Mineralogical characterization and remediation of asbestos-contaminated soil

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Asbestos-contaminated soils are a potential source of airborne asbestos which can potentially cause serious diseases. Therefore, the asbestos-contaminated soils should remediate and manage properly for human health. The objectives of this study were to examine mineralogical characteristics of asbestos and to investigate remediation of asbestos-contaminated soils.

Asbestos-containing soils were collected from around the serpentinite containing chrysotile fibers and carbonate rocks containing tremolite asbestos. For remediation, the asbestos-containig soils were reacted for 20 days within alkaline solutions (pH = 10 ~ 11) that made using bottom ash, sulfur and calcium hydroxide. And thermal treatment of the chrysotile and tremolite asbestos was performed at 850℃ and 1100℃ for 2 hours, respectively. Mineralogical characteristics of the asbestos fibers and transformed minerals by chemical and thermal treatments were examined by XRD, PLM, SEM-EDS, and TEM-EDS analyses.

Soils weathered from serpentinite and carbonate rock contained 2% fibrous chrysotile bundles and 5.5% needle-like shaped tremolite asbestos, respsctively. It indicated that these soils were classified as asbestos-contaminated soils (> 1%) based on U.S. EPA. After chemical treatment using alkaline solution, chrysotile showed low peak intensity, changes of dispersion staining colors, morphology and chemical composition compared to untreated chrysotile fibers. But tremolite asbestos had no changes of mineralogical and chemical properties after reaction with the akaline solution. As results of thermal treatment, chrysotile fibers was transformed into rod-shaped forsterite at 850℃ and tremolite asbestos was transformed into rod-shaped diopside and enstatite at 1100℃ due to dehydroxylation.

These results indicate that chemical treatment using alkaline soluiton have a potential for dissolving chrysotile fibers and also thermal treatment lead to mineralogical transformation of chrysotile and tremolite asbestos. Therefore, mineralogical properties of the asbestos-contaminated soils should be taken into account to decide a remediation strategy for a given asbestos because development and optimization of soil remedial technologies are based on mineralogical characteristics.