

Hitachi's Contribution to Global Water Business

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OVERVIEW: The 21st century has been called the “water century” and there are forecasts that predict the global water business will have a market size of 100 trillion yen in 2025. Hitachi is actively pursuing its water infrastructure business which is one of its social innovation businesses. The Global Water Recycling and Reuse System Association, Japan was established in 2009 by Japanese companies in the water business to support their aims to expand globally and Hitachi’s role in the Association is virtually as an operational company engaging in practical measures. Meanwhile, other leading-edge initiatives being pursued through research commissioned by New Energy and Industrial Technology Development Organization include projects on “demonstration study of an integrated systems business for reuse of seawater, fresh water, sewage, and other wastewater” in Japan and “demonstration study of a small-scale distributed water circulation business in emerging regions such as the Middle East.”

INTRODUCTION

AMID claims that the world is experiencing a water crisis, companies that in Japan are called “water majors” (large multinational water companies) are seeking to expand the water market. The overall water market which includes plants, products, EPC (engineering, procurement, and construction), and operations is forecast to become huge reaching the 100 trillion yen range in 2025. Hitachi, whose business structure focused in the past on plants and products such as pumps, is now accelerating reorganization toward a structure with objectives that extend to operating an EPC business for water treatment equipment including mechanical, electrical, and information systems and water business operation.

This article describes the recent global expansion of Hitachi’s water business with a particular emphasis on its pump business, water supply and sewage treatment business, and examples of new businesses.

GLOBAL EXPANSION OF WATER BUSINESS

Hitachi has for nearly a century been supplying a range of different types of products that relate to the water environment. Because of the need for change in its business structure due to the requirements of the water market becoming more diverse in recent years, Hitachi is seeking to shift its focus from the supply of plants and products that were its mainstay in the past toward mechanical and electrical equipment, information systems, and water business operation.

Water-related businesses can be said to have gone through two major turning points. One is the rapid rise in the value of the yen and the other is the privatization of water infrastructure.

Over the 30 years from 1980 to 2010, influences such as the sudden rise in the yen stemming from the 1985 Plaza Accord have resulted in the yen appreciating against the dollar by an average of four yen per year (see Fig. 1).

The first large overseas water treatment project

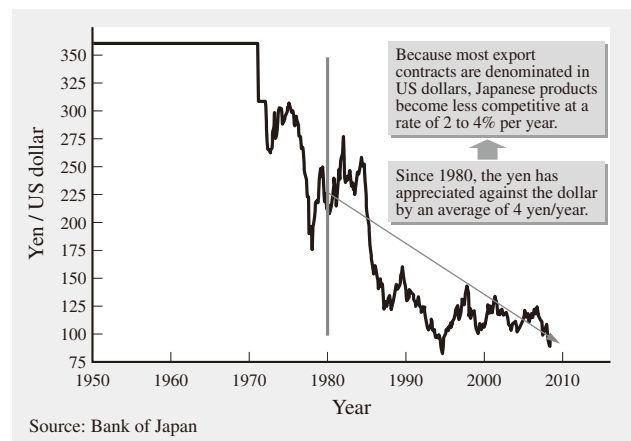


Fig. 1—Trend in Yen-Dollar Exchange Rate.

After having a fixed exchange rate in the 1960s, the yen was floated in 1973, and the rapid appreciation in the yen caused by the Plaza Accord after the oil crisis of the 1970s has reduced the competitiveness of Japanese products in overseas markets. As a result, varieties of measures are needed to find a way forward outside Japan.

undertaken by Hitachi Plant Technologies, Ltd. was stage one of the China Steel Corporation construction in Taiwan in 1977 and the company continued to bid in competitive tenders for water supply and sewage systems in the Southeast Asia region until about 1985. After 1985, however, the appreciation of the yen picked up pace bringing a halt to any further overseas water treatment work and triggering a shift in its business toward projects paid for by yen credits or aid from the Japanese government. And its activities in Southeast Asia and China involved industrial wastewater equipment for Japanese companies and other similar projects. This ODA (official development assistance) work saw the company win orders for several dozen upgrade or expansion projects for urban water treatment plants in Asia as well as Central and South America, and it also constructed five sewage treatment plants for Kuala Lumpur, the capital of Malaysia, which serviced the entire city.

