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Influence of phosphate and acid to geochemical mobility of arsenic in amended soil with limestone and steelmaking slag

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Stabilization is a widely applied method for remediating or rehabilitating contaminated soil. It decreases geochemical mobility and allows for the target elements to remain in the contaminated soil following a stabilization. Thus, several queries remain regarding the behavior of sequestered elements when exposed to environmental changes. This study conducted acid (1 M HCl) and phosphate (1 M NaH_2PO_4) leaching experiments to identify and predict the geochemical behavior of As in response to soil acidification and agricultural activities. In addition, a correlation analysis was performed to assess the relationship between soil amendment and As extraction mechanisms influenced by H^+ or PO_4^{3-} or both. Limestone and steelmaking slag were mixed with the studied soil to mimic soil stabilization. The total As concentration in the studied soil was 24.1 ± 11.7 mg/kg, and the soil pH increased from 6.5 to 7.4 after soil amendment using the additives. As extracted from the control soil without additives was 3.0 mg/kg (1 M HCl) and 3.4 mg/kg (1 M NaH_2PO_4). In the acid leaching experiments, the extracted As was decreased by 28% compared to the control soil, owing to the reduction of leaching efficiency by the additives. The variations in As extraction from the soil showed a positive correlation with variations in H^+ in solution, indicating H^+ consumption by the additives. However, phosphate leaching would release As from the soil, regardless of soil stabilization. The correlation analysis results showed that As extraction mechanism from the soil by 1 M NaH_2PO_4 could be attributed to exchangeable reactions between As and PO_4^{3-}. To summarize, soil stabilization could decrease As mobility under acidic conditions. However, sequestered As could be released under phosphate-rich conditions. Therefore, the geochemical conditions change of soil should be considered to achieve the As sequestration in the soil using these additives.