of BOD and COD_{Mn} of final sedimentation effluent, overall BOD was around 3 ㎎/ℓ, despite some high spikes, and thus favorable elimination was achieved. At the same time, COD_{Mn} slightly exceeded the treatment target during the winter. It was thought that this development was due to the influx of organic material that is resistant to biodegrading. Should the influx of high densities of such organic matter occur, it is thought desirable to engage in studies that include the introduction of rapid filtration methods that bear economic feasibility and rationality in mind.

(Conclusion)

This research project places focus on the achievement of treatment targets in the form of annual averages, and this report compiles results obtained over the course of 10 months from the Carrier Use A20 Process, which was implemented by modifying one series. One-year data are continuing to be obtained. Moreover, statistical materials and operation management materials using these data are being prepared for application to other sewage treatment plants in Fukuoka City. Amid continuing establishment of advanced sewage treatment technologies in treatment plants, the results of this research project are expected to make a contribution to water quality preservation in Hakata Bay.

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key words	Advanced sewage treatment, Carrier, Anaerobic non-oxygen-aerobic method