Long-term monitoring of industrially heavy metals contaminated soil stabilized by SPC binder

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Solidification/stabilization is routinely used in the remediation of heavy metals contaminated sites. However, this method is to immobilize the heavy metals into soil-binder matrix, rather than to eliminate them from soil. While the short-term effectiveness of *S/S* is secure, the long-term effectiveness is also a most concerned issue when the stabilized soil is exposed to extreme conditions, such as acid rain corrosion, dry-wet cycles and carbonization. This study presents a systematic long-term monitoring of a novel hydroxyapatite-based binder (SPC) stabilized industrially contaminated soil. A series of laboratory and outdoor investigations of heavy metals leaching and stabilized soil strength properties are conducted at 3 d, 7 d, 28 d, 3 m, 6 m and 12 m. Furthermore, the heavy metals immobilization mechanism is explored by XRD analysis. The outdoor and laboratory results demonstrate that both unconfined compressive strength and soil pH increase with the addition of SPC, but toxicity leaching concentrations of Ni and Cu decrease. These results are interpreted based on the changes in chemical speciation of Ni and Cu and products of $Ca_3(PO_4)_2$, $Ca(OH)_2$, $Ca_{10}(PO_4)_6(OH)_2$, CSH, $Ni_3(PO_4)_2{\cdot}8H_2O$, $Ca_2Ni(PO_4)_2{\cdot}2H_2O$, $Cu_3(PO_4)_2{\cdot}3H_2O$ and $Cu_2(PO_4)(OH)$ formed in the stabilized soil. The long-term monitoring results indicate that the heavy metals leaching concentrations slightly increase, but they are still far below their remediation goal; the q_u and pH of the stabilized soil after 12 m monitoring decreases by 2.6% and 0.3 units compared to the max q_u and max pH obtained at 90-day; the acid extractable fraction of Ni has an slightly increase of 2.1%, while the residual fraction of Cu has an slightly decrease of 3.5%. Overall, this study demonstrates that the heavy metals in soil can be effectively stabilized by SPC binder, and the heavy metals leached concentrations of the stabilized soil can still meet the remediation requirements after a exposure of 12 m in the outdoor.

Keywords: heavy metals, contaminated soil, hydroxyapatite-based binder, solidification/stabilization, leaching, strength

