

Water & Environment

Connective Industries

#Disaster Prevention and Resilience #Co-creation and Open Innovation #Sustainability #Generative AI #IoT/Data Utilization
#Water & Environment Solutions

1. Higashine City, Yamagata Prefecture: Water Supply Facilities Central Monitoring and Control Facilities Renovation Work

The water supply system in Higashine City, Yamagata Prefecture consists of both waterworks and industrial water services. It provides a stable supply of high-quality tap water and industrial-use water through remote monitoring and control of 18 facilities including water sources and water treatment plants from the city office.

In response to the aging monitoring and control facilities, Hitachi has replaced the liquid crystal display (LCD) monitoring and control equipment that performs central monitoring and control of water supply facilities from the city office, along with the controllers (10 sets) in these facilities, with a new system used to construct remote monitoring and control facilities.

• Waterworks facilities (supply commenced: April 1953, supply capacity: 21,000 m³/day)
JGSDF Camp Jinmachi, Maekawara Water Source, Fukuroda Water Source, Fukuroda Water Treatment Plant, Omoriyama Upper Water Distribution Reservoir, Omoriyama Lower Water Distribution Reservoir, Jinmachi Water Distribution Reservoir, Tobu Central/Upper Water Distribution Reservoir (Central), Tobu Lower Water Distribution Reservoir, Takaoka Relay Pumping Station, Iri Upper Water Distribution Reservoir, Iri Lower Water Distribution Reservoir, Yokodai Relay Pumping Station, Taira Water Distribution Reservoir, Kidoguchi Pumping Station, Iwasaki Pumping Station

• Industrial water supply facilities (supply commenced: April 1992, supply capacity: 10,060 m³/day)
Nodashita Water Source, Omoriyama Industrial Water Source

The main features are as follows:

- (1) Redundant control local area network (LAN) for improved reliability.
- (2) Includes a history data restoration function to enable restoration of missing history data in the event of line failure (storing of history data in the controller enables restoration of up to three days worth of data).
- (3) Uses network address translation (NAT) technology to enable support for control LAN redundancy in the city office over existing controllers on a single LAN configuration.

[01] Water Supply Facilities Central Monitoring and Control Equipment at Higashine City Hall, Yamagata Prefecture



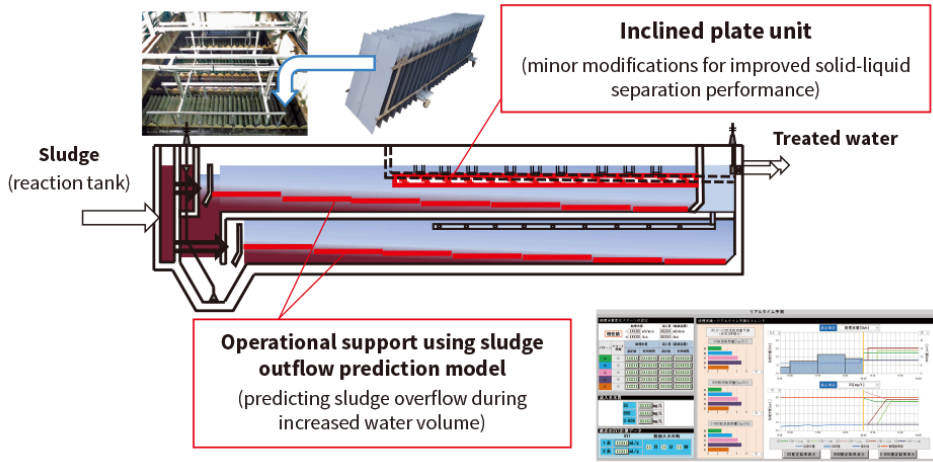
2. Case Study of Delivering Technology (Inclined Plate Unit) to Osaka City to Enhance Final Sedimentation Tank Performance in Combined Sewer System

As one method of improving its combined sewer system, Osaka City has been operating a wet weather wastewater treatment method (3W treatment method)—a wet weather activated sludge process that makes maximum use of the treatment capacity of wastewater treatment plant facilities. Among those facilities, at the Juhachijo Wastewater Treatment Plant, the solid-liquid separation performance of the multi-tiered final sedimentation tanks was a limiting factor in the 3W treatment volume. To address this, the application of an inclined plate unit was considered for improving the solid-liquid separation performance. The results after approximately a one-year demonstration test confirmed that stable treatment was possible with the unit even when the treatment quantity was increased to 2.5 Qsh (1.0 Qsh = planned hourly maximum wastewater volume). Currently, work is progressing on installing the inclined plate unit, and water is being partially supplied to the unit.

