

“Watering”

Expansion of Water Recycling Business in Dubai, Middle East

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OVERVIEW: Water shortages have been growing more severe in many countries as populations skyrocket and societies develop, making water the focus of international debate. Membrane separation is one of the technologies currently drawing attention as a possible solution. Hitachi Plant Technologies, Ltd. is providing Dubai in the United Arab Emirates with water treatment systems based on membrane separation technology, built around a newly developed MBR system. In addition, Hitachi has been actively participating in the Global Water Recycle System Association launched in January 2009 by domestic Japanese companies associated with the water business, and is contributing to the search for solutions to water issues on a global scale.

INTRODUCTION

THE 21st century is being called the “century of water,” with water becoming a key economic and sanitary issue in regions around the world. This includes the emirate of Dubai, which is located in a desert region facing the Persian Gulf, roughly in the center of the Middle East. Demand is expected to rise for drinking water production facilities and human sewage treatment facilities in Dubai as part of the

infrastructure necessary to support the development of cities to house the emirate’s growing population.

This article discusses Dubai’s water environment, MBR (membrane bioreactor: membrane separation activated sludge system) technology developed in Japan by Hitachi Plant Technologies, Ltd., the water recycling business developed in the field based on this technology, and future prospects.



Fig. 1—Conceptual Picture of Dubai in 20 Years (Nakheel P.J.S.C. Development Project).

Dubai in the United Arab Emirates has set the year 2030 as a target in its plan for increasing the city’s population from the current figure of 1.5 million to 7 million. Although Dubai is constructing many different artificial islands off its coast, and is working to develop the emirate as a tourist destination, the global economic crisis that began at the end of 2008 has forced the government to make major revisions to its plans.

WATER SHORTAGES AND MEMBRANE FILTRATION TECHNOLOGY

Water shortages are severe around the globe, and it is said that if humans continue to consume water at the same pace, by 2025 half of the world's population, or approximately four billion people, will be facing water shortages. Membrane filtration technology is drawing attention as one technology that may solve this water problem.

Classifications for the membranes used in membrane filtration technology include RO (reverse osmosis) membranes with pores of 1 nm or smaller that are used to desalinate seawater and other water, UF (ultrafiltration) membranes with nanometer-level pores that are used to filter protein and other high-molecular weight substances, MF (microfiltration) membranes with submicron-level pores that are used to filter bacteria etc., and others.

Seawater desalination facilities using RO membranes are in operation in Japan and throughout the world. Also, in Singapore, treated human sewage is processed further using RO membranes and then mixed into drinking water in the well-known NEWater Project.

Water purification facilities use MF and UF membranes to remove components suspended in the raw water of a water supply, such as bacteria, cryptosporidiums, and other pathogenic protozoa. In recent years, membrane technology has also been applied to the field of human sewage treatment, and a global MBR system market is starting to be formed at a dramatic pace.

Japanese products account for a share of approximately 60% of the global market for the membranes used in these membrane processing facilities.⁽¹⁾ In particular, Japan's share of the RO membranes used for seawater desalination has reached 70%. The names of Japanese corporations



Fig. 2—Tanker Trucks Lined up at Sewage Treatment Plant. Since approximately 4,000 tanker trucks transport human sewage and other materials every day, this also causes traffic jams on the area's roads.

are not mentioned in the discussion of water treatment facilities and the water business, however, and at present, global companies such as France's Suez and Veolia Water lead the global water market.

STATE OF WATER ENVIRONMENT IN DUBAI

Fig. 1 shows one sample picture depicting the completion of Dubai's development plans. The famous palm leaf-shaped artificial island Palm Jumeirah shown in the middle of this picture is the only development project that is nearly completed at this point. Although all other parts are still under construction, at present, due to the global economic crisis that started at the end of 2008, most development projects are currently on hold. According to statistical data, as of 2006 the city of Dubai had a population of 1.42 million people, with less than 20% of the population comprised of citizens of the United Arab Emirates, more than 50% comprised of Indians, or 70% comprised of Indians and Pakistanis. The amount of water produced for the water supply is 710,000 m³/d, the amount of sewage water treated is 390,000 m³/d, and the amount of irrigation water used is 250,000 m³/d. Also, for a development project to receive authorization in Dubai, the construction of a sewage treatment is compulsory as part of the development plan.

