

Simulation Study on Motions of a Towed Collector for a Manganese Nodule Mining System

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ABSTRACT

The motion characteristics of a towed collector for a manganese nodule mining system which consists of a mining ship, lifting pipes, flexible hoses and the collector are investigated by realistic computer simulations. The collector is controlled by the ship's tow only. Three typical scenarios are simulated: collector towed at sea, collector towed at sea bed, and collector landing on the sea bed. Some ship speed is important to avoid kinks in the hose at landing. Current from abaft removes landing problems. Two tugs may be necessary to operate safely in adverse wave and wind conditions.

KEY WORDS: Towed Collector, Manganese Nodules, Motion Characteristics and Simulation Study

INTRODUCTION

The Agency of Industrial Science and Technology, the Ministry of International Trade and Industry Japan, started a large-scale project entitled "The Research and Development Project of Manganese Nodule Mining System" in 1981. Much research and development for the mining system has already been performed, e.g. Wakabayashi (1986), Oyama (1990).

The mining system in the project is a hydraulic mining system in which nodules are collected by a towed collector on the sea bed and transported in a slurry of sea water and nodules through the lifting pipes onto the mining ship, Fig.1. The pipe strings are suspended by the gimbals on the mining system. The lifting pump modules and the air inlet nozzles are installed in the pipe strings. Flexible hoses are connected to the lifting pipes to assure flexibility near the sea bottom. Fig.2 shows a bird's eye view

of the investigated collector. The collector has sleds as traveling mechanism and a fin to keep stable in currents. It is connected to the end of the flexible hoses. Table 1 shows the principal dimensions of the collector and the stabilizing fin. This system is simple and reliable, but the efficiency of the sweep may be limited as the system is not self-propelled.

The present study deals with the collector's motion characteristics in the system. Three typical scenarios are simulated: collector towed at sea, collector towed at sea bed, and collector landing on the sea bed, Fig.3. The simulations are made in 2,200m depth of water since full-scale experiments for the collector's system are planned in sea area of this water depth.

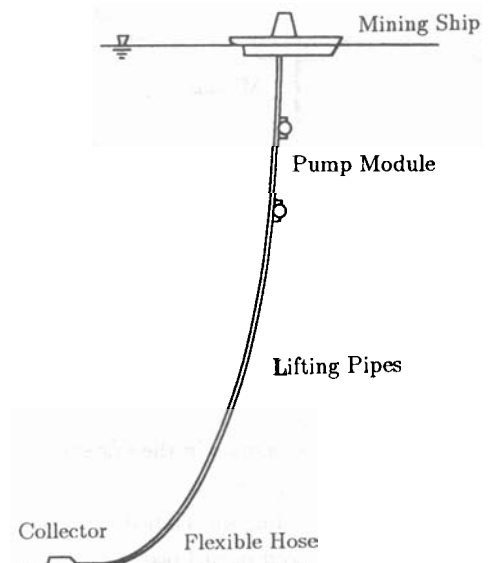


Fig.1 General view of the Manganese Nodule Mining System