Features of Hitachi's inclined plate unit include shorter installation time due to unitization of the equipment, and the capability of continuous processing even during automatic washing by accelerating the sliding down of accumulated sludge (automatic cleaning) by raising and lowering the inclined plate. Furthermore, the use of a sludge overflow prediction model is planned to provide operational support (viewing alerts, guidance, etc. on a monitor). These measures will both reduce the discharge load of combined sewer systems and improve the efficiency of treatment during wet weather, thereby contributing to the preservation of water environments.

(Hitachi Plant Services Co., Ltd.)

[02] Technology to enhance final sedimentation tank performance in combined sewer system



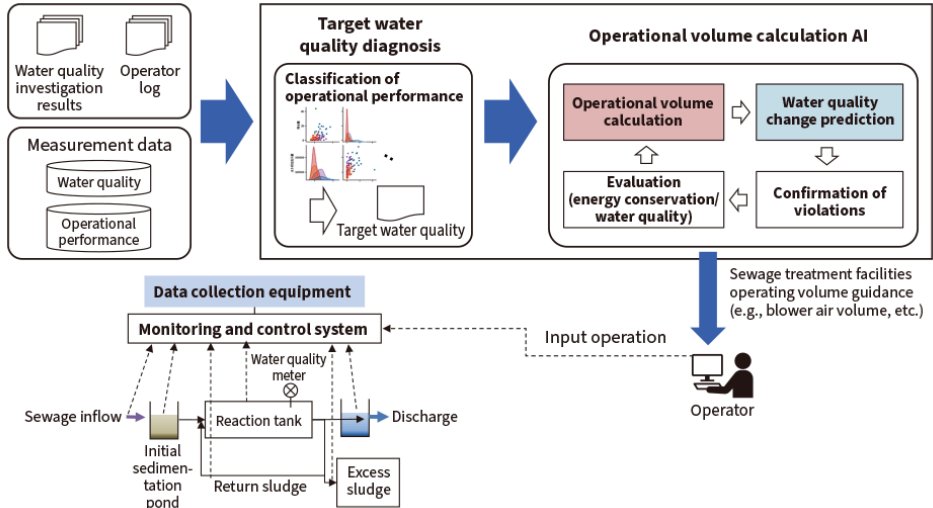
3. Sewage Treatment Plant AI Operational Support Technology

Sewage treatment accounts for 0.8% of Japan's electricity consumption, highlighting the importance of efficient operation in this area. Furthermore, the shortage of skilled workers is also a problem. To respond to this, Hitachi is developing sewage treatment plant artificial intelligence (AI) operational support technology to enhance maintenance and management efficiency.

This consists of two components: target water quality diagnostic processing that estimates the current processing status and the subsequent target water quality based on measurement data from monitoring systems and water quality test results. And, an operational volume calculation AI that provides guidance for energy-efficient equipment operation while meeting water quality targets. This technology provides support for operators' activities to achieve energy-efficient operation while still maintaining water quality.

Operation has been verified by the "Joint research project for practical application of AI-based sewage treatment" at the Saitama Sewage Systems Agency and the Arakawa Water Cycle Center. This technology was applied to sewage treatment plants from September 2022 through August 2023, with stable, AI-guided operation confirmed. Looking forward, commercializing this technology as a service will contribute towards solving problems in the sewage industry.

