# Water & Environment



## 1 Overview of Water Environment Solutions and Future Directions

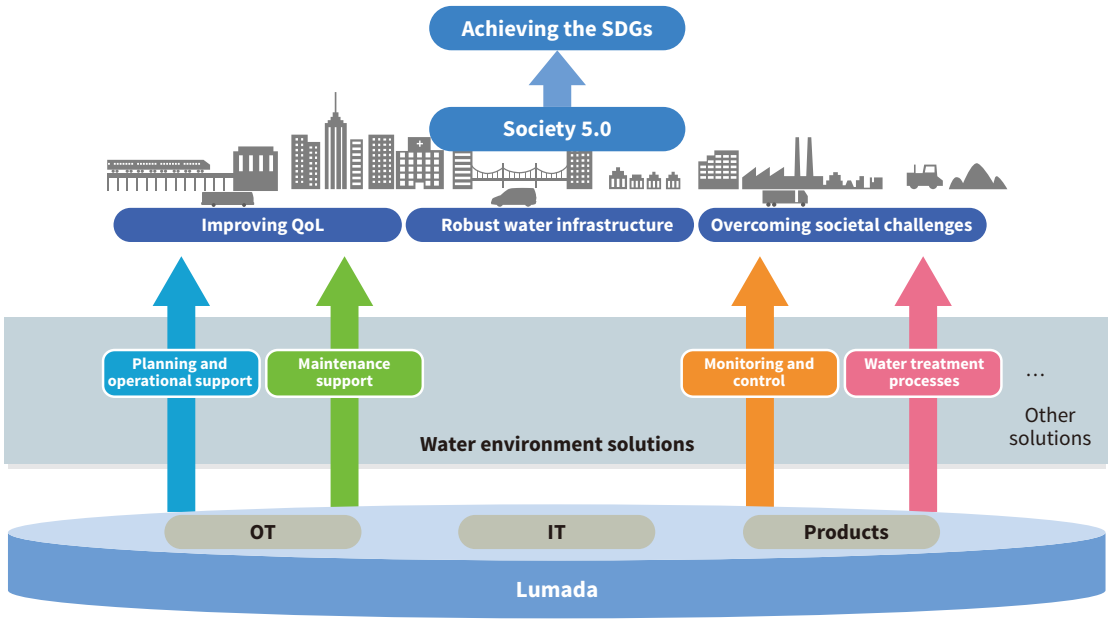
The Hitachi Group has laid out a strategy of accelerating its Social Innovation Business that seeks both to improve people's quality of life (QoL) and to deliver solutions to societal challenges by simultaneously enhancing social, environmental, and economic value for its customers.

It is against this background that Hitachi's water environment solution business is working to find comprehensive solutions for the issues affecting water, which is so indispensable to life, as well as for issues affecting the wider environment. In concrete terms, Hitachi contributes to solving problems by coordinating technology, systems, and services, including planning and management support, maintenance support, monitoring control, water treatment processes, etc. In addition to the operational technologies (OT), products, and systems that serve as operational and controlling technologies for water infrastructures, Hitachi is also actively promoting the utilization of Lumada and other IT and digital technologies, while accelerating efforts such as water demand forecasting, water quality simulation, management support for equipment and pipelines, and support for inheritance of the techniques of skilled personnel.

While contributing in a wide range of fields to the realization of a robust water infrastructure, including water source maintenance and flood control, water utilization, waterworks, industrial water, sewerage systems and industrial effluent, desalination, water reclamation, etc., Hitachi is also seeking to build Society 5.0 while achieving the Sustainable Development Goals (SDGs).

## 2 Central Monitoring and Control System for Central District Waterworks Office (Mito Water Purification Plant), Ibaraki Prefecture Public Enterprise Bureau

The Ibaraki Prefecture Public Enterprise Bureau supplies water for waterworks over a wide area covering the prefecture's four regions of Southern District, Rokko District, Western District, and Central District. Among them, the Central District Waterworks Office (Mito




1 Future directions for Hitachi's water environment solutions

2 Central monitoring and control system of the Central District Waterworks Office (Mito Water Purification Plant)

Water Purification Plant), which uses surface water from the Nakagawa River that flows through the prefecture as a water source to supply water to ten municipalities, one of which is Mito, the prefectural seat of Ibaraki, and one public enterprise.

