Geophysical Research Abstracts
Vol. 14, EGU2012-6972-1, 2012
EGU General Assembly 2012

Inhibition of Sulfide Mineral Oxidation by Surface Coating Agents: Batch

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Mining activities and mineral industries have impacted on rapid oxidation of sulfide minerals such as pyrite (FeS_2) which leads to Acid Mine Drainage (AMD) formation. Some of the abandoned mines discharge polluted water without proper environmental remediation treatments, largely because of financial constraints in treating AMD. Magnitude of the problem is considerable, especially in countries with a long history of mining. As metal sulfides become oxidized during mining activities, the aqueous environment becomes acid and rich in many metals, including iron, lead, mercury, arsenic and many others. The toxic heavy metals are responsible for the environmental deterioration of stream, groundwater and soils. Several strategies to remediate AMD contaminated sites have been proposed. Among the source inhibition and prevention technologies, microencapsulation (coating) has been considered as a promising technology. The encapsulation is based on inhibition of O_2 diffusion by surface coating agent and is expected to control the oxidation of pyrite for a long time.

Potential of several surface coating agents for preventing oxidation of metal sulfide minerals from both Young-Dong coal mine and Il-Gwang gold mine were examined by conducting batch experiments and field tests. Powdered pyrite as a standard sulfide mineral and rock samples from two mine outcrops were mixed with six coating agents (KH_2PO_4, MgO and $KMnO_4$ as chemical agents, and apatite, cement and manganite as mineral agents) and incubated with oxidizing agents (H_2O_2 or NaClO). Batch experiments with Young-Dong coal mine samples showed least SO_{42}- production in presence of $KMnO_4$ (16% sulfate production compared to no surface coating agents) or cement (4%) within 8 days. In the case of Il-Gwang mine samples, least SO_{42}- production was observed in presence of KH_2PO_4 (8%) or cement (2%) within 8 days. Field-scale pilot tests at Il-Gwang site also showed that addition of KH_2PO_4 decreased sulfate production from 200 to 13 mg L-1 and reduced Cu and Mn from 8 and 3 mg L-1 to below the detection limits, respectively. The experimental results suggested that the amendment of surface coating agents can be a promising alternative for inhibition of sulfide oxidation at AMD sites.