[03] Overview of sewage treatment plant AI operational support system



4. Operational Start of "Basin Flood Control Flood Damage Prediction System" First Delivered to Aomori Prefecture

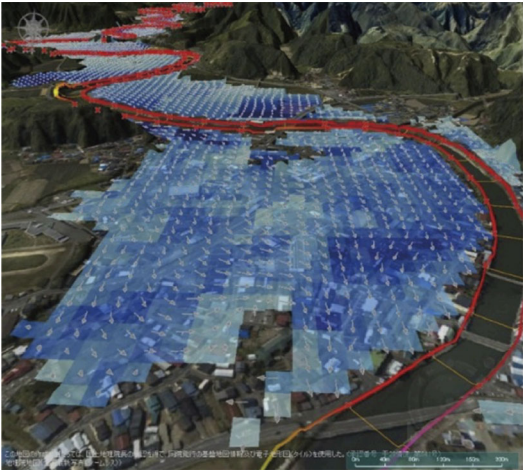
The first basin flood control flood damage prediction system was delivered to Aomori Prefecture, and full-scale operation commenced there in April 2023.

This system incorporates not only mapping data from the Geospatial Information Authority of Japan, but also river data and three-dimensional topographic data owned by prefectures to provide high-precision, high-speed flooding simulations. It also has expandability in terms of functionality in support of evaluations and emergency activities using simulation results, making it effective for both hardware and software aspects of river basin flood control measures for both national and regional governments.

This simulation utilizes DioVISTA/Flood technology, a real-time flood simulator from Hitachi Power Solutions Co., Ltd., which has a proven track record with deliveries to corporate customers.

Hitachi aims to contribute to reductions in flood damage caused by large-scale flooding events through broad deployment of this system to local governments that are working on flood control measures in their river basins.

[04] Nakamura River flood simulation using the basin flood control flood damage prediction system, based upon data from heavy rain in August 2022



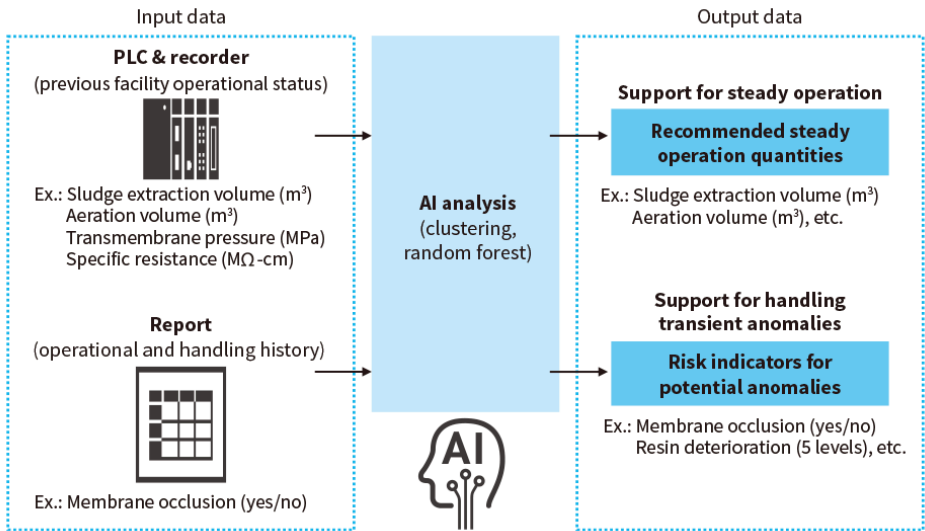
5. Stable operational support navigation for industrial water treatment facilities

Industrial water treatment facilities are essential for factories, and the causes of malfunctions and anomalies within these can vary widely, including auxiliary equipment and machinery along with external and environmental factors, and so skilled operators are required to address early indications of anomalies. However, number of skilled workers is decreasing as a result of the declining birthrate and aging population, with more cases of unskilled workers struggling when tasked with managing facilities.

In response to this, Hitachi has developed stable operational support navigation that uses AI to provide unskilled workers with support in operating facilities. Input data is collected from programmable logic controllers (PLC), recorders, and reports, including past equipment operational conditions and the operational and handling histories of skilled workers. Analyzing this data with AI provides output such as steady-state operating parameters and risk indicators for potential anomalies, and these can serve as support content for unskilled workers. By referencing this output data, unskilled workers can work toward more stable equipment operation, thereby preventing deterioration in water quality through early intervention, reducing workload, and avoiding serious problems.

(Hitachi Plant Services Co., Ltd.)

