Demonstration Study of B-DASH Projects on ICT/AI-based Technologies for Sewage Treatment Plant Operation and Management

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1. Introduction

In light of the financial difficulties and decrease in the number of technical personnel in municipalities engaged in sewerage projects, improving the efficiency of operation and management through the wide-area expansion of facilities and appropriately passing down the skills of skilled personnel have become urgent issues. As a method to solve these issues, use of operation management technologies based on ICT and AI is expected. On the other hand, relevant new technologies are being developed but many sewerage service providers are cautious about introducing them due to their limited track record. For this reason, the MLIT launched the "Breakthrough by Dynamic Approach in Sewage High Technology (B-DASH Project)" in FY2011. The Water Quality Control Department of the NILIM has been serving as an executing agency of this empirical project.
The purpose of this project is to demonstrate excellent and innovative technologies, formulate guidelines for introducing them, and disseminate them in order to realize cost reduction in sewerage service, efficient operation management, etc. In this paper, we report on three technologies for which we began a full-scale demonstration project in FY2021.

2. Outline of demonstrated technologies

The following provides an outline of each technology.

(1) Wide-area management system for sewerage facilities using ICT

This technology aims to realize a wide-area management system that efficiently performs remote monitoring and control for multiple and different treatment plants and pump stations by manufacturers of control equipment from a base facility. Specifically, the project will demonstrate the reliability and stability of communications and the effect of reducing construction and maintenance costs at six facilities in Kurashiki City by conducting remote monitoring and control, using a (i) common protocol method, (ii) remote desktop method, and a method that combines (i) and (ii), and defines common communication specifications for connecting systems of differing manufacture (**Fig. 1**).

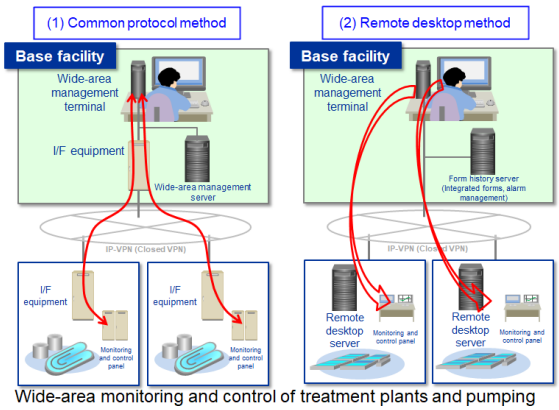

Fig. 1. Outline of the technology (Wide-area management)

(2) Advanced support technology for sewage treatment plant operation using AI

This technology aims to optimize and improve the efficiency of operation management by transferring the know-how of skilled engineers. Specifically, we demonstrate the stabilization of treated water quality and effect of reducing maintenance costs through operational support at the Seibu Water Reclamation Center in Hiroshima City and the Takase Sewage Treatment Plant in Funabashi City (**Fig. 2**), based on operation data on inflow water quality, treatment volume, etc. at the sewage treatment plants, using the following four functions:

(1) Image processing AI: Detects abnormalities from images such as the surface of water in settlement tanks;
(2) Water quality prediction AI: Predicts treated water quality for current and estimated operation volumes;
(3) Response decision AI: Visualizes the relationship between causes and responses, and presents measures to be taken, and;

(4) Operation AI: Derives optimum operation volume.

(3) AI-based support technology for water infiltration countermeasures for separate sewer systems in rainy weather

This technology aims to achieve optimal operation of separate sewer systems based on the increased volume of treated water at treatment plants due to infiltrated water in rainy weather. Specifically, at the Kinuura West Sewage Treatment Center in Aichi Prefecture, technology that supports the operation of pumps and other equipment during rainy weather will be demonstrated in terms of its effect on reducing operational burden, ensuring discharge water quality, and reducing overflow risk, by utilizing AI to learn inflow water volume, operational know-how of skilled engineers, etc. (**Fig. 3**).