Although this overseas business allowed the company to build up a broad-based competitiveness on overseas projects compared to other Japanese companies, it was not on a par with the international "water majors." And with companies from China, South Korea, and elsewhere having also entered the market, the company believes that, for the future, it needs to organize its business in such a way that it can become involved in the high-volume end of the market by changing its cost structure so that it can deliver high quality at a low price.

The second turning point was the privatization of water supply and sewage infrastructure businesses which was a consequence of a new philosophy which The World Bank expressed in the late 1990s by saying that "privatization is essential for the world's water infrastructure."

In the early 2000s, the privatization of water supply and sewage businesses in emerging economies and developing economies got underway in cities such as Manila, Jakarta, and Buenos Aires. However, the transformation of these businesses into private operations run by European companies represented a serious threat because it left no room for any other companies to enter the market. The reason for this was that, with water infrastructure being in public ownership in Japan, Japanese companies faced the problem that, even if they had adequate management capabilities, they were unable to enter the market because they had no track record of operating a water business.

To circumvent this situation, Hitachi Plant

Technologies established a water reclamation business in the Emirate of Dubai in 2008 and acquired shares in the Male' Water & Sewerage Company Pvt. Ltd. (MWSC) in the Republic of Maldives in the Indian Ocean in 2010 with the intention of building up know-how and other resources in the water supply and sewage business. Also, Hitachi in November 2009 became the first Japanese corporate group to sign a memorandum of understanding on the environment and energy efficiency with China's National Development and Reform Commission, and it intends to accelerate the expansion of its water business.

An expansion in Hitachi's overseas privatization business is anticipated and Hitachi intends to proceed actively with its overseas activities in order to establish a firm position for itself in the global water business.

GLOBAL EXPANSION OF PUMP BUSINESS

As a pump manufacturer, Hitachi has contributed to the water business globally by participating in major projects and national projects in Japan and elsewhere for irrigation, domestic water supply, industrial water supply, wastewater, and electricity generation. The following sections give overviews of the Mubarak Pumping Station Project in Egypt and the South-North Water Transfer Project in China in which Hitachi participated.

Mubarak Pumping Station Project in Egypt

Egypt has been undertaking desert greening projects for many years and Hitachi has supplied roughly 60 large irrigation pump systems since the 1960s. The Mubarak Pumping Station is a water supply system for the Toshka Plan that aims to construct a new town on reclaimed desert land and is part of a large-scale project that was finished only five years after the completion of construction, being driven by advanced Hitachi technology and demonstrating technical leadership of a multinational consortium. The pump station achieved a high level of efficiency with a maximum discharge capacity of 334 m³/s which it must raise over a 31.5-m difference in elevation. In addition to demonstrating Hitachi's engineering capabilities and being well regarded in Egypt as an example of foreign aid, it has contributed to the future international water business (see Fig. 2).

South-North Water Transfer Project in China

China's South-North Water Transfer Project gets its name from the fact that it transfers water from the south (Yangtze River catchment) to the water-deprived



Fig. 2—Mubarak Pumping Station.

This high-capacity pump for a desert greening scheme in Egypt constituted a large project and remains in operation today.

north (Yellow River catchment) of the country.

The plan is one of the world's great water transfer projects and will supply water to Beijing, Tianjin, and other major northern regions from the water-rich Yangtze River (which has an outflow of 960 billion m³/year) via three routes called respectively the Eastern Route (which takes water from the mouth of the Yangtze), Central Route (which takes water from the mid-catchment Danjiangkou Reservoir), and Western Route (which takes water from the headwaters of the Yangtze).

Hitachi received the order for the Baoying Pumping Station (on the Eastern Route) which was the project's first pump station and completed the installation of three adjustable-blade pumps with a capacity of 100 m³/s in 2005. Later, in 2006, Hitachi Plant Technologies together with Hitachi Pump Manufacture (Wuxi) Co., Ltd. received an order for tubular adjustable-blade axial-flow pumps for the Lin Jiachang Pump Station.

This pump station is located in Tongshan County in Xuzhou, Jiangsu Province and pumps 100 m³/s of water supplied from Xietai Pump Station to Nansi Lake and was completed in March 2009. Hitachi Pump Manufacture (Wuxi) Co., Ltd. is also participating in the Eastern Route section of the South-North Water Transfer Project as a Chinese manufacturer and has contributed to the national project by supplying pumping equipment to the Huaian No. 4 Pumping Station (four 33.4 m³/s × 4.68 m × 2,240 kW upright axial-flow pumps) and Liushan Pumping Station (five 31.5-m³/s × 6.43-m × 2,800-kW upright axial-flow pumps).

