Szlezak, Agnieszka M. Ph.D., Purdue University, December 2006. In Situ Immobilization of Arsenic, Chromium, Cadmium and Lead by Addition of Chemical Amendments to the Soil. Major Professor: M. Katherine Banks.

In situ chemical stabilization of contaminated soil with arsenic, chromium, cadmium and lead has been investigated in this dissertation research. In laboratory studies, combinations of chemical amendments, including rare earth elements, Mn and P, were added to soil with low redox potential to reduce the bioaccessible fraction of As, Cr, Cd and Pb. Lanthanum and Ce are able to form low solubility precipitates with As, as determined in aqueous solutions. Spectroscopic studies confirm that $LaAsO_{4(s)}$ can form under pH conditions as low as 2.2. The addition of La to soil increased the bioaccessible fraction of As and was both ratio and time dependent. Chemical modeling, using Visual MINTEQ, showed that redox potential played a role in the increase of bioaccessible As. At Eh -29, even at neutral pH, $LaAsO_{4(s)}$ was unable to decrease the concentration of As below that controlled by realgar, which controls the As in the target soil. Because of lack of solubility constants for lanthanum/cerium sulfides/sulfates, the possible hindrance of S was not determined. Cerium was not affected by the low redox potential or possible interaction with S, and the addition of Ce was able to decrease the As bioaccessible fraction, but was ratio and time dependent. Combination amendments of Ce, Mn and P showed promising results. With the addition of 1:5 Pb+Cd:Mn and Pb+Cd:P, bioaccessible Cd was reduced below detection limit and bioaccessible Pb was reduced to 11% compared to 66% in the control. Also, the addition of 1:3 As:Ce and any ratio of Mn and P were able to decrease the Cr bioaccessible fraction significantly compared with the control. The bioaccessible fraction of As increased with the addition of Mn and P, and Ce was unable to offset this decrease. There was a slight offset with the addition of 1:3 As:Ce, but this was not significant compared with 1:1 As:Ce. Additional research is needed to assess the long-term in-situ stabilization of soil with multiple metal contaminants.