The monitoring and control system of the Mito Water Purification Plant supervises equipment inside the water purification plant itself as well as equipment at one water intake pumping station, three booster pumping stations, and 17 water distribution stations. Due to the aging of the monitoring and control system, Hitachi implemented a general upgrade of the monitoring and control system at the Mito Water Purification Plant and water intake pumping station with the goal of improving reliability and streamlining operation monitoring tasks.

The upgraded monitoring and control system provides the following features:

(1) Equipment installed at the Mito Water Purification Plant enables communication between the Hinumagawa River Water Purification Plant located in the same Central District, thereby enabling the sharing of information regarding water distribution stations monitored and controlled by the Mito Water Purification Plant while integrating operations across the Central District.

(2) Controllers installed at the water intake pumping station communicate with a municipality and control water intake equipment in a cooperative fashion. This increases operation efficiency by reducing the number of pumps when compared with would be required for separate water intake operations.

## 3 Application and Demonstration of Digital Solutions that Support Operation and Maintenance for the Hakodate City Enterprise Department

Domestic water utilities are faced with a variety of issues, such as deteriorating facilities and the need to hand on skills. Against this background, the Hitachi Group is working toward an operation and maintenance (O&M) support digital solution by strengthening public-private partnerships and utilizing the cloud.

In FY2018, Hitachi began demonstrating the O&M support digital solution by targeting the city of Hakodate's water purification plants in the Akagawa area and the eastern district water supply system for which Hitachi has partial management responsibilities. This


3 Waterworks management facilities in the City of Hakodate

solution provides functions such as equipment inspection support, water volume management utilizing machine learning, residual chlorine calculation utilizing a reaction model, etc. by integrating with monitoring and control systems, tablet terminals for inspections, data centers, etc., thereby achieving the following two benefits:

(1) Efficient management of the maintenance of multiple waterworks facilities across a wide area

(2) Management of appropriate water volume and residual chlorine management at water purification plants in the Akagawa area with different water treatment methods

Hitachi is going to adapt and expand the "O&M support digital solution" in the project, contract to upgrade, operate, and monitor water purification plants at Hakodate to contribute to sustainable business management for water supply.

