THE REPORT FOR RESEARCH ACTIVITY

Laboratory of Mineral Processing and Resources Recycling
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The researches for utilization of waste materials and recovery of valuable materials have been performed for 6 months. Two subjects have been researched; the recovery and the removal of metal ions by sulfate reducing bacteria, and the recycling of scrapped batteries: The results are summarized briefly as follows.

1. The Synthesis of Metastable γ – Manganese Sulfide by Sulfate Reducing Bacteria

Manganese sulfide (MnS) is a semimagnetic semiconductor with a large band gap (E_g 3.8eV at 0 K), and metastable γ–MnS occupies a potential position in short wavelength optoelectronic applications. In conventional methods, metastable γ–MnS has been synthesized in high temperature (60-200℃) because heating process is required to generate H_2S as a sulfide source from some reagents (thiourea and thioacetamide).

In Hokkaido, Japan, acid mine drainages (AMD) containing Mn and sulfate in high concentration has been generated from abandoned Mn mines. The wastewater has been treated by increasing pH to 10 using alkali reagents which are so costly.

Sulfate reducing bacteria (SRB) can reduce sulfate to sulfide at 37℃. The biological synthesis of metastable γ-MnS was examined by SRB, with Mn and sulfate from simulated AMD. In this study, the removal of Mn and sulfate and the synthesis of metastable γ – MnS were accomplished with the technique using SRB. These results would suggest that valuable materials can be recovered from waste materials.

2. The recycling of scrapped batteries

In Japan, 1.1 billion Mn dry batteries and 1.3 billion alkali batteries were produced in 2002. Hydrometallurgical and pyrometallurgical methods have been used to recover valuable metals from scrapped batteries. Since these methods are costly and complex, an alternative method for their recycling has been required.

The recycling of the scrapped batteries is to recover Mn and Zn components. The characterization of the batteries indicated that the chemical forms of Mn and Zn were oxides. Since magnetic property of Mn and Zn oxides is different, Mn and Zn

components could be physically separated. Therefore, magnetic separation would be expected to be useful to recover Mn and Zn from spent batteries and is investigating.

Publication

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Journal

[J1] **K. Yoo**, K. Sasaki, N. Hiroyoshi, M. Tsunekawa, and T. Hirajima: 'Effects of Mn^{2+} Concentration on Mn Removal by a Sulfate Reducing Bacteria Bioreactor' Materials Transactions, (2004) (submitted).

[J2] **K. Yoo**, K. Sasaki, N. Hiroyoshi and M. Tsunekawa: 'Fundamental Study on the Removal of Mn^{2+} in Acid Mine Drainage using Sulfate Reducing Bacteria' Materials Transactions, (2004) (submitted).

Proceeding

[P1] **K. Yoo**, K. Sasaki, N. Hiroyoshi, and M. Tsunekawa; 'The Synthesis of Metastable γ-MnS by Sulfate Reducing Bacteria', Proc. MMIJ Annual Meeting (2004) (accepted).