Promotion of Global Warming Countermeasures in Sewerage (Study period: FY2017 to FY2019)

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1. Introduction

As global warming countermeasures in sewerage, NILIM has been studying on how to grasp and reduce emissions of nitrous oxide ("N_2O"), one of the greenhouse gases.

2. Field survey on N_2O emissions in sewage treatment facilities

It is known that N_2O is generated as by-product or intermediate material when household effluent is biologically treated in sewage treatment facilities. There are a number of sewage treatment methods available and the amount of N_2O emitted in treatment process differs according to methods as known from the results of field surveys. Particularly in the advanced treatment method and MBR method, which both have a high nitrogen removal rate, the level of N_2O emissions is low and stable, while in the conventional activated sludge process (the "conventional process"), emissions differ according to treatment facilities and are higher than other treatment methods. Hence, with focus on the conventional process, in which emissions are relatively large, it is necessary to examine the relationship between operating conditions and N_2O emissions and take countermeasures. For this fiscal year, we are conducting a field survey for sewage treatment facilities that have adopted the staged advanced treatment operation, which is one of the operation control measures for improving water quality while using conventional process facilities. The result of this survey shows that N_2O emission factor and N_2O conversion factor in the staged advanced treatment operation are lower than those of the conventional process in the existing knowledge, which suggests a possibility of reduced N_2O generation. It is expected from this result that the staged advanced treatment operation has an effect on the control of N_2O emissions in the conventional process.

3. Study on operation with reduced N_2O emissions in the conventional process

In order to examine operation with reduced N_2O emissions for the conventional process, which accompanies particularly high emissions, we are investigating the relationship between operating conditions and N_2O emissions with a test using an experimental device (bench reactor) imitating the conventional process. As a result of considering the pre-aeration limitation operation (RUNA) and the nitrification-suppressed operation (RUND) as an operating condition, reduction of N_2O emissions was confirmed (Figure). In the pre-aeration limitation operation, insufficient nitrification in the aeration tank leading to post-aeration was suppressed since nitrous acid generated through nitrification was consumed promptly due to the proceeding denitrification in the pre-aeration limitation tank and organic matter was consumed through denitrification. It is consequently considered that nitrous acid accumulation in the system was reduced and N_2O generation on the whole was controlled. Hence, operation incorporating denitrification process in the conventional process is considered effective for reducing N_2O emissions.

4. Future issues

It was found how to prevent accumulation of nitrous acid in operation is important to reduce N_2O emissions in the conventional process. For establishment of appropriate operating methods according to various environmental conditions, it is necessary to organize microorganisms related to metabolism and operation control factors and clarify the control mechanism and we are going to work for clarification.

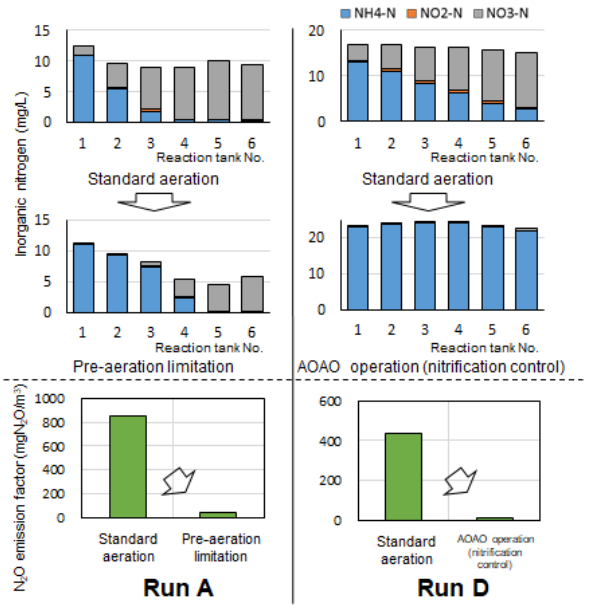

Figure: N_2O emission factors and behavior of inorganic nitrogen during different operation using the bench scale reactor