## 4 AI-assisted Optimization of Flocculant Dosing Rate during Coagulating Sedimentation Process

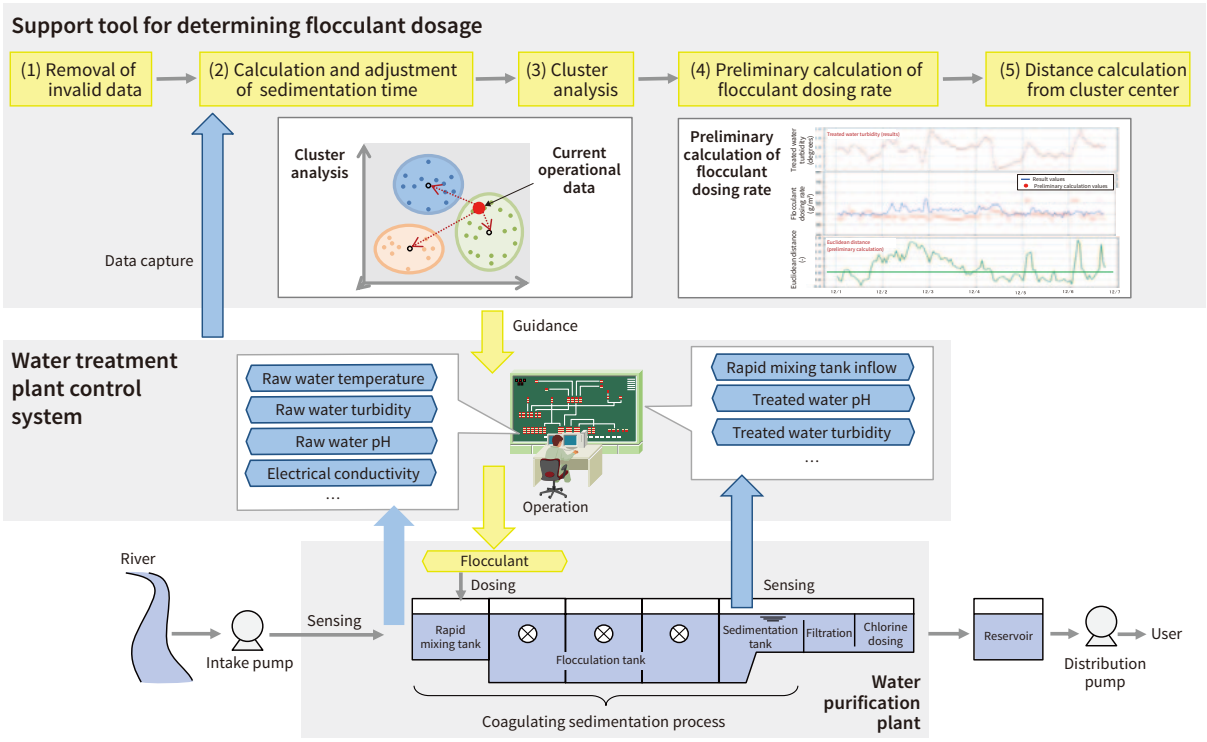
As the water treatment market in Japan experiences ongoing privatization and consolidation driven by the financial difficulties of local governments and decreasing populations, hopes are being placed on the use of information and communication technology (ICT) to help pass on operation and management know-how, to provide better training tools, and to enable deskilling.

In response to these issues, Hitachi is proposing and working to optimize flocculant usage amounts based on artificial intelligence (AI) at the water treatment plants where it has been contracted to do maintenance work. Determining how much flocculant to add has in the past been treated as a skilled task, with quantities being adjusted in proportion to current water quality and based on past experience. However, population aging is starting to lead to a shortage of skilled workers at operational sites.

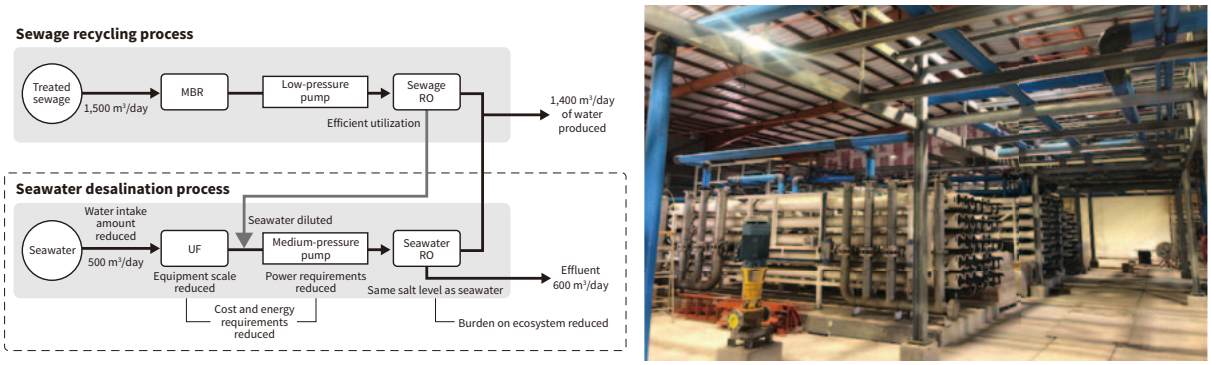
Hitachi has developed a preliminary method for calculating flocculant dosing rates based on machine learning using operational records, with the goal of optimizing flocculant dosage amounts at water treatment plants. This method uses cluster analysis to classify trends in the operational results of historical operational records, so that it can capture the obtained clusters as operational patterns for a water treatment plant when performing the preliminary calculation of flocculant dosing rate aimed at operational maintenance with a target turbidity.

