

## **The Lifting Installation of Manganese Nodules and Pump Test**

*Ning Yang, Dasheng Tang, Ling Yang*

State Key Laboratory of Exploitation and Utilization of Deep-sea Mineral Resources

Changsha Research Institute of Mining & Metallurgy

Changsha, Hunan, China

### **ABSTRACT**

The newly built lifting test installation includes two towers of pipestring, five working platforms and instrumentations. The height of two towers is 30 meters. Inner diameter of lifting pipe is 204mm. One way and circular lifting tests can be run in this laboratory. In the circular lifting test, the nodules in the storage bin can fall back to the storage bin after passing the feeder, the pump and the pipe. To simulate sea level during the tests, the storage bin and water tank is acted on water head of 30 meters to make back flow close to mining operation as much as possible. With such set of lifting, pump can be tested under low revolution, and simulation of discharge for the pipestring can be done when accidental stop is encountered. In one way transporting tests, the nodules transport directly to a separator with pressure regulation via the feeder, the pump and pipe. Nodules no longer return to the storage bin. Maximum pressure can reach 2.5MPa by adjustment of the opening of the valve. With such set of lifting test, the pump performance with nodules can be obtained.

**KEY WORDS:** Manganese nodules; hydraulic lifting.

### **INTRODUCTION**

The lifting subsystem is one of the most important elements of deepsea mining system. This subsystem acts as the passage of deepsea mineral resources from the collector to the surface platform and supporting body of subsea equipments while launching and retrieving, power and communication cables fixing. Comparing the tests research and economic technology of slurry pump, cleaning pump, jet pump and air lifting, slurry pump is selected as the lifting method of pilot mining testing of china. A lifting test installation was built to verify the design of the lifting pump, to simulate the process flow of lifting system of deepsea mining, to test different slurry concentrations, flow velocities and particle sizes of hydraulic lifting, to examine the capability of overflowing and reflux of coarse slurry in the annular interval channel of pump and motor which is the performance and the basis of improve and design of lifting pump, to test various pumping heads under large range of resistance characteristic of pipeline network by tuning up and controlling the pressure of pipeline outlet.

### **CONFIGURATION OF THE SYSTEM**

In order to satisfy the specifications and function requirements of lifting tests, the lifting test installation includes closed loop lifting, open

loop lifting, two towers of pipestring, five working platforms and instrumentations.

Circular lifting test installation is designed for simulation of deepsea manganese nodules lifting. It includes five parts (Figure 1):(1) water supply and pressure regulator; (2)lifting pipe and reflux pipe with 30m height and 204mm inner diameter; (3)feeder: storage bin with 2.25m height, 1m inner diameter and volume 1.6 m<sup>3</sup>, feeder and hydraulic control device; (4)control and measure device; (5) calibration.

Circular lifting test is designed to simulate the sea level. In order to satisfy the lifting technology of deepsea mining, hydrostatic pressure of 30m height water column is applied to the feeder and water tank.

In the circular lifting test, the nodules can fall back to the storage bin after passing the feeder, the pump and the pipe. The revolution of lifting pump is adjusted to low level by the inverter to get resistance characteristic of slurry pipeline under low revolution and reflux capability of slurry after emergency shutdown.

One way lifting test is designed to consume pumping head and includes four parts (Figure 2):(1) Lifting pipe; (2) water supply and feeder; (3) back pressure device; (4) control and measure device: inverter, hydraulic power unit, flow meter, pressure gauge, differential pressure gauge, thermometer, revolution speed transducer, control and measure cabinet.

To consume the pumping head, the back pressure compensator and V ball valve are applied to the pipeline outlet to form a closed bearing path. Maximum pressure can reach 2.5MPa by adjustment of the opening of the valve at the outlet to back pressure compensator. In the one way test, the nodules transport directly to a separator with pressure regulation via the feeder, the pump and pipe. Nodules no longer return to the storage bin. The pump performance with nodules can be obtained through controlling the pressure of pump outlet by adjusting the opening of electric ball valve.