Treatment of Metal Wastes with Deep-sea Manganese Nodules

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ABSTRACT

With shortage of metal mineral resources and generation of huge amount of wastes containing valuable materials, the effective and economical recovery of valuable metals from secondary resources such as spent catalysts has become quite important. Korea has developed smelting/hydro combination process to treat manganese nodules. In smelting process, there is no restrictions on the compositions and properties of the feed ore or materials compared to full hydrometallurgical one. This work explained the treatment of the spent Ni-Cd battery and the spent catalyst in reduction smelting process of manganese nodule to recovery valuable metals containing in this materials. The nickel in the spent Ni-Cd battery could be recovered with adding 5% coke as a reducing agent regardless of the amount of battery added. However, to recover cobalt from the spent catalyst, it is required to add more coke for reduction of cobalt oxide in the catalyst. The treatment of metal wastes with manganese nodules can contribute to lower the cost for the processing of nodules and also to facilitate the recycling of metal wastes.

KEY WORDS: Manganese nodules, metal wastes, recovery, smelting.

INTRODUCTION

Smelting-leaching method is known as one of the most likely processes for the treatment of nodules due to its many advantages on the technical side (best known) and on the economic side (presumably highest return on investment) (Kohga 1995). This process also shows smaller environmental impact: less solid waste as inert slag and easy recovery of manganese. Smelting-leaching process combines classical pyrometallurgical unit operations of the Cu/Ni metallurgy and hydrometallurgical treatments for the final recovery of nickel, copper and cobalt (Sridhar 1976, Thetis 1992). In addition, manganese is recovered as Si-Mn alloy. In the first stage of reduction smelting in an electric furnace a metal alloy and a slag containing the manganese is obtained. This slag represents the feed of the Si-Mn alloy production. The metal alloy is charged to a converter, where matte is formed by addition of sulfur bearing materials. The matte basically contains copper, nickel cobalt, and iron. The slag obtained containing almost all the iron is recycled to the first stage of smelting. The matte is granulated, slurred, and pressure leached with sulfuric acid at elevated temperature. The unit operations for the final recovery of valuable metals are precipitation solvent extraction and electrowinning. Figure 1 shows the brief flow sheet of smelting-leaching process. In smelting process of manganese nodules, there are no strict restrictions on the composition and properties of the feed ore or materials compared with hydrometallurgical one.

Fig. 1. Smelting-leaching process of Mn Nodules

World consumption of metals production has increased dramatically, particularly since World War II, and have shown an exponential rate of growth up to the late 1970s (Jackson 1986). Therefore the metal recycling from the secondary resources is essential to solve the waste problems and to save the natural resources under the call for sustainable