Study of Nitrogen removal process controlled by NADH(Fukuoka city)

Year of Research	2009～2012	Water quality improvement by advanced sewage treatment

(Introduction)

Fukuoka City has searched for a new technology for nitrogen removal from the perspective of reducing of reconstruction and maintenance costs as well as reducing CO_2 emission. Under these situations, a method of nitrogen removal process using supplied air flow system controlled by NADH sensor has caught attention, and the process has been introduced into one reactor series of an existing wastewater treatment plant in Fukuoka City as an experimental system. The objective of this study is to establish a low-cost nitrogen removal process that does not require both reconstruction and expansion of the facility. For achievement of the objective, the operating condition of advanced treatment process that satisfies the effluent quality prescribed in 'Master plan of advanced wastewater treatment for the Hakata Bay' is studied. In addition, the ease of maintenance and performance of energy saving are also investigated. In the fiscal year 2012, the demonstration experiment was continuously carried out from the fiscal year 2011. The specific purposes of the study in 2012 were as follows:

- evaluating the performance of nitrogen removal for practical application,
- preparing the manuals on design, operation and maintenance.

(Results)

(1) Technical summary

The nitrogen removal process controlled by NADH is consists of dual zone treatments. **Fig. 1** shows the DO concentration in sludge flocs. In the case of DO concentration profile- (b), the shell of each flocs is under nitrifying condition while the core is under denitrifying conditions, which allow simultaneous nitrification and denitrification(SND).

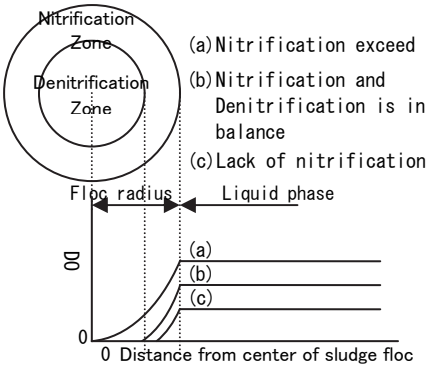

Fig.1 DO concentration in a floc

(2) Outline of demonstration experiment

The NADH system flow is shown in **Fig. 2**.

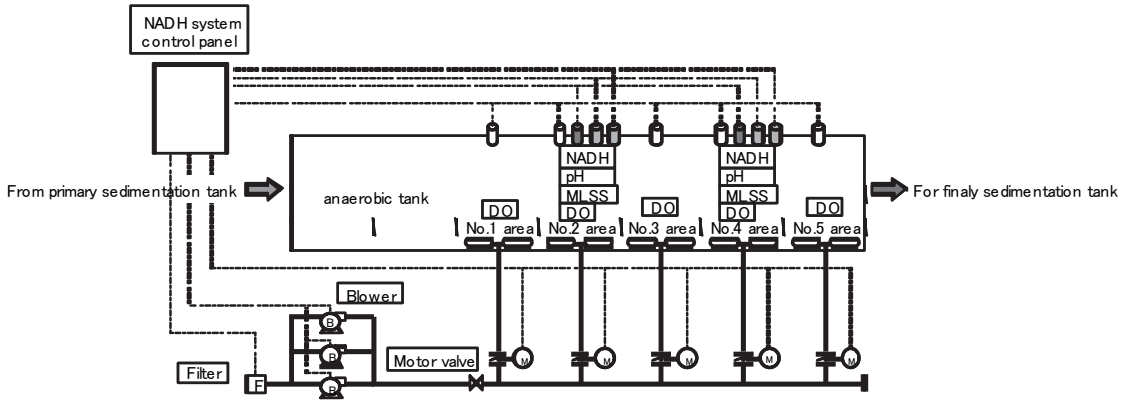

Fig.2 Flow of NADH system

The influent flow rate (Q) of 9,000m^3/day is used in case of the standard condition of the fine weather all through the year. The maximum influent flow rate of 14,000 and 11,000m^3/day are also studied in summer period and winter period, respectively. Return sludge ratio of 0.5－1.0Q is used. The range of 2,200－2,900mg/L of MLSS is also used. The followings are the main purposes of this study.

① Operation for demonstration experiment. (2011.12－2013.1)
② Arrangement of results in the demonstration experiment.
③ Evaluation of the nitrogen removal process.

(3) Outcomes

①Sludge sedimentation property

SVI was 130(average), SS in effluent was 1－4 mg/L, and transparency was usually over 1 m. The sludge sedimentation property in NADH process was better than that was observed in an AO process operated in the WTP of Fukuoka City.

②Nitrogen removal

The most of observed T-N in influent were over 30mg/L, and especially T-N in influent exceeded 40mg/L in winter season. The average of the T-N value in effluent was 9.36mg/L whereas the target value was 9mg/L. The mean value of removal efficiency of nitrogen was about 73%. Any place except for the aerobic zone controlled by NADH sensor for SND, denitrification occurred also in the part of the condition that was anoxic namely the inlet zone of final sedimentation tank. The annual average concentration of removed nitrogen in such anoxic condition and in the SND zone were as follow as:

- 7mg/L in SND zone,
- 5mg/L in inlet zone of final sedimentation tank.

The nitrogen removal as the waste sludge was as follows:

- 7～11mg/L as waste sludge.

The nitrogen content of waste sludge of 20-30% was as same as the content in the traditional biological nitrogen removal processes.

The decline of nitrogen removal was observed in winter season, because of the lack of organic matter and/or water temperature lowering. In such case, high concentration T-N flowed in. In this case, as for the addition of the organic matter such as methanol, it was confirmed that it was an effective countermeasure for reinforcement of the nitrogen removal.

③Phosphorus removal

T-P in influent was over 6mg/L in winter season, and the most of T-P in influent were above 4mg/L. The T-P average in effluent was 0.59mg/L whereas the target value was 0.4mg/L. The annual average of removal efficiency of phosphorus was about 85%. The instability of phosphorus removal occasionally took place. The inflow of T-N from sludge treatment process was considered as the reason of the instability as well as the inflow of high concentration of NO3-N to anaerobic tank through the return sludge operation. Naturally, like a conventional phosphorus removal process, the influence of precipitation was observed, too. Therefore the addition of PAC will be effective countermeasure for instability of phosphorus removal.

④Electricity consumption

- The total electricity consumption rate of NADH process was 0.41 kW/m3.
- The electricity consumption of blower system was 0.21 kW/m3.

※ Fukuoka City， Japan Institute of Wastewater Engineering and Technology
Inquiries ; Shigeharu Inoue, Yasumasa Sakabe, Kikuo Yanagiya, Yoshinari Abe; 1st Research Department [03-5228-6597]

Key words	Nitrogen removal， NADH， blowers control