Selenium treatment with iron oxides at a WV surface mine.

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This investigation was a field-scale lysimeter test of the effectiveness of a single basal iron oxide layer at reducing Se mobility in leachate derived from carbonaceous, shaly spoil. The field study at the Hobet mine, Lincoln County, WV, employed fresh surface-mine waste rock layered with an iron oxide amendment obtained from a limestone-treated mine-drainage wetland. The experimental design employed nested amendment concentrations in replication to account for hydrologic and starting-material uncertainties. Thirty lysimeters (4.9 x 7.3 m), each containing 55 metric tons (1.2 to 1.8 m thick) of mine-run carbonaceous shale overburden, were installed at the Hobet mine in SE West Virginia. The fine-grained iron oxide was determined to be primarily metal oxides, 91.5% ferric and 4.36% aluminous, with minor (<3%) SO_4 and Ca, perhaps as gypsum. Based on x-ray diffraction, the mineralogy of the iron was goethite, although residual ferrihydrite may also be present. Various thicknesses of this amendment (0.0064, 0.057, 0.229, and 0.457 m, plus a zero-amendment control) were employed, ranging from 0 to 2.2% weight percent of the spoil. The control and each treatment were replicated 6 times, to estimate uncertainty due to compositional and hydrological variation. Infiltration of rainfall-created leachate that drained to individual batch-collection tanks was sampled 46 times at approximate 2 week intervals from 2010-12. Basal iron oxide layers in the three highest amendment categories removed up to 76.1% selenium (in comparison to unamended piles) from leachate by adsorption. Only lysimeters with very thin iron oxide layers showed no significant reduction compared to unamended piles. Reproducibility of replicates was within acceptable limits for both amended and unamended lysimeters. Results indicate that in-situ amendment using iron oxide obtained from treatment of mine water can sequester Se by adsorption on surfaces of goethite and possibly also ferrihydrite. This process is demonstrated to substantially reduce dissolved Se in leachate. The general technique of using iron-oxide sludges or similar waste materials as an absorbent for Se at mine sites is novel and merits study for further implementation. These results are being examined in the context of historical Se observations at this mine to develop a strategy to improve compliance with regulatory discharge limits until natural long-term exhaustion of the Se source occurs.