

Reduction Leaching of Manganese Nodules with Sodium Sulfite in Ammonium Chloride Solution

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Abstracts

The leaching characteristics of manganese nodules were investigated in ammonium chloride solution by using sodium sulfite as a reductant.

Experiments were conducted in leaching of manganese, cobalt nickel, copper and iron using sodium sulfite in the ammonium chloride solution. It was found that the leaching behaviour of manganese, copper, cobalt and nickel depended on the amount of added sodium sulfite. The ratio of liquid to solid is important factor on the extraction of metals during leaching. The dissolution of manganese, cobalt, nickel, copper, and iron increased with the increase in ammonium solution and that in temperature of leachant. When the leachant pH was decreased, the leachability increased for each of the metals.

The sodium sulfite has been found to be an effective reductant for extracting more than 95.8% of Mn, 93.5% of Ni, 98.5% of Cu, 89.1% of Co, 3.1% of Fe when leached in 5N NH_4Cl at 80°C for 2.5hr. The dissolution rates of Mn, Ni and Cu are controlled by pore diffusion, while that of Fe is controlled by surface chemical reactions and that of Co is controlled by both the surface chemical reaction and pore diffusion process.

KEY WORD : Manganese nodule, sodium sulfite, leachability,
pore diffusion, surface chemical reaction.

Introduction

The leaching behaviour of manganese nodules in ammoniacal solution have been investigated by many workers(1-11). In 1974, Lester J.(1) studied the leaching of deep sea manganese nodules with an 'ammoniacal-Cu' solution allows the selective recovery of the Ni, Co and Mo from the nodules. The reducing-ammoniacal leaching process was also carried out by some investigators(3-5). In this process, NH_4Cl , $(\text{NH}_4)_2\text{SO}_4$, $(\text{NH}_4)_2\text{CO}_3$ or NaCl solution were used as leachant. Okuwaki etc. (6) studied the leaching behaviors of ocean nodules in ammoniacal ammonium salt solution with reductants, such as D-glucose and starch. Jena(3) reported manganese nodules can be leached with an ammonia solution at ambient temperature for 1~4hr in the presence of glucose as a reductant, to recover 100% of Cu, 70% of Ni and 80.4% of Co. Annad(4) developed a process for extracting 100% of Cu, Ni and Co when leached in 5.85 M $\text{NH}_4\text{OH}-(\text{NH}_4)_2\text{SO}_4$, 65°C using $\text{Fe}_2(\text{SO}_4)_3$ as reductant in dilute NH_4OH solution. Rokukawa(7) also carried out the reduction leaching in ammonia solution. From their result, the leaching recovery was 93.2% of Ni, 98.7% of Co, 97.2% of Co, 0.65% of Mn and 1.2% of Fe when leached in the mixed solution of 120g/ℓ $(\text{NH}_4)_2\text{CO}_3$ and 50g/ℓ $(\text{NH}_4)_2\text{SO}_3$, 80°C for 2hr. In this