論説 Commentary

# Contribution to the global water issues by Japanese science & technology

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## Global water Issues

The earth is called "Planet of Water," largely covered in water. However, approximately 97.5% of this water is seawater, while sources of fresh water such as rivers and lakes that human can use untreated account for no more than approximately 0.01%. From ancient times, humans have lived near water or water resources as civilization has evolved. Shortages of water resources and deterioration in the quality of water resources only became apparent from the Industrial Revolution onward, when water-related problems emerged in many countries and regions due to growing populations and rapidly advancing industrialization. According to United Nations statistics in 2004, of the world population of six billion, approximately 1.1 billion, mainly in Asia and Africa, do not have access to safe drinking water, while approximately 2.4 billion do not have the benefit of hygienic sewage treatment facilities[1], making water-related problems one of the most important issues currently facing humankind along with carbon dioxide emissions, food shortages and the energy crisis.

Furthermore, the situation relating to water-related problems differs from country to country and region to region, being affected by many factors including the natural environment, the economic climate and politics, and this means that solutions to these issues as social infrastructure-related problems also differ depending on the region. To give some examples, while the Middle East and North Africa are economically sound, fresh water is a scarce commodity, leaving the use of seawater and recycled wastewater, for example, as the only option. Northern China suffers a shortage of actual water resources, while pollution caused by industrial wastewater has led to a shortage of safe water resources in the south.

As the world population grows and industry continues to develop in the future, it is predicted that the world will face ever greater shortages of water resources and deterioration of water resource quality. While it goes without saying that using water sparingly and economically is important, it is also important to secure stable water resources through measures such as using seawater as a water resource and the purification of sewage and industrial wastewater, for example, for reuse.

## Water purification technology

The rapid pace of industrialization and population growth in recent years has developed to the point where we can no longer rely solely on natural purification effects for the treatment of sewage and industrial wastewater, for example, and, to address this situation, technologies such as the use of sand filtration and the breaking down of organic substances into micro-organisms have been developed and disseminated. However, ensuring water quality and quantity by the use of these technologies has become difficult, and in the 1990's, increasing attention has been paid to membrane water purification technology applied to higher quality, high speed processing, and energy conservation processing and the demand for it has been rapidly expanded from the year 2000 onward.

The "membranes" used for water purification are classified according to the size of the substance to be isolated or filtered out into reverse osmosis (RO) membrane, nano-filtration (NF) membrane, ultrafiltration (UF) membrane and microfiltration (MF) membrane. RO and NF membranes allow the removal of dissolved ion and organic substances, for example, and are used for processes such as ultra-pure water production, seawater desalination, and sewage and wastewater reuse. UF and MF membranes are capable of removing substances such as polymers, colloids, suspended solid, viruses and micro-organisms and are used for the purification of groundwater, river water, lake water, sewage and wastewater.

Cumulative shipment of water purification membranes by the year 2006, were worth approximately 32 million cubic meter per day on a water production base. Japanese membrane manufacturers hold an overall share of the market of approximately 60% and share of approximately 70% of the market for RO membranes used for seawater desalination[2]. It is no exaggeration to say that the point has already been reached where the world's water-related problems could not be resolved without Japanese membrane technology.

## Problems in the water business and partnership between the public and private sectors

The scale of the global water supply and sewage-related business reached approximately 60 trillion yen in 2005 and is expected to increase to as high as 100 trillion in the year 2025. A breakdown of this figure shows that (1) The device and materials supply business, including membrane products, a field in which Japan holds predominance, accounts for approximately 1 trillion yen, (2) This figure rises to 10 trillion yen when plant construction business is included and, (3) The total figure including water supply business comprising elements such as facility management, operation and maintenance amounts to 100 trillion yen. Japan is lagging in areas (2) and (3) above (See **Fig.1**).

Companies such as Veolia (France) and Suez (France) are referred to "the Water Majors" and are engaged in water supply business across the globe, while companies such as GE (U.S.) and Siemens (Germany) have become new participants through mergers and acquisitions (M&A). Countries and regions such as Singapore, Spain and Korea cultivate companies as a matter of national policy and are making inroads onto the global stage. In Japan, because almost all water supply businesses are public enterprises, the private sector lacks the know-how to run such enterprises, and this means that there are no water supply businesses capable of competing on an international level.

