

Development of Simplified Deep Sea Water Intake System

— Plan, Design, Analysis and Experiment

*Dong-ho Jung, *Hyeon-ju Kim, *Deok-soo Moon, *Seung-won Lee, **Hyeon Chung, ***Han-il Park

*Maritime & Ocean Engineering Research Institute (MOERI), KORDI, Daejeon, Korea

**Ocean space Ltd., Korea

*** Korea Maritime University, Busan, Korea

ABSTRACT

A simplified intake system for pumping deep sea water (DSW) far away from land is developed. Based on a development system for natural gases or oils, the structure in new concept for DSW intake consists of a riser pipe, an anchor, and a buoy. The riser connected with a polyethylene pipe stands vertically in the low tension due to the specific gravity of 0.95 of a Polyethylene without a mooring line. The bottom end of the riser is positioned far from the seabed in order to prevent the influx of particles on the seabed. With a hose inserted on hole of the riser pipe and a water pump on a ship the DSW located at deeper than a water depth of 200m is transferred to a tank on a ship. The structural safety of the riser pipe made from a P.E. material that has a low allowable strength must be checked with the numerical or experimental studies before it is actually installed at sea. From the results of the 3-D dynamic structural analysis it is concluded that the designed riser pipe under a severe ocean environment can perform its function without destruction. The actually experiment at sea was carried out to certify the pumping performance of the newly designed development system. From the results of the experiment, it is demonstrated that the DSW intake can be done with the development system suggested in this study in very simple and low cost.

KEY WORDS: Deep seawater; Land-off based development systems; simple intake system; riser pipe;

1. INTRODUCTION

Two hundred meters under the sea where sunlight does not reach, deep sea water (DSW) maintains stable low temperature throughout the year. In the deep sea, there are almost no organic substances or agents of disease but there is infinite seawater supply with rich nutrients and minerals for the growth of ocean plant (Kim et al., 2005).

There are two types of deep seawater development system; land-based development type and land-off-based development type, which is according to the characteristics of the DSW, economic efficiency, and so on. Land-based development is most commonly used today since it

secures large amount of DSW. However, new development type in a small amount of DSW and at a low cost should be developed for products such as cosmetics as well as food which is possible to industrialize with a small amount of DSW.

There are two types of land-off-based development; the plant type, which is utilized for fertilization of sea areas, and the buoy type, which is used to acquire small amounts of deep seawater. Since its main purpose is to fertilize sea areas, plant-type development cost is performed as public development, the cost of which is not much different from the land type. However, buoy-type development pumps only a small amount of DSW but has low investment cost, so that it could be a good means to develop the DSW industry if it is well utilized with that purpose.

This paper studies the planning, design, analysis and actual experiment at sea for a simple DSW development system that can pump DSW at a low cost. Based on a development system for natural gases or oils, the structure in the new concept for DSW intake consists of a riser pipe, an anchor, and a buoy. The riser connected with a polyethylene pipe stands vertically in the low tension due to the specific gravity of 0.95 of a Polyethylene without a mooring line. The structural safety of the riser pipe made from a P.E. material that has a low allowable strength is checked with the numerical studies before it is installed at sea. This study also deals with the experiments in the actual sea area to check possible intake of DSW with the developed system.

2. SURVEY ON DSW DEVELOPMENT IN FOREIGN COUNTRIES

Japan has long developed the plant-type development and buoy-type development systems. An example plant-type development system called the Takumi is installed at the Sagami Bay (Fig. 1 (a)) (Bando et al., 2005). Takumi is a device to pump DSW up near the sea surface and discharges it in the euphotic zone in order to promote proliferation of the phytoplankton. Built at the Sagami bay in May 2003, it is still in test process in actual sea areas until now.