Hitachi intends to construct a system that can automatically acquire the operational records of water treatment plants to use for supporting water treatment plant operations.

(Hitachi Plant Services Co., Ltd.)




4 Support for determining flocculant dosing rate during coagulating sedimentation process




MBR: membrane bio reactor RO: reverse osmosis UF: ultrafiltration

**5** Integrated system of seawater desalination and sewage treatment: processing flow (left), plant under construction (right)

## 5 Integrated Seawater Desalination and Sewage Recycling Verification Project in South Africa

By integrating both seawater desalination and sewage recycling processes, this integrated system of seawater desalination and sewage treatment achieves both a massive improvement in energy efficiency as well as a reduced burden on the marine environment compared to traditional processing methods.

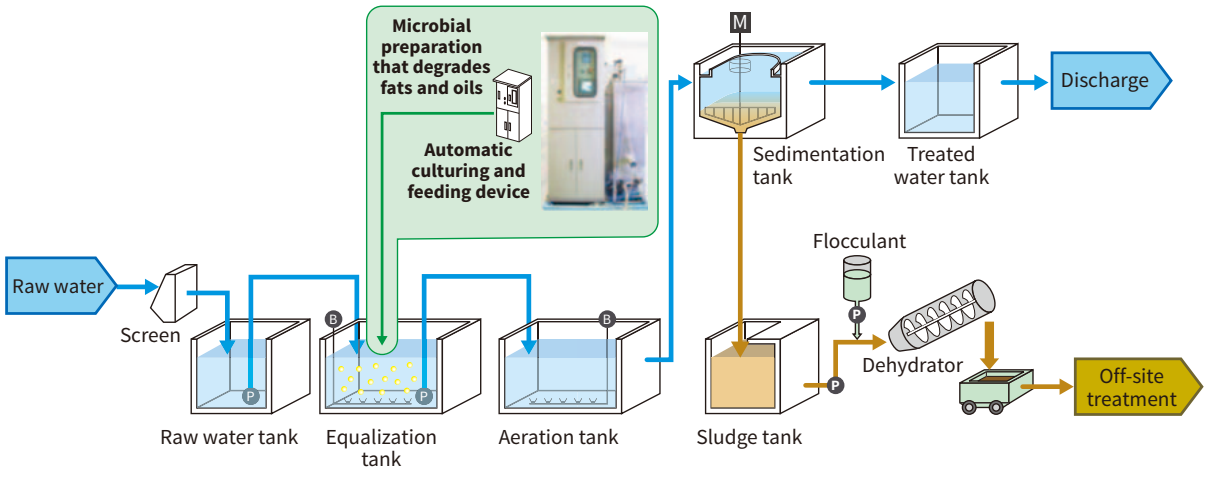
Since this technology is a multiple recycling process that can recycle the wastewater produced by sewage recycling, it is expected to contribute to achieving the SDGs, and for this reason, not only is it drawing attention in regions with water shortages, it is also attractive to developed nations as well as Asia, Africa, island countries, and other countries that are enthusiastic about global environmental protection.

Hitachi contracted with the New Energy and Industrial Technology Development Organization (NEDO) in February 2015 to carry out the "International Energy Consumption Streamlining Technology System Verification Project," and launched a verification project in the city of Durban in the Republic of South Africa, which has expressed a strong interest in this technology. The company plans to complete construction on a demonstration plant in 2019 that will desalinate 6,250 m³ of water per day, and will operate this plant as a demonstration project for approximately one year.

## 6 High-efficiency Food Wastewater Treatment Technology Using New Oil-degrading Microbial Preparation

The fats and oils in food wastewater are eliminated using dissolved air flotation and other treatment equipment, but if the fat and oil component is large, discharge water quality management and sludge disposal costs can increase, resulting in problems for customers.

Hitachi has conducted fundamental evaluations and field experiments regarding the fat and oil degradation performance in wastewater of a new




**6** Wastewater treatment flow using microbial preparation

microbial preparation (manufactured by Nissan Chemical Corporation) that can efficiently decompose fats and oils derived from animals and plants.