Dubai's entire water supply is provided through the desalination of seawater, and most of the treated sewage water is recycled for use as irrigation water.

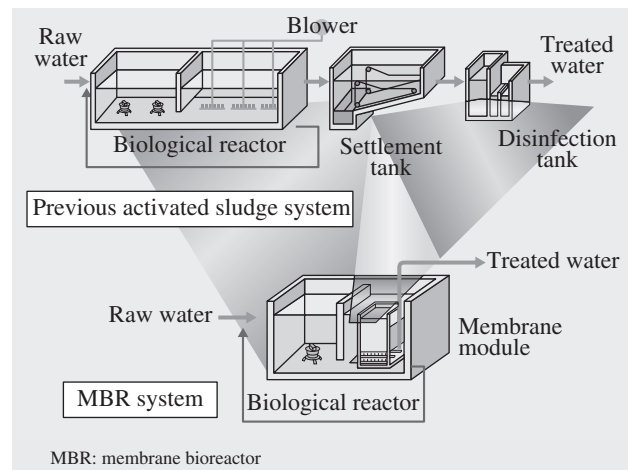


Fig. 3—Comparison with a Previous System.

Previous activated sludge systems used to have large biological reactors, and required settlement tanks and disinfection tanks as well. An MBR system, on the other hand, can maintain a high density level in the activated sludge liquid, and so the reaction tank can be made compact. Also, since membranes are used for filtration, there is no need for settlement or disinfection tanks.

There is only one public sewage treatment plant, however, and since its expansion has been outpaced by the demand, instead of the planned amount of 260,000 m³ of sewage/d, at present, the plant must treat 500,000 m³ of sewage/d, resulting in a less than ideal quality for the recycled water. The reason for this is the increase in laborers required to work on construction projects that are part of the city's development rush (the laborer population is said to be approximately 500,000). Laborers are concentrated in regions referred to as "labor camps," and tanker trucks are used to transport the human sewage produced in these camps to the sewage treatment plant for treatment.

Fig. 2 shows tanker trucks lined up at the sewage treatment plant. The efficiency of transportation is so low with wait times between two and five hours, and the cost of these tanker trucks, which is to say the cost of treating the human sewage, is skyrocketing.

MBR/MBR-RO SYSTEM OVERVIEW

MBR systems immerse a membrane module in a biological treatment reaction tank, omitting the traditional activated sludge settlement tank. Fig. 3 shows a conceptual diagram comparing an MBR system to a traditional treatment system. An MBR system is compact and easy to maintain and operate, can produce high-quality treated water that is reusable, and is the ideal biological treatment system for a region suffering from water shortages.

Each company proposes a variety of different membrane units, which act as the heart of an MBR



Fig. 4—Membrane Unit for MBR. This two-tiered membrane unit features a membrane area of 400 m², and can produce approximately 250 m³/d of treated water.

system. A membrane unit used in an MBR system is shown in Fig. 4. The material used in the membrane is PVDF (polyvinylidene difluoride), which is formed into a flat membrane with 0.1 μm pores that can remove not only pathogenic protozoa, but E. coli bacteria and other microbes as well. In fact, the membrane's ability to even remove viruses smaller than 0.1 μm has also been demonstrated.⁽²⁾

Hitachi Plant Technologies has delivered what is currently the largest MBR system for sewage treatment in Japan (2,140 m³/d) to the Heta Water Purification Center in Shizuoka Prefecture. Dubai has already ordered approximately 60 standard models for labor camps, with treatment capacities of 250 m³/d, 500 m³/d, and 750 m³/d.