It is anticipated that, having entered the “water

century,” the demand for large-scale projects will continue to grow in order to secure water resources that can be used safely and with confidence. To respond to this market demand, Hitachi will apply the latest technology to make an even greater contribution to society by offering optimum pump systems including highly reliable pumps with high efficiency that have a small environmental impact.

GLOBAL EXPANSION OF WATER TREATMENT BUSINESS

Hitachi has for many years supplied water-related plants and systems around the world. Hitachi currently operates a “social innovation business” that undertakes the transformation of social infrastructure utilizing technologies such as those that deal with the environment, information, and safety and peace of mind, and in the water-related environmental sector which includes water supply and sewage, Hitachi aims to realize the “intelligent water” concept that contributes to the overall optimization of the water-related environment by utilizing and integrating water environment solutions and information technology using its extensive systems, services, and other products.

This concept deals with the water-related environment from a network-wide perspective rather than just considering individual facilities, equipment, and other components, and sets out to manage water, information, and energy as a single entity. The intention is that, by contributing to aspects such as the optimization of the water-related environment on a per catchment basis, managing water operations based on supply and demand, and improving the efficiency of

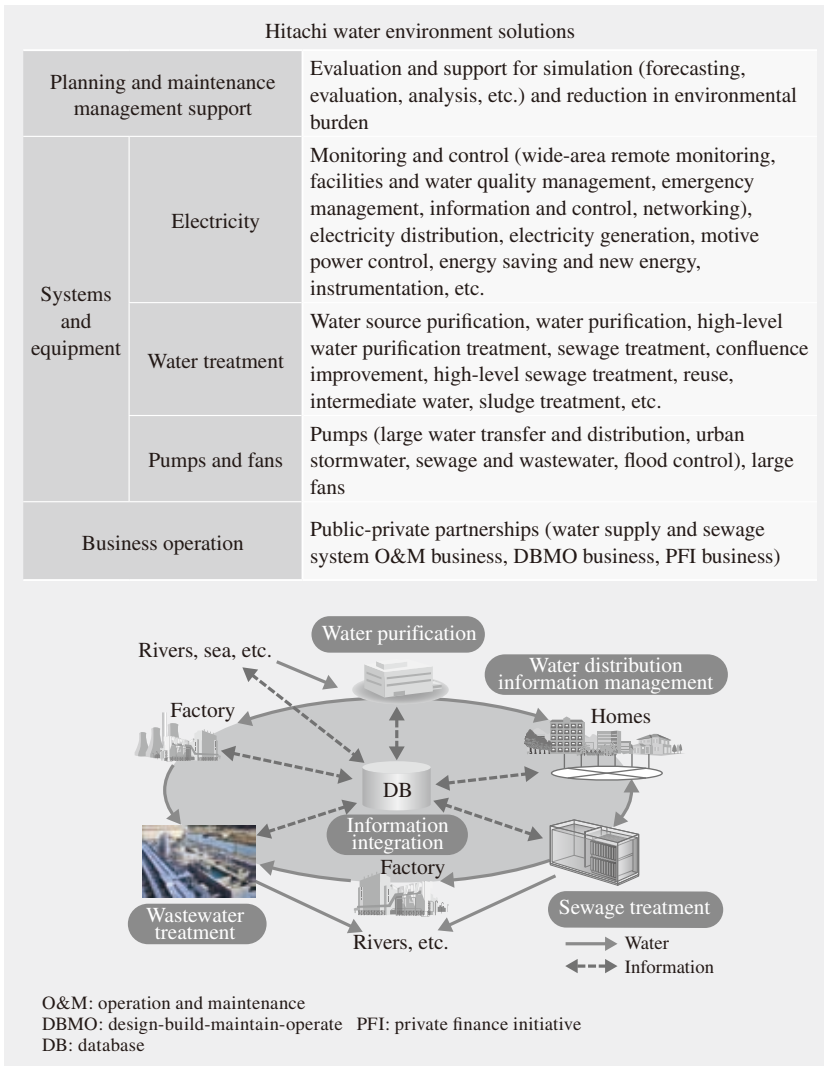


Fig. 3—Concept Behind “Intelligent Water” Integrated Water Environment System.

