B-DASH: Demonstration of Nutrients Removal with ICT/AI Control of a Single-tank Nitrification/Denitrification Process

(Research of FY 2019-2020)

1. PURPOSE

This study aims to evaluate the treatment performance, treated water quality, power consumption, economic efficiency, and maintainability of Nutrient Removal with ICT/AI Control of a Single Tank Nitrification/Denitrification Process by full-scale demonstration. The technology consists of three elemental technologies. As figure 1 describes, aeration control using ICT and AI achieves the equivalent treated water quality to the A2O process in shorter HRT than the conventional nutrients removal processes. Besides, the optimized system using ICT-based facility combination and pressure variable control reduces power consumption, and AI supports seasonal fluctuation to improve maintainability.

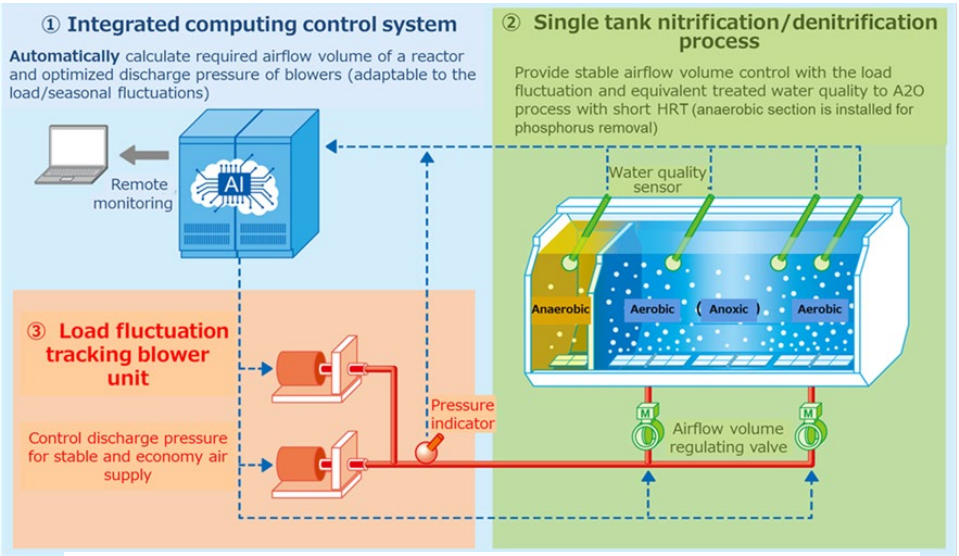

Figure 1. The schematic drawing of the demonstration technology

This research was adopted as the B-

DASH Project of MLIT in 2019. A joint research team of Metawater Co., Ltd, JS, and Machida city demonstrated as an entrusted research of the National Institute for Land and Infrastructure Management (NILIM).

2. Outcomes of the past years

One train with four tanks of the Naruse WWTP of Machida city was remodeled as the demonstration facility in 2019, and the demonstration started in January 2020.

3. Outcomes of this year

- **Treatment performance and treated water quality:** The demonstration's goal is the equivalent or better-treated water quality to the A2O process with 20% shorter HRT than the general A2O. The treated water quality at the final settling tank's outlet had an average T-BOD of 5.0mg/L, T-N of 10.8mg/L, and T-P of 1.3mg/L under the average 9.8hr HRT, all of which satisfied target values. The nitrogen removal rate of an average of 68.1% also achieved a target value of 60-70%, equivalent to the A2O process.
- **Operational power consumption:** The pressure variable control reduced blower power consumption per 1Nm3 air volume by 16% against the pressure constant control (target: 10% or more.) The power consumption per 1m3 treated water was estimated to be a 29% reduction against the A2O process (target: 20%.)
- **Control performance:** Required air volume was controlled through forecast calculation using facility data, including measuring water quality sensor values and air volume values. The air volume control could maintain concentrations of NOx-N, each in the middle and end of a reaction tank, to ±0.5mg/L, control target value. It also achieved an average of 98% precision against a target value of 95%. It was verified an automatic tuning function could change the calculation parameters for seasonal fluctuations.

- **Others:** The area where nitrification and denitrification progress simultaneously in a reaction tank was verified. According to this assumed area existed, the study manner of reaction tank capacity was established.

4. Conclusion

The full-scale experiment demonstrated stable and economic aeration control applicable to inflow load fluctuation and the equivalent treated water quality to the A2O process with a shorter HRT. The demonstration will continue next year to study treatment performance for a longer term and verify the marginal treatment performance.

Keywords: **ICT, AI, Nutrients removal, Nitrification/Denitrification**