Fe colloid formation and effects on the mobility of toxic elements in Ainai mine drainage

A. KOIDE*, A. ITO, T. OTAKE AND T. SATO

Division of Sustainable Resource Engineering, Graduate School of Engineering, Hokkaido University, Sapporo, Japan (*correspondence: aoi-hokudai@eis.hokudai.ac.jp)

In mine drainages, dissolved heavy metals and toxic elements need to be treated before releasing to the environment. Whereas recent researches have shown that Fe is one of the dominant metals in mine drainages, Fe may exist as dissolved ions or colloids. The formation of Fe colloids may affect the mobility of other elements, for example, by adsorption or co-precipitation. Therefore, the objective of this study was to understand the formation and transport processes of Fe colloids and its effects to the mobility of other elements in a drainage from Ainai mine, Akita prefecture, Japan, where Zn and Cu were mined from sulfide ores. In the drainage, a passive treatment of drainage waste is accomplished simply by aeration.

The results of drainage water samples filtered with both 0.2 μm and 200 kDa filters showed that dissolved Fe, mostly present as Fe^{2+}, (i.e., < 200 kDa) decreased with increasing colloidal fraction downstream in the upper part of the drain. This is likely due to oxidative precipitation of Fe^{2+} associated with pH increase by aeration of mine water that was oversaturated by CO_2. Whereas Fe colloidal fraction gradually decreases in the lower part of the drain, turbidity kept increasing. This suggest that Fe colloids aggregate in the midstream to downstream, where some are still present as suspended solids in the water. The result of XRD and SEM-EDS of the drain sediments shows that they are predominantly composed of ferrihydrite. The As concetrations in colloidal and dissolved fractions show similar trends to those of Fe, indicating that As is likley adsorbed on the surface of Fe colloids immidiately after the Fe colloid formation. In constrast, change in Zn concentrations in the fractions did not behave similarly with Fe or As. SEM observation and XRD analsysis of the sediments as well as thermodynamic modeling from the chemical compositions of drainage water suggest that Zn may have been removed from the drainage water by incorporation into a LDH (Layred Double Hydroxide) structure.