

Effect of Leaching Scale on Prediction of Total Dissolved Solids Release from Coal Mine Spoils and Refuse

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Abstract: Coal surface mining in the Appalachian USA coalfields can lead to significant environmental impacts including elevated total dissolved solids (TDS) levels in receiving streams. Column leaching procedures are recommended by many studies for TDS prediction, but many question their applicability to field conditions. The objective of this study was to assess results from a simple column leaching method relative to larger scale leaching vessels (scales) using one coal mine spoil and two coarse coal refuse materials. A non-acidic mine spoil sample from SW Virginia (crushed to < 1.25 cm) was placed into PVC columns (~10 cm x 40 cm) in the laboratory and leached unsaturated with simulated acidic rainfall. The same spoil was also placed into larger “mesocosms” (~1.5 m³) with run-of-mine material and into barrels (~0.1 m³; screened to < 15 cm) under natural field environmental and leaching conditions. Similarly, two coarse coal refuse samples were placed into lab columns and field barrels. Comparative results suggest the column method was a reasonable predictor of TDS release from the coal mine spoil relative to the two larger scales studied. However, there were significant differences at times during the study, including during initial peak TDS elution (1,750 $\mu\text{S cm}^{-1}$ in columns vs. 2,250 $\mu\text{S cm}^{-1}$ in mesocosms). Field leaching also produced a distinct seasonal time-lagged EC pattern that was not observed in the columns. On the other hand, significantly different and dissimilar leaching results were noted for the refuse column vs. barrel leachates, calling into question their prediction ability for refuse.

References and Related Publications:

Daniels W.L., Z. Orndorff, C. Zipper. Predicting release and aquatic effects of total dissolved solids from Appalachian USA coal mines. *Int J Coal Sci Technol* (2014) 1:152-162.

Daniels W.L., J.M. Parker, Z.W. Orndorff, L.C. Ross, S.C. Koropchak, C.E. Zipper, M.J. Eick.. 2015. Evaluation of a Simple Column Leaching Method to Predict Potential TDS Losses from Central Appalachian Overburden Materials. In: Craynon J.R. 2015. Second Environmental Considerations in Energy Production Conference. Society for Mining, Metallurgy & Exploration, Littleton CO.

Daniels W.L., C.E. Zipper, Z.W. Orndorff, D.K. Johnson. 2015. Can We Limit TDS Discharge from Appalachian Coal Surface Mines? In: Proceedings, Sustainable Development in the Minerals Industry conference, Vancouver, 17-20 July 2015.

Evans D., C. Zipper, P. Donovan, W. Daniels. 2014. Long-term trends of specific conductance in waters discharged by coal-mine valley fills in central Appalachia, USA. *Journal of the American Water Resources Association*. Volume 50. 1449–1460.

Orndorff Z.W., W.L. Daniels, C.E. Zipper, M. Eick. 2015. A column evaluation of Appalachian coal mine spoils' temporal leaching behavior. *Environmental Pollution* 204: 39-47.

Ross L.C.. 2015. Effect of Leaching Scale on Prediction of Total Dissolved Solids Release from Coal Mine Spoils and Refuse. M.S. Thesis, Virginia Tech, Blacksburg. (The above abstract is from that thesis).

Zipper C.E., E.V. Clark, W.L. Daniels, R.J. Krenz. 2015. Mine Spoil Fill Construction for Reducing Total Dissolved Solids in Discharged Waters. In: Craynon J.R. 2015. Second Environmental Considerations in Energy Production Conference. Society for Mining, Metallurgy & Exploration, Littleton CO.

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