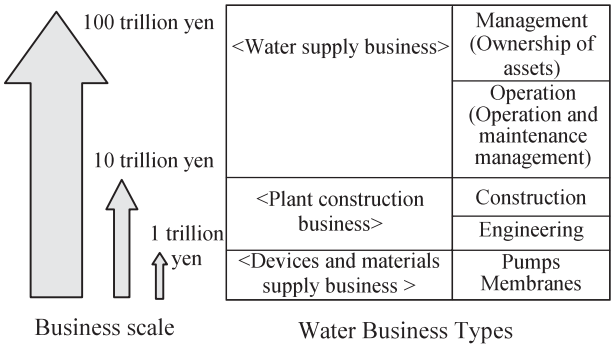


**Fig.1** Scale of Global Water Supply and Sewage-related Business

Water business across the world is shifting to a public-private partnership (PPP) basis, and, to be able to contribute to the solution of global water environment problems, it is essential for Japanese businesses to promote measures such as cost reductions and energy conservation by refining water purification technologies and, at the same time, to forge a partnership between the public and private sector that will be capable of comprehensively handling water business. With the strong support of the government, the Global Water Recycling and Reuse System Association, JAPAN (GWRA) was established in November 2008, and, with a subsequent membership of forty companies, the first steps toward participation in water business were taken. Additionally, this was followed successively in January 2009 by the foundation of the "Conference of Related Ministries and Agencies on Water-related Problems" by 13 ministries and the "Water Security Council of Japan" comprising the government, industry and academia, with the result that an all-Japan system based on the concept of "Team Water Japan" is now in the process of formulation.

Thanks to initiatives such as these, we are now also seeing the beginning of research technology development and national verification projects. For example, in connection with Ministry of Economy, Trade and Industry, research and development of membranes, devices and systems for water purification, research and development in areas such as the recovery of valuable resources and biodegradable persistent substance and verification research both within Japan and overseas into water purification systems are underway under the auspices of the "Water Conservation/Environmental-harmonization-oriented Water Recycling Project." Projects relating to government bodies such as the Ministry of Education, Culture, Sports, Science and Technology and the Ministry of Land, Infrastructure, Transport and Tourism are also underway. Furthermore, research and development themes that study internationally-competitive large-scale water purification plant in the future have been selected under the "Leading-edge Research Support Program" announced by the Cabinet Office and finalized in September of this year.

## Proposals for future research technology development

The participation of Japanese companies in the global water supply business has only just begun. To achieve major contributions to the solution of global water-related problems in the international stage, I believe that Japanese companies will need to tackle and resolve the following issues.

Firstly, leading-edge elemental technologies such as "membranes" that represent Japanese excellence to the world need to be further refined and, based on such solid elemental technology, highly-efficient system technologies must be developed. Examples of such systems include seawater desalination systems that reduce energy consumption by half, groundbreaking use of concentrated brine (e.g. Osmotic power generation, recovery of valuable substances). Additionally, field centers need to be developed to asses and verify new technologies. Support from the government in the form of preferential tax systems regarding investment for research and development, for example, will play an important role in achieving these goals.

Secondly, companies in the private sector need to acquire and accumulate the know-how required to operate water supply businesses. For this to happen, the formation of partnerships with countries and local autonomies where water supply and sewage facilities have been operated as a public enterprise will be essential. Additionally, water supply is a business that is tied into the social infrastructure and, as such, partnerships with the government will represent an important form of backing in the development of international businesses.

It is to be hoped that, through partnerships between the government, academia and industry, Japanese companies will succeed in realizing contributions to the world through water purification business.

1) WHO: UN Declares 2005-2015 "Water for life" Declares, Health in Emergency, 2004-March, **2004**, *19*, 13.
2) Water Purification Membranes (2nd Edition), Published by Gihodo, **2008**, 12.



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