DEEP OCEAN WATER DEVELOPMENT IN TAIWAN: WATER QUALITY AND FUTURE APPLICATIONS

Ta-Kang Liu, Tainan Hydraulics Laboratory, National Cheng-Kung University
Hwung-Hweng Hwung, Department of Ocean and Hydraulic Engineering, National Cheng-Kung University
Jin-Li Yu, Tainan Hydraulics Laboratory, National Cheng-Kung University
Ruey-Chy Kao, Tainan Hydraulics Laboratory, National Cheng-Kung University

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INTRODUCTION

Taiwan is a continental island located in the southeastern edge of the Eurasian plate. Lying on the rim of the Asian continental slope, the east coast of Taiwan is adjacent to some of the deeper parts in the Pacific Ocean. Taiwan's eastern Coastal Range is so precipitous that it deepens into the Pacific Ocean abruptly, dropping to a depth of 4,000 meters only 50 kilometers offshore. The special seabed bathymetry in the east coast of Taiwan makes it one of the few places in the world that can exploit DOW economically from just several kilometers offshore.

DOW development in Taiwan began with the ocean thermal energy conversion (OTEC) during the oil crisis in 1980s. However, the attempt for OTEC has gradually faded out and the attention for DOW was diverted to other type of uses. In the recent years, the success experience of exploiting the DOW for utilization in water, pharmaceutical, cosmetic, and fishery industries in Japan and the United States (Hawaii) has greatly influenced the DOW development and stimulated interests from various sources in Taiwan, including both governmental sectors and other private stakeholders. Since 2000, Taiwan's government has started the evaluation and planning for the exploitation of the deep ocean water resources. DOW is now recognized as an emerging new and valuable water resource in Taiwan. The current proposed capital investment up to 2010 is estimated at approximately 5 billion Taiwan's dollars ($155 millions) (MOEA 2006).

BACKGROUND

In order to promote the development of DOW in Taiwan, the Water Resource Agency (WRA) have evaluated the potential sites for DOW exploitation during 2000~2004 (WRA 2005). The siting criteria includes coastal topography, temperature difference between surface and deep ocean water, ocean climate conditions, earthquake and typhoon frequencies, length of intake pipe, transportation, corporation of local government, developing potential in surrounding area, and available land of the site. Several potential sites were short-listed during the previous planning. However, the information regarding DOW quality is still not fully investigated. Such information are very crucial for the future use of DOW. Therefore, we were retained by the WRA to conduct the first comprehensive site investigation during 2005~2006 in order to better

understand the DOW for further evaluation.

METHODS

Six potential sites, i.e., Nanou, Heping, Chilaibe, Shiti, Chiben, and Jinlun, were investigated in this project. Ocean research ships equipped with CTD/Rosette water sampling instrument was used for DOW sampling. Water samples were taken from top and bottom of the 100 m, 200 m, 300 m, 400 m, 500 m, 600 m, and 750 m of bathymetric depth for the six potential sites. For deeper locastions, the middle layers were also sampled for analysis. Overall, 18 samples were taken for each site.

RESULTS

More than 60 water quality parameters were analyzed, including heavy metals, herbicides, chlorinated compounds, dioxins, as well as essential trace elements. Higher nutrient concentrations were found for all the sampling locations exceeding 200m bathymetric depth. The water quality analysis indicated that the DOW in several sites along Taiwan’s eastern coast has several edges over traditional water resources, such as not contaminated with anthropogenic chemicals, rich in nutrients, and having a temperature difference as large as 20 degree Celsius compared to surface water.