This preparation includes two types of microorganisms that can degrade fats and oils. One of these microorganisms (*Burkholderia*) uses an enzyme (lipase) to degrade fats and oils into glycerin and fatty acids. The other microorganism (*Yarrowia*) degrades and assimilates the fatty acids. To apply this preparation to wastewater treatment equipment, Hitachi installed an automatic culturing and feeding device on the manufacturing floor, cultured the microorganisms, and then added them to the wastewater. The results of this research confirmed that the preparation offers excellent performance when decomposing fats and oils, even in high concentrations. This method is expected to efficiently treat fats and oils while reducing sludge production.

Hitachi will promote this preparation mainly for use in food factories, while proposing its adoption at existing wastewater treatment facilities as well.
(Hitachi Plant Services Co., Ltd.)

## 7 Decontamination Engineering Technology Using $H_2O_2$ Gas for Medicine Factories

The general method used during lot changeovers at medicine and sterile product factories is to decontaminate (sterilize) the inside of the booth that covers the production line, often using hydrogen peroxide ($H_2O_2$) as a decontamination reagent due to its low toxicity and minimal residual effects. The steps involved during $H_2O_2$ decontamination are dehumidification, conditioning, decontamination, and aeration. Although the settings of $H_2O_2$ concentration, humidity, and processing time during each decontamination process are all important parts of determining the design and conditions of decontamination equipment, the most indispensable factor is estimating the changing concentration of $H_2O_2$ over time.

It is against this background that Hitachi has constructed a technique of analyzing concentration during the conditioning and aeration processes of a closed restricted access barrier system, for which demand has been growing in recent years. By modeling the adsorption and desorption of $H_2O_2$ molecules from the surface of the analyzed decontamination object material, Hitachi was able to estimate an average difference of 22 ppm between actual measurement values and analysis values in the upswing of the $H_2O_2$ concentration. This newly constructed analysis method enables decontamination engineering based on selection of the $H_2O_2$ gas generator and setting of the operation conditions.

Hitachi intends to improve accuracy by storing data for various conditions and reflecting this data in simulations, while also expanding coverage (expanding the target to regenerative medicine as well as the entire room during changeovers).
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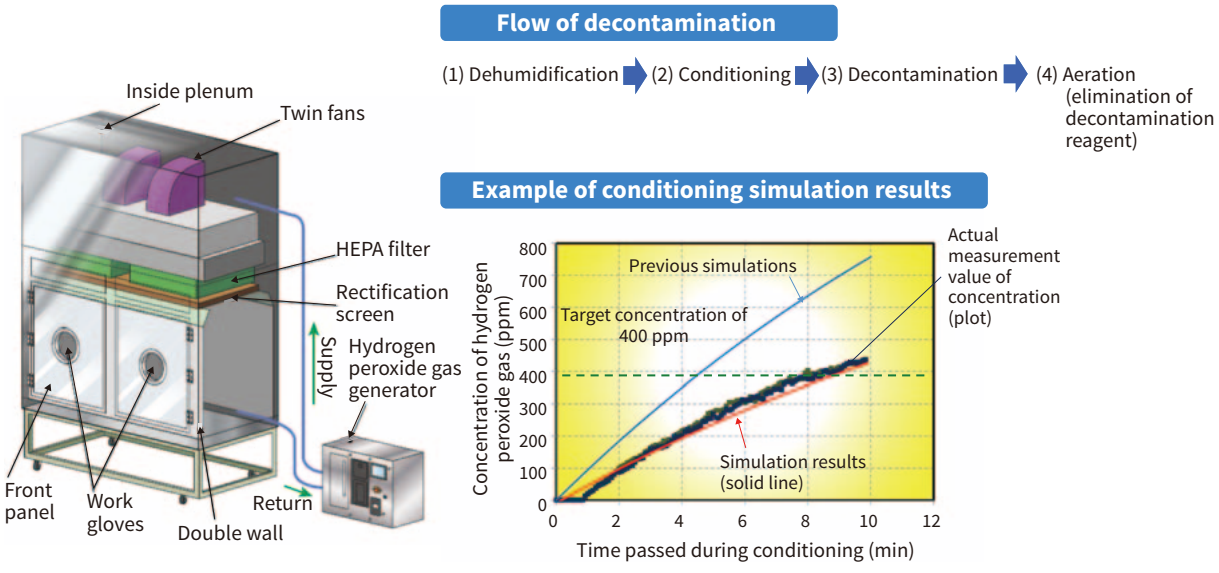



