

Comparison of speciation and solubility of arsenic, lead, and cadmium in contaminated soils from Kamegai mine tailing, Toyama, Japan

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Mining extraction and processing generate large volumes of metal-rich waste tailings. This tailing considered to be a principal cause of soil contamination in mining areas. Once these toxic metals are introduced into soils with surface water, they can be transported deeply into the soil and groundwater, threatening environmental health. This study determined speciation and solubility of As, Pb, and Cd in soils from the mine tailing area, by employing a sequential extraction (SEP) and X-ray absorption fine structure (XAFS).

The results revealed that most of As in the soil is pentavalent oxidation states and is adsorbed on primarily goethite and secondarily ferrihydrite. The As(V) favorably can adsorb to the ferric oxides under acidic conditions, while it prefers to desorb from the minerals under alkaline conditions. Results showed most of Pb was adsorbed on goethite which is rich in the soil sample. Based on the SEP, the high ionic strength and/or slightly lower pH solution can lead to the significant release of Pb to solutions. Cd is mainly adsorbed on clay minerals. Due to the high cation exchange capacity of clay minerals, Cd placed in the interlayer can be released with the other cations with high concentrations in the surrounding solutions.

The river water in this area is characterized by low ionic strength and slightly alkaline pH. The concentrations of Pb and Cd in the river are always less than 0.07 ug/L, while that of As in the river sometimes exceeds 10 ug/L. The solubilities of heavy metals in the river in this area are consistent with those predicted by the chemical speciation.

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