[05] System overview of stable operational support navigation for industrial water treatment facilities



6. Commercialization of a 250-kW Hydrogen Co-firing Generator to Contribute to Realizing a Low-carbon Society

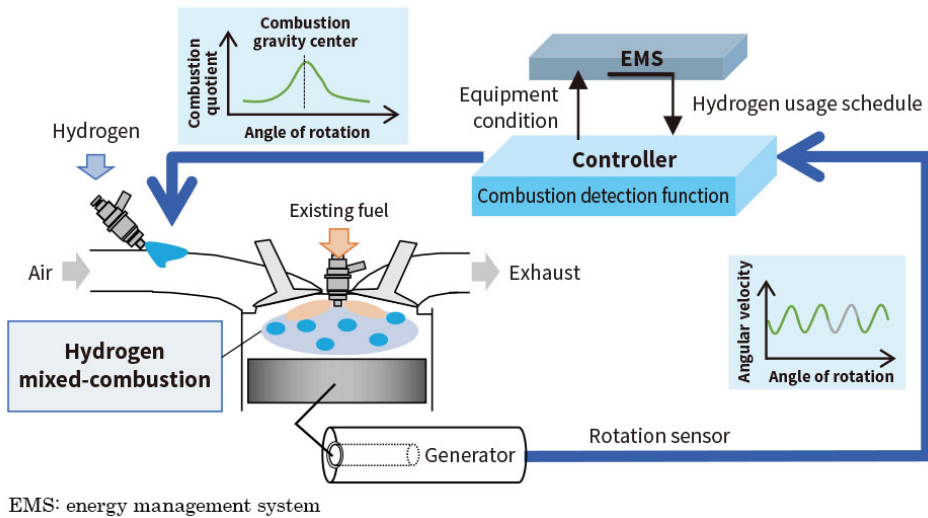
Having developed and commercialized a hydrogen co-firing generator that can efficiently utilize hydrogen, Hitachi has delivered this to construction machinery plants for realizing a low-carbon society. The hydrogen co-firing generator developed here is based upon a diesel engine and supports electricity generation using a blend of conventional diesel fuel and hydrogen. With a maximum mixing ratio of 50%, this generator can reduce carbon dioxide (CO₂) emissions by up to 50% when compared to generation using diesel alone.

During development, the high combustibility of hydrogen fuel meant it was necessary to detect the occurrence or signs of abnormal combustion during co-firing and to control the supply of fuel appropriately. To accomplish this, Hitachi developed functionality that monitors the combustion status within the engine combustion chamber. It uses existing electromagnetic pickup signals on rotating parts to estimate ignition timings, thus ensuring combustion integrity during co-firing and enabling stable operation.

This generator supports hydrogen mixing ratios of 30–50%, or use of conventional fuels such as diesel alone when hydrogen is not available, thereby enabling operation under different usage conditions.

Hitachi will accelerate its efforts to become carbon neutral through the practical utilization of hydrogen, while proactively undertaking the needs of society.

[06] Hydrogen co-firing generator energy system

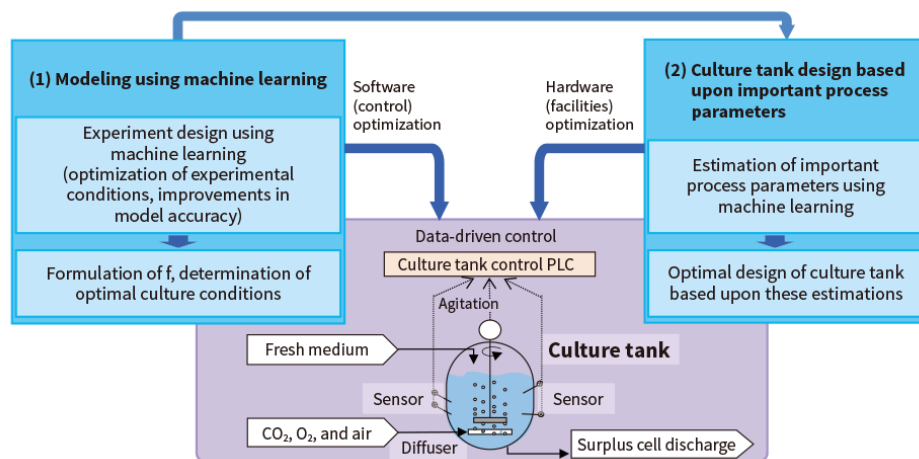


7. Process development support technology using continuous culturing and advanced culture simulation models

Biopharmaceuticals such as antibody drugs produced by propagating animal cells in a culture tank are becoming increasingly mainstream in the pharmaceutical market given their high efficacy and minimal side effects. However, the manufacturing process is complex, and finding process conditions that enable high productivity and mass production within a short time frame is challenging, resulting in prolonged development periods becoming a significant issue.

