Shallow Lifting Test for the Development of Deep Ocean Mineral Resources in Korea


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ABSTRACT

Mining technology for deep ocean mineral resources are composed of two main things. One is the lifting technology and the other is the collecting technology. To develop the lifting technology, the shallow lifting test was conducted near sea at Hupo port of East Sea of Korea. The depth of the sea was about 100m. The lifting system for deep ocean mineral resources includes flexible hoses, lifting pump, buffer, lifting pipes and control/measurements devices. For May and June of 2009, the lifting system was successfully tested.

KEYWORDS: Deep sea mineral resources, lifting technology,

INTRODUCTION

Steeply rising oil prices change the individual consumer lifestyle. Many countries are trying to own oil resources and mineral resources and build the national policy based on the state-owned power. Now to secure metallic mineral resources is the key word for determining the national existence not the economic problems. Korea has the limited mineral resources and there are no nickel, cobalt, and copper in it. To develop the mining technology in Clarion-Clipperton zone in the Pacific Ocean which was secured by the ministry of land, transport, maritime affairs in Korea government, are being undertaken for the future strategy of the country(Yoon, et al., 1999, Chung 1994; Chung 2002). The mining system is composed of the collecting system, which collects the mineral resources on the seabed, the lifting system, which lifts the manganese nodules from the seabed to the surface of the sea, and the mining ship. Most of all, the lifting system is the important factor to determine the success of this project. KIGAM, which is in charge of the lifting system, has developed the lifting technology since 1994. The 30m-height-lifting tower was constructed and the experiments of the lifting pipes and the flexible pipes were conducted. (Yoon, et al., 2003; Yoon, et al., 2004; Yoon, et al., 2005a; Yoon, et al., 2005b; Yoon, et al. 2009, Yoon, et al., 2001) Also the lifting pump which was designed and manufactured for the shallow sea test was tested to verify the performance of the lifting system. In addition, for May and June of 2009, the shallow sea near Hupo port of East Sea of Korea, the lifting test was conducted successfully. In this paper, the shallow, lifting system verified in the 100m-depth sea are introduced and presented. This test will help to minimize the predicted risk and reduce expenses for the sea test scheduled in 2012(1,000m-depth sea) and 2015 (2,000m-depth sea)

Lifting System for Shallow Sea Test

The lifting system is composed of lifting pump, lifting pipe, buffer, discharging pump, flexible hose, solid-liquid separator, power equipment, imitation collector, and measuring instrument. Generators supply power to the lifting pump, which lifts the mixture of manganese nodules and seawater from the imitation collector to the solid-liquid separator. Collected nodules enter the imitation collector and circulate in the lifting system.

Lifting Pump

The lifting pump employed for the shallow sea test is shown in Fig.1. This 2-stage pump is a mixed flow type with 70m of head and 2.5m\(^3\)/min of flow rate. Motor power and input voltage are 110 kW and 3300V respectively. The parts were made by SUS316 to prevent corrosion caused by water. As a result of this test, the 20mm-diameter-solid passing through the system was confirmed and required head and flowrate were maintained during all tested periods. The clogging of the solids in the flow passage was the main reason for system instability and should be solved to ensure the performance of this system. Because next test is scheduled to be done in seafloor at the depth of 1000m, impeller design, sealing problem, axis design, pressure compensator and motor cooling are important problems to resolve.

Buffer

The buffer shown in Fig. 2 is the function of connection between a pump and flexible hoses. Also it is the function of dead weight at the end of lifting pipes. In this test, the buffer with the dimension of 1500mm×1200mm×300mm was constructed by using the material STS304. The characteristics of this buffer are the simplified flow