The concept aims to optimize the overall water-related environment in cities and other regions by using information technology to integrate Hitachi’s numerous water environment solutions.

business operations, Hitachi can contribute to realizing and maintaining a robust water-related environment (see Fig. 3).

Water Supply Business

In January 2010, Hitachi purchased from the government of the Maldives a 20% share of MWSC, the company that operates the country’s water supply and sewage system.

MWSC was established in Male, the capital of the Maldives, in 1995 and operates water supply and sewage systems on Male and six other islands in the Republic, covering approximately 40% of the country’s population. The company also has licenses to operate water supply and sewage systems on another six islands.

A Hitachi Group company Hitachi Aqua-Tech Engineering Pte. Ltd., a manufacturer of RO (reverse osmosis) membrane systems based in Singapore, has already supplied approximately 200 seawater

desalination units in the Maldives.

Hitachi plans to participate in the operation of MWSC and bring together the comprehensive strengths and know-how of the group to encourage rationalization of the Maldives’s water supply and sewage system business while at the same time acquiring know-how in the operation and management of water supply and sewage systems to work toward creating a water supply and sewage system operations business that has a global scale.

Water Reclamation Business

Since February 2009, Hitachi has been operating a water recycling business in the Emirate of Dubai in the United Arab Emirates (UAE) that collects and processes domestic wastewater then sells the output as recycled water.

The societal background to this business model is the rapid rise in the number of workers caused by the urban development boom in Dubai. Because

Dubai's only public sewage treatment plant is unable to cope with this rapid increase in population, workers' domestic wastewater has to be carried by tanker to a sewage treatment plant some tens of kilometers away for treatment. However, this requires the sewage treatment plant to process volumes of domestic wastewater well above its capacity and the resulting degradation in the quality of the treated water became a major problem when it came to be reused, and the traffic congestion caused by tankers themselves also became a problem for the community. Also, Dubai relies on sea water desalination for the bulk of its water supply which makes water charges expensive and yet the water is used for industrial and other purposes.

Hitachi established a business by collecting the workers' domestic wastewater and levying treatment charges, and by establishing a treatment facility close to the source of the domestic wastewater that it uses to treat the water which it then supplies to nearby factories for industrial use at a cheaper price than water from the public water supply system. The treatment facility uses a combination of MBR (membrane bio-reactor) and RO techniques. Both of these use membrane technology which is characterized by the small size of the plant and the good quality of the treated water.

This business started in February 2009 and was set up as a joint-venture company with Al Ghurair Group, a major local conglomerate.

The stage I plant will be located in a cement works where it will collect domestic wastewater from nearby and supply the treated water for use as industrial water in the cement works. Construction of the stage II plant is planned for the 2010 fiscal year (see Fig. 4).



Fig. 4—Operation of Water Recycling Business in Dubai. Domestic wastewater is delivered by wastewater tanker for processing using MBR (membrane bio-reactor) and RO (reverse osmosis) and the recycled water is transported for sale by a recycled water tanker.

Water Treatment Plant that Utilizes New Energy

The population of the Arabian oryx, a member of the bovine family that is native to desert regions, is decreasing year by year due to over-exploitation for reasons that include its consumption as meat or use of its horns in arts and crafts, and the species is now at risk of extinction. Hitachi has received an order for water supply equipment that was installed in the Emirate of Abu Dhabi at a total of 15 sites in the desert along the border with the Emirate of Dubai with the aim of protecting the Arabian oryx, gazelle and other species. The water is sourced from wells that have a high concentration of salt, treated by desalination equipment that uses an RO membrane, and the desalinated water then supplied via channels to water holes for the endangered animals that live in the vicinity.

Also, out of concern for the local environment, the power supply for the equipment is supplied via a solar power system (stand-alone generation system with a maximum output of 45 kW per power supply unit). The capacity of the RO membrane system is 4 m³/h per site and the units only operate in the daytime. Although batteries are included to improve the stability of operation, the system does not operate at night. Because the Arabian oryx are nocturnal and have a habit of standing with their feet in the water when they drink, shallow water holes shaped like a pond are used rather than troughs. Also, a remote monitoring system was installed to manage the status of the 15 sites scattered across a wide area of desert efficiently using GPRS (general packet radio service) (see Fig. 5).