In response to this, Hitachi has developed a technology that leverages the characteristics of perfusion cultivation. This technology can maintain a constant environment during culturing and search for optimal conditions while modifying cultivation parameters, a task hitherto difficult to achieve using conventional process development. Furthermore, through collaborative research and development with academia, it has been confirmed that combination with Hitachi's proprietary machine learning enables optimal culture conditions using a small number of trials. Additionally, this modeled important process parameters and applied these to culture simulations leading to proposals for cultivation tank shapes and operating conditions that achieve high productivity even when using batch culturing, which is currently mainstream. Hitachi will verify its effectiveness with customers through a proof of concept (PoC) as a proposal that leads to a reduction in environmental impact.

(Hitachi Plant Services Co., Ltd.)



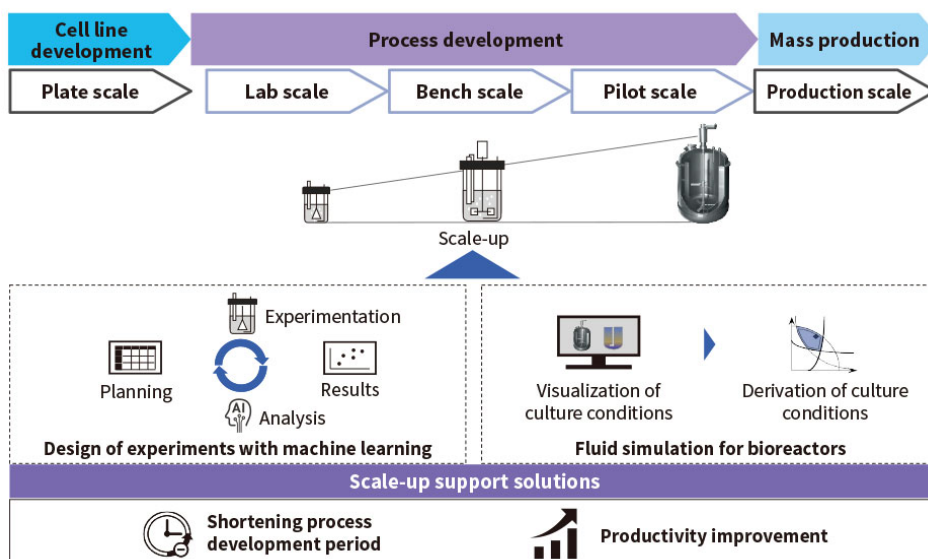
8. Solutions for Scale-up Support Business in the Biomanufacturing Field

Material production using biotechnology (biomanufacturing) which enables the simultaneous resolution of social issues and economic growth, is expected to experience high growth in various fields such as functional materials, energy and food, in addition to healthcare. The technical challenges for the social implementation of biomanufacturing are scale-up studies to achieve mass production from laboratory scale, which requires significant time and cost to identify cultivation conditions that maximize productivity while maintaining quality.

Accordingly, Hitachi is developing solutions to support customers' scale-up studies, and to resolve the challenges detailed above. To achieve this, Hitachi will utilize knowledge obtained from the pharmaceutical field to enhance fluid simulation for bioreactors that predict cultivation conditions based on production scale operating parameters, as well as the design of experiments with machine learning to identify optimal cultivation conditions at the laboratory scale with the minimum number of trials. In addition, it is also studying how to integrate these technologies with digitalization.

Hitachi aims to expand digital solutions and establish support business for the market growth in the biomanufacturing field.

[08] Solutions for Scale-up Support Business in the Biomanufacturing Field



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