

Predicting TDS Release From Overburden

Zenah Orndorff¹, W. Lee Daniels¹, Jeff Skousen², and Louis McDonald²

¹ Crop and Soil Environmental Sciences, Virginia Tech

² Plant and Soil Sciences, West Virginia University

Overburden in the Appalachian coalfields can affect water quality as runoff or via drainage percolating through valley fills. In particular, over the past decade, concerns about the biological effects of elevated long-term emission of total dissolved solids (TDS) have emerged. By understanding and predicting the leaching potential of mine spoil materials, valley fills can be better designed to minimize environmental impacts. This research program focused on the determination of leaching potentials of 55 coal mine spoils from the Central Appalachian coalfields. Major goals were to characterize the elemental composition of the leachates, to determine the temporal pattern of elemental release, and to compare the results obtained from column leaching trials with larger scale leaching methods and with possible static test predictors. The bulk raw spoil materials were typically near-neutral to alkaline with saturated paste pH values ranging from 4.5 – 8.7. Saturated paste EC values were typically low (<1000 uS/cm), and ranged from 200 – 3800 uS/cm. Most spoil samples contained little or no reactive CaCO_3 (as indicated by fizz test) and low total-S ($\leq 0.25\%$), although a few samples contained up to 1.5% total-S. All materials were leached in columns for 20 weeks (2 leaching events per week) under unsaturated conditions, and the leachates were analyzed for pH, EC, and several ions of concern. A subset of samples also was leached under saturated conditions. Leachate pH typically increased over the first few leach events, and most samples equilibrated at pH 7.5 – 8.5 within 5 to 8 leaching cycles. Highly acidic leachate was observed only from black shale. For many samples, EC decreased notably over the first several leaching events, and achieved a relatively steady state within 18 leach cycles, at which time 80% of the samples were equilibrated to EC levels <500 uS/cm. Samples that exceeded 500 uS/cm throughout the 20 week leaching period were typically finer grained materials, with black shales producing the highest EC. For all rock types, weathered materials equilibrated at lower pH and EC values than their unweathered equivalents. Scaling effects were evaluated for one spoil material by comparing leachate quality from the columns with field-scale barrels (200 L) and large (2.5 m^3) mesocosm tanks. Overall, bulk EC and component elements were similar in levels and temporal response at all 3 scales; however, initial EC levels were higher from the mesocosm tanks, and EC levels in the barrels and mesocosms slowly rose towards the end of the study (likely due to seasonal effects). Preliminary statistical analyses indicate that total-S and saturated paste EC offer promise as predictors of field TDS release potentials; final predictors may involve mixtures of parameters.