

# Study of Nitrogen Removal Process Controlled by NADH

Year of research	2009~2012	Establishment of sound water environment
------------------	-----------	--

**(Introduction)**

Fukuoka City set up 'Master plan of advanced wastewater treatment for the Hakata Bay' to meet the environmental water-quality standards in the Hakata Bay in 1998, and discussed details to install an advanced wastewater treatments process. Improvement project for phosphorus removal had started in 1993 and the project has been completed by 1999. For nitrogen removal, A<sub>2</sub>O process has partly been installed since 2007. However, from the prospective of reducing of converting and maintenance cost as well as CO<sub>2</sub> emission, the new technologies for nitrogen removal are required. Under these situations, a method of maintaining simultaneous nitrification and denitrification in a single tank at very low dissolved oxygen concentration controlled by NADH sensor has been caught attention, and this nitrogen removal process has been planned to be introduced in part of the wastewater treatment plant in Fukuoka City as the trial. The process for nitrogen removal controlled by NADH has already been used in Europe, United States and Korea in the last decade. The aim of this study is to establish the operating condition of nitrogen removal process controlled by NADH, the low-cost waste water treatment process which does not require conversion nor expansion of the facility, to achieve 'the designed treatment water quality for advanced treatment'. In addition, the ease of maintenance and energy conservation ratio were also investigated. In the fiscal year 2010, a part of the equipment for the demonstration experiment was installed. And the effluent water quality, the specific contents and schedule of the experiment were discussed for fulfilling the requirement to obtain the permission of sewage works concerned in the configuration of advanced treatment plant and for preparing the manuals on design, operation and maintenance.

**(Results)**

(1) Technical summary

NADH (nicotinamide adenine dinucleotide) is an indispensable coenzyme for chemical reactions of metabolism. NADH absorbs light at a wavelength 340 nm and fluorescence at a wavelength of 460 nm. The concentration of NADH in a living bacterial cell is monitored by the NADH fluorescence sensor (shown in Figure 1). Changes in NADH concentration provide real-time information on the metabolic condition of sludge flocs; with this information, it is possible to determine whether the biological process is in state of oxygen respiration, nitrate respiration or anaerobic respiration. The nitrogen removal process controlled by NADH is consists of dual zone treatments. Figure 2 shows the DO concentration in sludge flocs. In DO curve(b), the shell of each flocs is under nitrifying condition while the core is under denitrifying conditions, which allow simultaneous nitrification and denitrification.

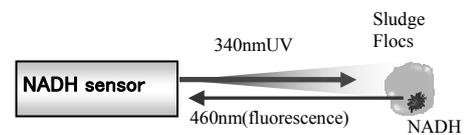


Fig.1 NADH sensor

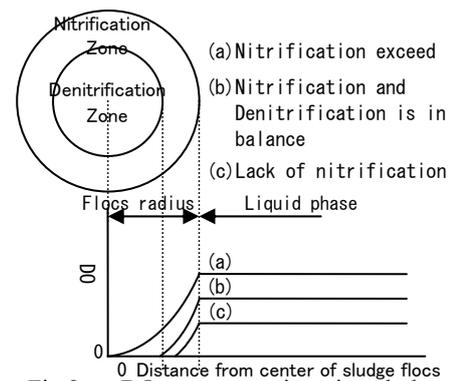


Fig.2 DO concentration in sludge

(2) Outline of demonstration experiment

The NADH system flow is shown in Figure 3. The influent flow rate (Q) of 9,000m<sup>3</sup>/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<sup>3</sup>/day are also studied in summer period and winter period, respectively. Return sludge ratio of 0.5Q is used. The range of 2,500-2,800mg/L of MLSS is also used.

### (3) Results

The followings are the summary of study results in the fiscal year 2010.

① The demonstration experiment plan and schedule were decided. The experimental period of the proposed process is one year from December 2011.

② The permissible maximum concentration was studied for the final effluent of this process and was decided as T-N of 13.5mg/L, T-P of 3mg/L and BOD of 15mg/L. And, for annual average concentration, T-N of 9mg/L, T-P of 0.4mg/L and BOD of 10mg/L were also decided.

③ A part of the equipment for the demonstration experiment was installed.

#### (4) Investigation plan in future

In the fiscal year 2010, planning for demonstration experiments was conducted and a part of the equipment for the demonstration experiment was installed. In the fiscal year 2011, remaining demonstration experiment equipment will be installed. Then, operating conditions of nitrogen removal process controlled by NADH to achieve designed effluent quality will be examined. The demonstration experiment for level 5 will be carried out in one year from December 2011.

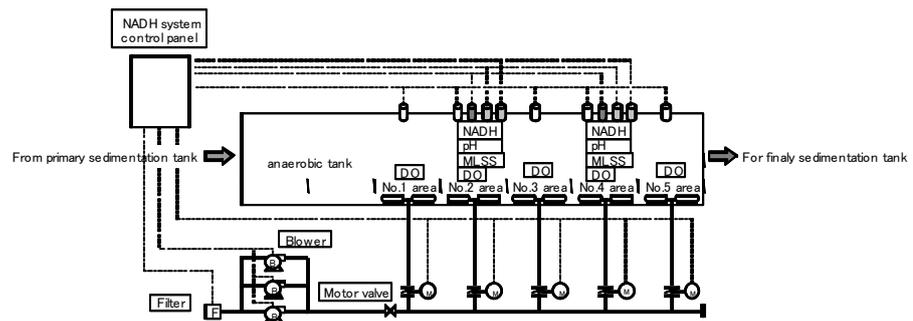


Fig.3 Flow of NADH system

Funded research from Fukuoka city

Contact: Hiroaki Morita, Akio Tada, Akinori Maeda, Shigeki Yoshida [03-5228-6597]

Key words

Nitrogen removal, NADH, blowers control