FUTURE DOW APPLICATIONS

Typical applications of DOW can be seen in Figure 1. DOW was extracted from the deep ocean and then sent to a distribution facility. Part of the untreated DOW was directed, without further treatment, from the distribution facility to the fields for use in aquaculture or agriculture. Part of the DOW was treated with high pressure reverse osmosis to remove the salt contents. The desalinated fresh water can be used to produce drinking water and beverage, or added during food processing. Brine from desalination process can be further concentrated to produce table salt or added during the manufacturing of health care and cosmetics products. Part of the water can be used for OTEC. Due to the lack of natural energy resources, Taiwan imports more than 98% energy resources from abroad. The government should carefully review the national energy policy and exam the feasibility of OTEC. The OTEC demonstration plant and R&D should be subsidized to evaluate the practical engineering problems of OTEC and the feasibility of multipurpose utilization of DOW.

Since utilization of DOW is new in Taiwan, its application and future use is under considerable influence from the Japan and Hawaii where the DOW industry is developed to maturity. Their experiences indicated that a large part of DOW has been applied in agriculture and fishery. In recent years, the domestic agriculture and fishery sectors have been greatly challenged by foreign imports since Taiwan's accession to the World Trade Organization (WTO) in 2001. The government has implemented new policies that emphasize quality over quantity in order to help these two sectors to stay competitive in the market. For example, Taiwan’s Council of Agriculture (COA) has been promoting knowledge intensive post-modern agriculture, developing technology in marine cage aquaculture and methods to produce ornamental fishes in order to develop higher value-added products. Therefore, more researches are needed to develop new technologies for applying DOW in agriculture and fishery to transform these two sectors

into innovative and modernized green industry. Especially, the feasibility of applying DOW in sea ranching should be evaluated, since it has a great potential to create a very productive fishing grounds (Kirke 2003).

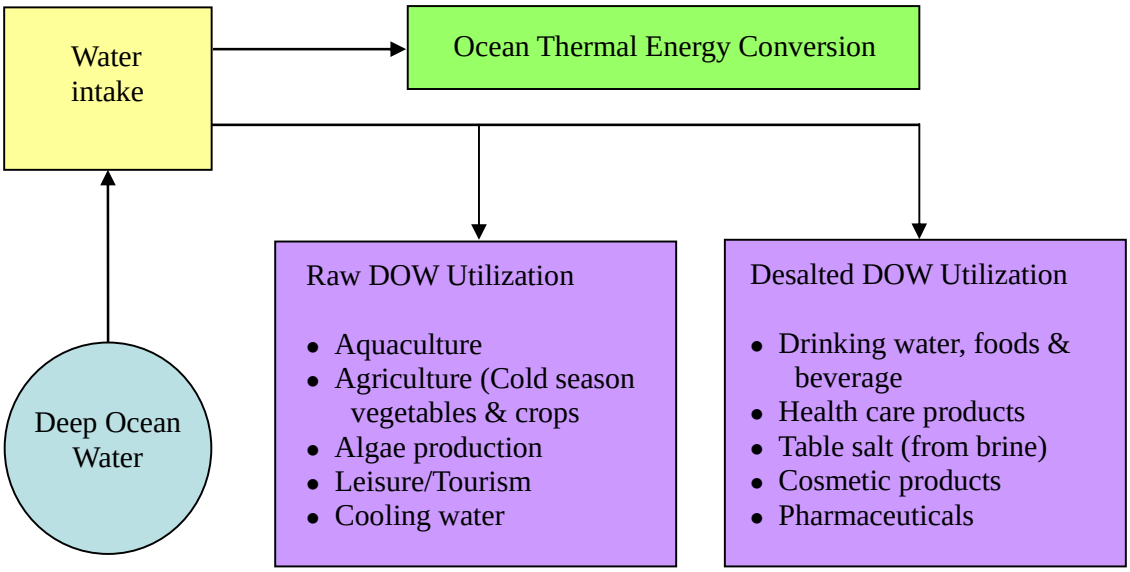

Figure 1. Applications of Deep Ocean Water

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Ta-Kang Liu, Ph.D., P.E.
Tainan Hydraulics Laboratory
National Cheng-Kung University
1 University Road
Tainan City, Taiwan 70101
Phone: +886-6-2371938 ext.242
Email: tkliu@thl.ncku.edu.tw