Promotion of Global Warming Countermeasures in Sewerage

YAMASHITA Hiromasa, Head, SHIGEMURA Hiroyuki, Senior Researcher, TAJIMA Atsushi, Senior Researcher, MICHINAKA Atsuko (Dr. Eng.), Researcher, ITAKURA Mai, Researcher, YAMAGUCHI Shuji, Guest Research Engineer, MAEDA Kotaro, Guest Research Engineer, HORII Yasuo, Guest Research Engineer
Wastewater and Sludge Management Division, Water Quality Control Department

(Key words) sewerage, global warming, nitrous oxide

1. Introduction

As one of the global warming countermeasures concerning sewerage, the MILIM is proceeding with the study for reducing emissions of nitrous oxide (N_2O), one of the greenhouse gases ("GHG") emitted from sewage treatment process, and on the effect of the rising air temperature attributable to global warming on sewage treatment.

2. Control of GHG emissions from wastewater treatment process

The widely adopted sewage treatment system is characterized by the generation of N_2O gas in addition to CO_2 generated from energy use since reaction of activated sludge (microorganism) is used in the system. Since it was found from the results of past studies that the amount of N_2O emitted from the conventional activated sludge process (the "conventional process") is outstanding among total N_2O emissions in water treatment process, we are studying the method of reducing N_2O emissions with focus on the conventional process. According to the results of the experiment using a pilot plant, when the aeration air flow at the first stage of treatment process is restricted, the rate of nitrogen removal improved approx. 10% and N_2O emissions reduced more than 80%. In addition, according to the results of the survey on actual amount of N_2O emissions in treatment facilities that operate the staged advanced treatment system, which removes nitrogen etc. by devising the operating method without changing the facility structure of the conventional method, the possibility of reducing N_2O emissions by the staged advanced treatment operation or nitrification control operation was demonstrated (Figure 1). Since the results of the study show that N_2O emissions can be reduced by the operation method that improves the ratio of nitrogen removal, introduction of the staged advanced treatment is expected to lead to reduction of N_2O emissions as well as quality improvement in treated water.

3. Effect of air temperature rise resulting from global warming on advanced sewage treatment

The advanced sewage treatment technology introduced in developed countries not only removes organic matter but also nutrients (phosphorus and nitrogen) using microorganisms such as phosphate-accumulating bacteria, nitrifying bacteria, and denitrifying bacteria. Since the temperature of sewage is expected to rise as global warming progresses in the future, we studied the effect of water temperature conditions on phosphorus removal and microbial communities in the sewage system. As the temperature was successively raised using a laboratory reactor, the capability of phosphorus removal was maintained from 22 to 28°C and declined at a temperature above 30°C (Fig. 2). These results suggest that if water temperature reaches the same level as in the torrid zone, activated sludge in the developed countries located in the temperate to subarctic zones may be affected by air temperature rise.

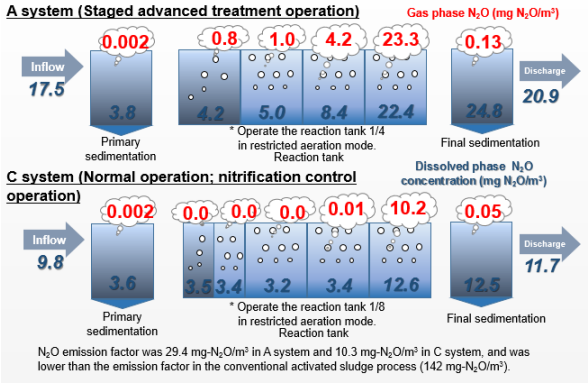

Figure 1: N_2O emissions in each operation mode

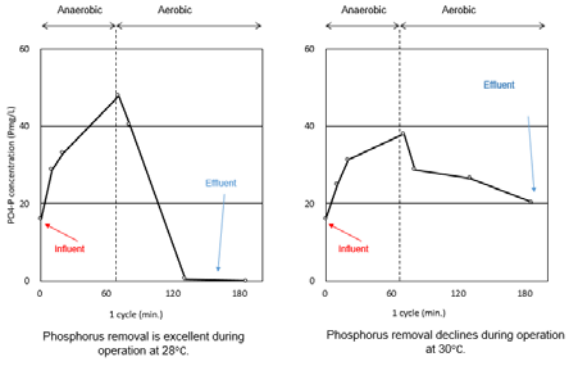

Figure 2: Fall of phosphorus removal ability due to temperature change

[Reference]

Michinaka (2015), "Journal of Japan Society on Water Environment," 38(9) pp.340-344