An MBR-RO system is a system designed for the reuse of water by removing ions from MBR-treated water with RO equipment, resulting in recycled water that can be used as industrial water. In Dubai, these systems are used for supplementary water in district cooling systems, mixing water for concrete, and other such applications.

Fig. 5 shows a conceptual picture of the completed Burj Dubai, which will be the tallest building in the world. There is a pond in the vicinity of this building in which a fountain system will be built that can reach a height of 150 m. The plan is to use recycled water produced by treating 3,000 m³/d of human sewage from local residents with an MBR-

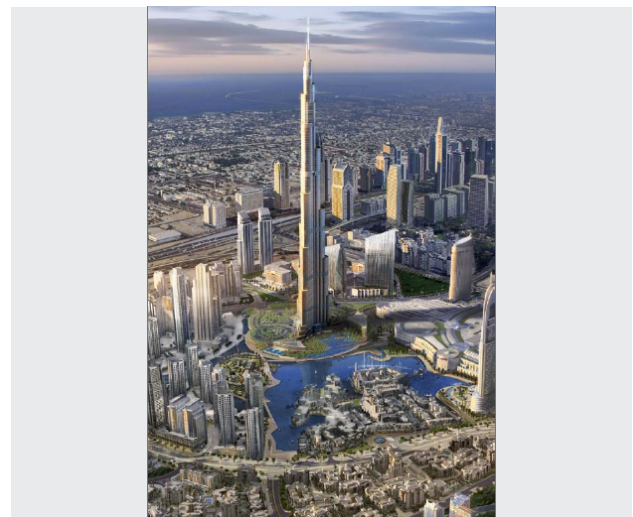


Fig. 5—Conceptual Picture of Completed Burj Dubai (Emaar Properties PJSC Development Project). Burj Dubai is currently under construction, with completion projected for the fall of 2009. Although its height is said to be 850 m, the final height has not been officially disclosed. Planned uses include shopping centers, hotels, residences, and so on.

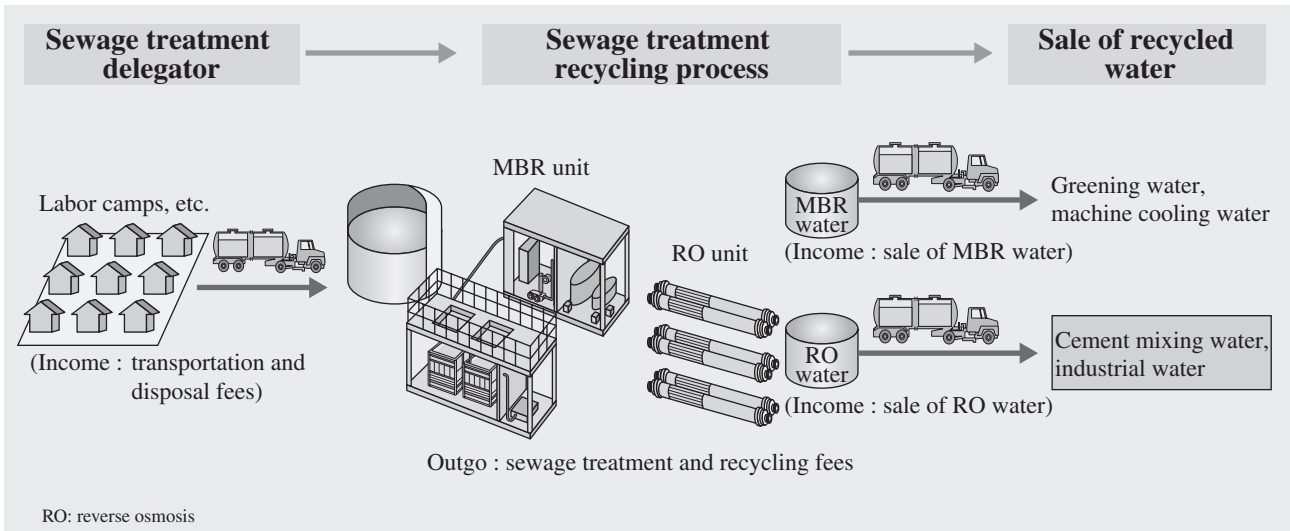


Fig. 6—Water Recycling Business Model.

