Report for 2005MO53B: Fate and Transport of Heavy Metals in Artificial Soil

Publications

- Conference Proceedings:
    - Conference Proceedings: Wayllace, A., and Likos, W.J., 2006, “Numerical modeling of artificial soil as an evapotranspirative cover,” Proceedings of 4th International Conference on Unsaturated Soils, Carefree, AZ, April 2006.
- Dissertations:
    - Masters Thesis: Bergsten, J., 2006, “Sorption and transport of heavy metals in artificial soil,” M.S. Thesis, University of Missouri – Fall 2006.

Report Follows

FATE AND TRANSPORT OF HEAVY METALS IN ARTIFICIAL SOIL

Objectives, Methodology, and Results

The objective of this research is to assess the short- and long-term fate of metals in "artificial soil" produced by blending yard waste, biosolids, cement kiln dust (CKD) and coal ash and use for land reclamation applications. Field sampling has been conducted within relatively recently placed (< 6 months) and relatively mature placements of artificial soil at a pilot site in Hannibal, MO. Materials were analyzed for pH, organics, carbonate content, cation exchange capacity, metals concentrations as a function of depth from the surface to assess in-situ transport. Batch sorption tests were conducted to quantify sorption parameters (e.g., Figure 1). Column leaching tests using distilled water and a pH-buffered solution (4.5 – 5.3) were conducted to quantify metals transport behavior. Concentrations of metals in the leachate (Cd, Zn, Pb) were below detection limits (>1ppm) after approximately 20-30 pore volumes of flow. A finite-difference based model for variably saturated fluid transport has been developed to model the liquid transport at the field site. Wetting front propagation was simulated under a series of sustained and short-term precipitation events and compared with actual infiltration data obtained from the Hannibal site. The predicted depth of the wetting front is 250 cm, which compares reasonably well with moisture data obtained from the field site and is less than the total thickness of the cover (425 cm). The artificial soil acts as an effective evapotranspirative cover system by restricting wetting front propagation and causing water to either evaporate or flow laterally. Results provide initial quantitative data to support the beneficial reuse of select waste materials in land reclamation applications.

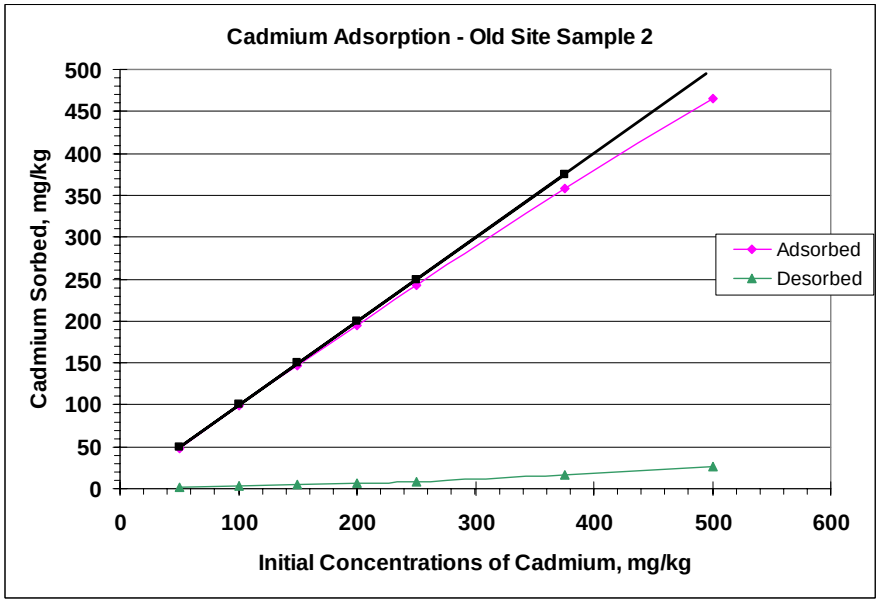

Figure 1. Batch sorption results: Cd, Mature site, Sample 2.

Students Directly Supported

Joshua Bergsten, Graduate Student (M.S.), completion date = Fall 2006

Publications

Bergsten, J., 2006, "Sorption and transport of heavy metals in artificial soil," M.S. Thesis, University of Missouri – Fall 2006.

Wayllace, A., and Likos, W.J., 2006, "Numerical modeling of artificial soil as an evapotranspirative cover," *Proceedings of 4th International Conference on Unsaturated Soils*, Carefree, AZ, April 2006.

Supplemental Grants Obtained

Portland Cement Association (PCA) Education Foundation Fellowship Award – $20,000 fellowship awarded to Alexandra Wayllace (UMC Graduate Student).