3. Utilization of results and future development

In the future, we will compile research results as guidelines for each technology, based on the results of the demonstration studies and taking into account the opinions of experts and local governments. The standard structure of the guidelines is as follows.

Table: Structure of Guidelines

Chapter 1. General Provisions	Objective, scope of application, definitions of terms
Chapter 2. Outline of the Technology	Characteristics of the technology, terms of application, evaluation results
Chapter 3. Consideration of Introduction	Method of considering introduction, examples for consideration of introduction effect
Chapter 4. Planning and Design	Introduction planning, design
Chapter 5. Management	Inspection items, frequency, etc.
Data Part	Demonstration results, case studies, etc.

In addition, the NILIM is striving to disseminate and develop innovative technologies by holding guideline explanatory meetings, etc. As of May 2021, 52 technologies have been adopted for full-scale demonstration projects, 35 guidelines have been published, and 140 B-DASH technologies have been introduced for 13 technologies. For further dissemination and development, we are also working with the Sewerage and Waste Water Management Department of the MLIT to "establish energy performance indicators based on B-DASH technology and use the indicators as a grant requirement," "improve guidelines through follow-up of independent research after demonstration studies," and "create cost calculation tools". We will continue to work on the demonstration of new technologies as well as to promote their dissemination and development.

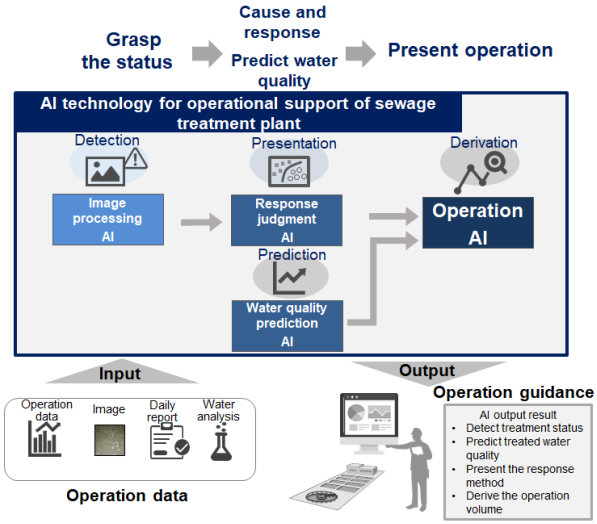

Fig. 2: Overview of the technology (AI-based operation support)

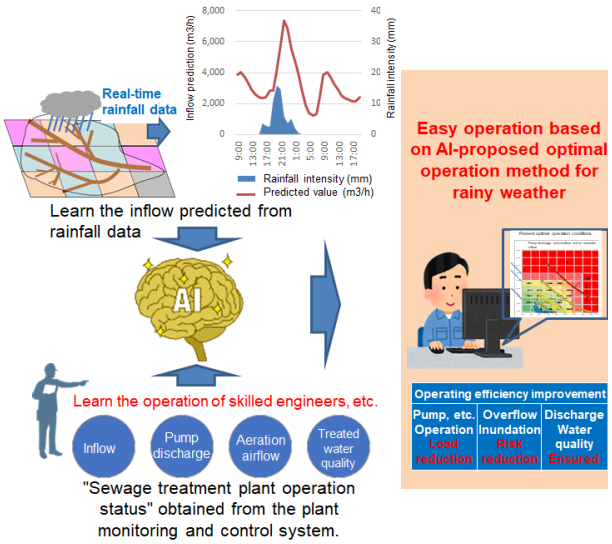

Fig. 3: Overview of the technology (Support for countermeasures during rainy weather)

☞See the following for details.

[Reference] Various guidelines are posted.

http://www.nilim.go.jp/lab/ecg/bdash/bdash.htm

[Reference] B-DASH technology application chart, etc. are posted.

https://www.mlit.go.jp/mizukokudo/sewerage/mizukokudo_sewerage_tk_000450.html