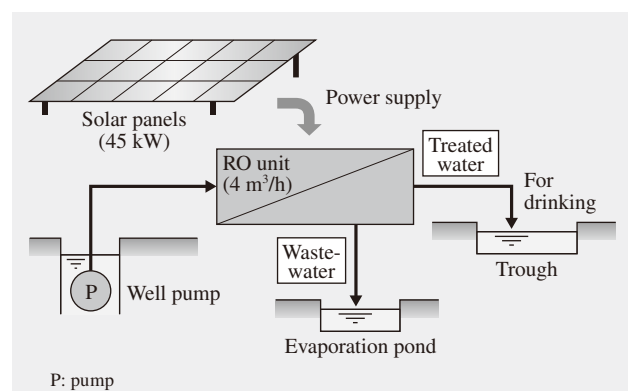


Fig. 5—Flow Diagram of Drinking Water Production Plant Using RO System Powered by Solar Electricity.

Water contaminated with salt that has been pumped up from wells drilled in the desert is used as feedstock for desalination using an RO membrane to produce drinking water for animals at risk of extinction. Power is supplied by solar power generation. The system was installed at 15 locations in the desert.

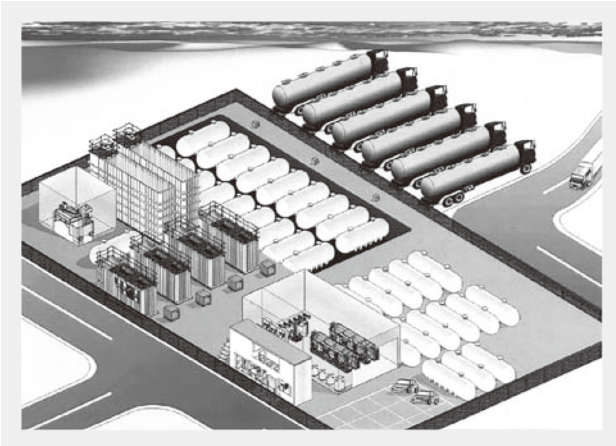


Fig. 6—Concept Diagram for NEDO Project in Emirate of Ras al-Khaimah.

Domestic wastewater is transported from worker housing at an industrial park for treatment by MBR and RO systems and the recycled water supplied for use as industrial water in the industrial park. A trial to verify the operation of the plant is planned as a New Energy and Industrial Technology Development Organization (NEDO) project.

The water supply system is environmentally conscious and is suitable for remote islands and other inaccessible locations, and the solar technology is also considered suitable for deployment with compact wastewater treatment systems.

Expansion of Water Business Utilizing Outside Capital

With the aim of expanding overseas water business, the Global Water Recycling and Reuse System Association, Japan was established in January 2009 by approximately 30 private-sector companies including Hitachi, Ltd. and Hitachi Plant Technologies, Ltd. to facilitate the establishment of the underlying basis for overseas expansion through activities such as conducting surveys, developing technology, and trialing model businesses. This section describes examples of research commissioned by New Energy and Industrial Technology Development Organization (NEDO) in which Hitachi has been participating through this association.

Water Conservation and Water Treatment Technology in Harmony with Environment

(1) Research into trialing an integrated systems business for reuse of seawater, fresh water, sewage, and other wastewater

The demonstrational operation of a system that combines treatment of domestic wastewater with an energy-efficient seawater desalination system that uses

RO membranes started in the 2009 fiscal year with the aim of developing efficient production technology for industrial water in response to the global water shortage. The plan is to install a 1,500-m³/d MBR/RO plant at the Hiakari Sanitation Center in Kitakyushu City together with test-bed equipment to establish the infrastructure for carrying out various types of trials with the aim of reducing the energy required to convert seawater to fresh water by 30% by mixing MBR-treated water with seawater to lower the osmotic pressure of the seawater.

Similarly, there is a plan to install an MBR/RO plant at the Tokuyama Central Sanitation Center in Shunan City that will mix water treated by the MBR process with wastewater from adjacent factories and then pass this through RO treatment to produce high-quality industrial water that can be reused at the factories.

(2) Small, distributed water circulation business for Middle East and other emerging regions

At the Al Ghail Industrial Park in the Emirate of Ras al-Khaimah in the UAE, the water supply was delivered by tanker and domestic wastewater was also carried away by tanker for treatment at a sewage treatment plant located several tens of kilometers distant. Now, Hitachi is operating a trial business at this site that has installed a 2,000-m³/d MBR plant and 1,000-m³/d RO plant to process domestic wastewater and produce water for industrial use that earns income from the treatment charges for the domestic wastewater and the sale of the industrial water (see Fig. 6).