HEPA filter: high-efficiency particulate air filter

**7** Example of applying to closed restricted access barrier system

## 8 Utilization of Automatic Marking Robot System in Digital Construction

In response to a lack of skilled engineers on construction sites caused by the decreasing birthrate and aging population, and for the sake of implementing work style reform, Hitachi has developed an automatic marking robot system to enable the automation of work that has previously required multiple experts.

During the installation of piping, ducts, suspension devices, and other equipment, marking work requires skilled techniques involving confirming blueprints on-site, measuring, and drawing installation positions on floor surfaces. These tasks would benefit from streamlining and a reduction in the level of skill required.

This system's main functions are as follows:

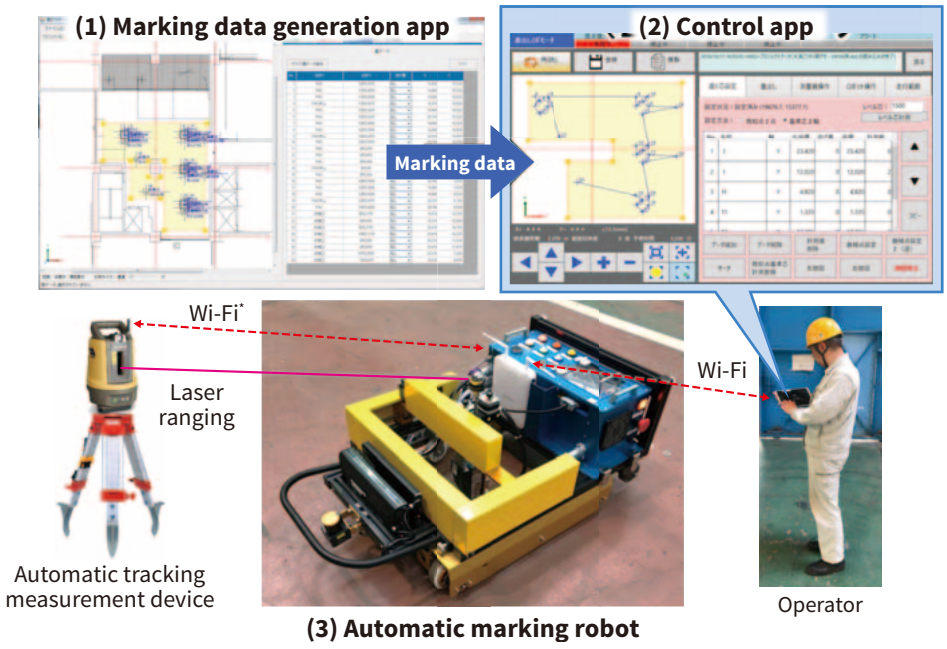
(1) A "marking data generation app" that extracts marking positions from a computer-aided design (CAD) (building information modeling) blueprint and automatically creates operational data for a robot

(2) A "control app" that uses AI to create the correct marking order, sets up automatic travel, issues instructions, and monitors a robot

(3) An "automatic marking robot" that can recognize its own position to a high degree of accuracy by coordinating with an automatic tracking measurement device

The results of applying this system at internal company sites (eight locations) showed an achievement of a marking accuracy of ±3 mm and a marking speed of three minutes/point, saving labor by, for instance, doing two man-days (two workers × one day) of work in 0.5 man-days (one person × one half day). Hitachi is currently working on designing a mass production model that can be provided to users outside the company, by improving both reliability and quality.

(Hitachi Plant Services Co., Ltd.)




* See "Trademarks" on page 151.

8 Overview of the automatic marking robot system