The new company's income is from human sewage transportation and disposal fees and the sale of recycled water, and its outgo is from the cost of constructing MBR-RO plants and running costs.

RO system to supply this fountain. The decision to use recycled water desalinated at RO facilities was made based on a consideration of the sanitation needs of local residents and the fact that this is a region in which water evaporates extremely rapidly. Hitachi Plant Technologies received the order for these recycled water production facilities, which it completed at the end of March 2009.

EXPANSION OF WATER RECYCLING BUSINESS

Background of Joint Corporation Establishment

As part of its project to expand MBR system sales



Fig.7—First Stage Plant of Water Recycling Project.

The two MBR tanks are fabricated from steel plate and the RO unit enclosure is on the bottom-left. The plant is located in a cement works in the Al Quze district.

in Dubai, Hitachi Plant Technologies has used its recycled water business to contribute to the solution of Dubai's water environment issues from 2008, and has gained confidence that this business is justified. This is why the company decided to consider entering into a joint project with Dubai's powerful Al Ghurair Group, with which it has an association due to its history of cooperating on the construction of Burj Dubai's air conditioning equipment construction, to gather human sewage from labor camps, treat it, and sell it as recycled water.

In August 2008, Hitachi Plant Technologies and the Al Ghurair Group cofounded the recycled water joint venture Hi Star Water Solutions L.L.C. In Dubai, foreign companies cannot own 50% or more of a company's capital, and so the investment ratio is 51% from the Al Ghurair Group, and 49% from Hitachi Plant Technologies.

New Corporation's Business Model

The water recycling corporation's business model is shown in Fig. 6. Sewage treatment and recycling process plants will be built near labor camps in order to gather human sewage at a cost below market value. The human sewage will then be subjected to both MBR and RO processing, producing recycled water of medium to high quality. The medium-quality MBR water will be sold at a low price for use as toilet and irrigation water, and the high-quality RO water will be sold at the same price as the regular water supply for industrial uses such as concrete mixing, supplementary water for district cooling,

and so on. Since there are industrial parks near the labor camp, the water can be used for many different purposes in a small region within several kilometers of the source.

Business Plan and Future Expansion

Treatment facilities have been running smoothly since the first stage began in February 2009 (see Fig. 7). After the start of operations with small-scale sewage treatment plants, the treatment scale will be increased, and there are plans to build medium-scale second stage plants in 2009.

There are also plans to spread this business model horizontally from Dubai to other regions. Having used M&As (mergers and acquisitions) to join with RO system companies in Singapore in January 2009, Hitachi Plant Technologies is strengthening its MBR-RO system sales, and there are plans to collaborate with the new company in water businesses including O&M (operation and maintenance) while expanding aggressively.

In addition, in January 2009, Hitachi, Ltd. and Hitachi Plant Technologies played a central role in launching the Global Water Recycle System Association, in which 28 water business corporations participate in order to give Japanese corporations a boost in the expansion of their water business overseas. This association aims to act as a receptacle for the full support of the Japanese governments and related institutions in the expansion of model business projects overseas, and plans to use successful demonstrations in Japan to expand its water business internationally.

CONCLUSIONS

This article discussed Dubai's water environment, an overview of the MBR technology and systems developed in Japan by Hitachi Plant Technologies, Ltd., the company's establishment of a joint venture with a local Dubai corporation in order to start a local water recycling business, and future prospects.

In the latest James Bond movie "Quantum of Solace," the story was set against the background of South American water resource rights, showing how water issues have even entered into the world of entertainment. Water is a precious resource in the Middle East, and we intend to continue aggressively expanding our water business based in this region, starting with the water recycling business introduced in this article.

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