Ultra-large Seawater Desalination Technology

A new national science and technology program called the Funding Program for World-leading Innovative R&D on Science and Technology was established in the 2009 fiscal year and one of the topics selected was the “Mega-ton Water System” (proposed by Masaru Kurihara, Consultant to Toray Industries, Inc.). The idea behind the topic was “to create an energy-efficient seawater desalination and sewage treatment system with the largest capacity in the world to solve the worsening global water problem, and in the future to secure reliable water resources by deploying the systems globally as core technologies for a Japanese water major,” and the reason stated for its selection was that “it is an important proposal for undertaking the development of practical desalination systems by establishing a strong organizational structure that links industry and academia and is significant because it involves the use of systemization technologies in which

TABLE 1. Sub-topics of Mega-ton Water System Project
The lead researcher for this four-year project to construct an ultra-large seawater desalination plant is Masaru Kurihara, a Consultant to Toray Industries, Inc. The supplementary budget for the 2009 fiscal year invested 100 billion yen to fund 30 researchers. Also, Hitachi Fellow Dr. Akira Tonomura will develop a world-leading electron microscope as part of the Funding Program for World-leading Innovative R&D on Science and Technology.

Category	Sub-topic
Research and development of specific technologies	Highly efficient, high-capacity separation membrane element module
	Technology for extraction of water from seawater
	Osmotic pressure power generation
	Highly efficient energy recovery
Research and development of system technologies	Durable low-cost piping
	Optimization of the configuration of a large plant with a capacity in the 1,000,000-m ³ /d range
	Innovative sewage integrated membrane processing system suitable for resource production
	Chemical-free seawater desalination system

Japan is weak and the technology can be expected to provide the basis for the international expansion of Japanese water businesses.”

Hitachi, Ltd. and Hitachi Plant Technologies, Ltd. are core members of the project and are responsible for progressing two of its eight sub-topics, these being “optimization of the configuration of a large plant with a capacity in the 1,000,000-m³/d range” and “highly efficient energy recovery.” Hitachi Plant Technologies is coordinating the “optimization of the configuration of a large plant with a capacity in the 1,000,000-m³/d range” sub-topic in particular and will proceed with development (see Table 1).

Water Business in China

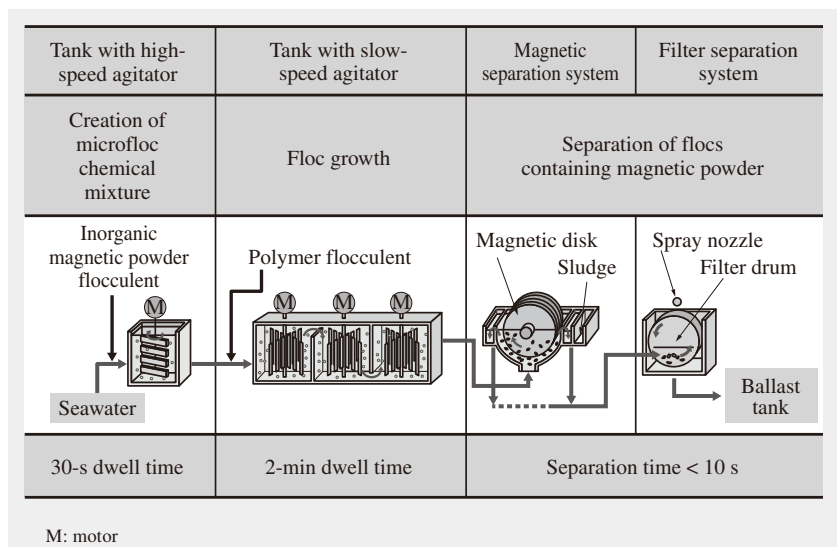
In November 2009, Hitachi was the first Japanese corporate group to sign a comprehensive contract with China’s National Development and Reform Commission in the field of resource recycling and building a low-carbon society. The intention is to proceed with various collaborative models directed toward urban development that takes account of the environment in five different fields, these being new energy, smart grids, transport, water resources, and recycling.

