Studies on techniques for dewatering of polymetallic manganese nodules

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ABSTRACT

Mining of polymetallic nodules from the oceans, found in mineable abundance and mineral quality on the abyssal plain of the oceans at depths of 4000 – 6000 m, has found renewed interest with the growing demand for cobalt, nickel, copper and REEs. The harvested nodules are conventionally planned to be transported from the depths to the surface as seawater slurry, pumped up through the riser pipelines. It is essential to separate the nodules, broken pieces and the particles from the transportation, from the seawater before suitable disposal of the seawater. As compared to dewatering ashore, which allows for elaborate arrangements, permits use of additives and allowance of time for settling, the onboard dewatering system needs to be compact, averse to use of additives and coalescing agents, and essentially has to be a quick and continuous process. Towards this objective, several dewatering techniques have been studied based on sedimentation, screening, pressure filtration, pulp density, flow rate, etc. and system for onboard application was developed and tested in pilot-scale to test the feasibility.

KEY WORDS: Polymetallic manganese nodules, on-board dewatering, vibrating screens, filter press, sedimentation

INTRODUCTION

Global economic growth has fuelled the rise for metals such as Cu, Ni, Co and REEs. While land bases resources currently meet the demand, deep sea mining will have to become a significant addition to the economy (Childs 2018). Deep sea mining of nodules, particularly in the Indian Ocean is carried out at a depth of 5000-6000 m. An underwater mining vehicle collects the nodules in the size range of 20-100 mm. It is then crushed using an underwater crusher to a size range of 25-30 mm. The crushed nodules are then transported to the support ship on surface through hydraulic transport in a flexible riser (Deepak et al. 2007). In addition, about 20% sediments to nodule weight is expected to adhere to the nodules during collection and vertical transport. The transported slurry is then dewatered on-board the support ship. The collected nodules are transported while the water is rejected back to the ocean (Figure 1). A dewatering system for on-board applications has been developed and tested on pilot scale.

CONDITIONS FOR DEWATERING

The dewatering system was designed with the following criteria:

- The size of the total equipment may be restricted to 1/3rd of a standard shipping container (14’ x 8’ x 8’).
- The input quantity of slurry is 60-80 m³/h with slurry pulp density of 5-10% (w/v) and particle size distribution being not less than 1 mm at the lower end and nor greater than 30 mm at the top end.
- The system should be a continuous flow unit, without need for interruption or for change of elements or in removing the sieved particles. Alternatively, twin flow system can be considered (one channel being used at a time).
- The composite system would be equipped to discharge the