In the field of water resources, the plan is to construct specific model cities that feature water recycling to realize the “intelligent water” concept that seeks to optimize the overall water-related environment by combining information systems for water distribution data management with infrastructure technologies in the form of water purification technology, industrial wastewater treatment technology, sewage treatment technology, and reclaimed water production technology. Further, it is anticipated that this will contribute to achieving water management at a national level, including the implementation of a water environment information system that enables the sharing of water-related environmental information between a number of cities to manage water sources and catchments over a wide area.

NEW BUSINESSES THAT CONTRIBUTE TO GLOBAL ENVIRONMENT

Hitachi is developing new businesses that will contribute to the global environment by utilizing technologies developed by its research and development arms.

Fig. 7—System Flow Diagram of Ballast Water Purification System.
The system uses magnetic separation technology to reduce its size and achieved high-speed operation. Microorganisms in the seawater are aggregated by the magnetic powder and flocculants and then collected and removed by a magnetic disk. Small particles are removed by an output-stage filter.



Ballast Water Purification System

Ballast water is seawater taken on-board a ship to act as ballast (to help keep the ship stable). Because ballast water taken on in one country may be discharged in another, it is alleged that when this happens plankton or other microorganisms contained in the seawater can spread disease-causing organisms or otherwise damage the marine ecosystem in the harbor where the ballast water is discharged. To counter this environmental problem, the International Maritime Organization (IMO), an agency of the United Nations, issued an International Convention for the Control and Management of Ships' Ballast Water and Sediments in 2004 that obliged ships to fit treatment systems.

In 2003, Hitachi, Ltd.'s Business Incubation Division and Mechanical Engineering Research Laboratory in collaboration with Mitsubishi Heavy Industries, Ltd. and Yuyo Steamship Co., Ltd. commenced development of a new ballast water purification system⁽¹⁾ that combines agglomeration and magnetic separation based on the concept of creating systems that take account of the environment. Commercialization of the system by Hitachi Plant Technologies, Ltd. commenced in 2007 and it won an award for excellence at The Nikkan Kogyo Shimbun environment awards in 2008.

The system became the first from a Japanese manufacturer to receive final certification from the IMO in July 2009, and having also received certification in Japan, it has since gone on sale (see Fig. 7).

High-speed Treatment System for Water Contaminated with Oil

Oil production sites produce water as well as oil and the proportion of this water is growing year by year. Because the increasing volume of water restricts the quantity of oil produced, there is a need to separate the oil and water at the production site to keep the proportion of water in the oil to a minimum. For offshore oil fields in particular, there is a need to develop small high-performance water-oil separation systems that can perform high-speed processing on the production platform and discharge the separated water back into the ocean.

In response, Hitachi commenced joint research with Japan Oil, Gas and Metals National Corporation (JOGMEC) in 2009. This work aims to use agglomeration and magnetic separation technology belonging to Hitachi Plant Technologies, Ltd. to develop a system that can reduce the amount of oil in

the water to a level at which discharge into the ocean is permitted. The project will start by surveying conditions at oil fields where the system could be used such as in Mexico to determine the required design specifications for oil removal. Next, a container-type demonstration system will be used to collect data on the actual water in parallel with the production of a scaled-up pilot system for on-site land-based and offshore testing to verify the processing performance. Alongside this work, development of additional technologies associated with the agglomeration and magnetic separation technology will also be undertaken which will involve the development of flocculants and recovery flocculation processing techniques suitable for use on an offshore platform.

Fresh Water Export Project

Exporting fresh water from water-rich Japan to the State of Qatar which suffers from water shortages contributes to solving the country's water problems. To determine the business viability of a fresh water export system that exports industrial water and highly treated sewage or other recycled water from Japan to Qatar on ships where it is used in place of sea water ballast, a business viability study was carried out as part of a 2009 fiscal year Japan External Trade Organization (JETRO) project for supporting oil resource development and similar activities.

As a result, the project was referred to in a joint communique on economic relations issued by Japan and Qatar on November 19, 2009. This indicates the level of interest in Qatar and provides a major boost toward further work such as carrying out detailed studies and implementation.

CONCLUSIONS

This article has described the recent global expansion of Hitachi's water business with a particular emphasis on its pump business, water supply and sewage treatment business, and examples of new businesses.

Hitachi has initiated a number of activities aimed at participating in the water business which is characterized by a rapidly expanding market. For the future, it intends to accelerate the deployment of its businesses in an active way to supply the water environment solutions it has built up in the past in a range of different fields to contribute to society by bringing together the comprehensive strengths of Hitachi while also encouraging links between industry, government, and academia.

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