POSTER SESSION

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PRELIMINARY COMPARISON OF PLANT SPECIES FOR HEAVY METAL CONCENTRATION WHEN GROWN ON RECLAIMED MOLYBDENUM TAILINGS[1]

by

Henson, James F.[2], Wendall R. Oaks[3], and Scott Vail[4]

Abstract. Our objective was to compare the response of 14 plant species (grasses, legumes and forbs) for heavy metal concentrations when grown on reclaimed Mo tailings and non-tailings background sites. Above-ground vegetation concentrations of Al, As, Cd, Cr, Cu, Mo, Ni, Pb, Se, and Zn were measured. All plant species were not present at each site, therefore the data was not statistically analyzed. Comparisons between Mo tailings and non-tailings sites suggest that growth on Mo tailings did not affect the plant concentrations of Al, As, Cd, Pb, Ni, Se, and Zn. The concentrations of Cr, Cu, and Mo were seemingly higher for plants grown on Mo tailings than non-tailings background sites. Plant species seemingly differed in their responses to Mo tailings for Mo concentration but not for Cr and Cu concentrations. Only one heavy metal concentration in one plant species (Mo concentration in *Melilotus officinalis*) exceeded the maximum tolerable dietary level for mule deer. We are planning an experiment to clarify the differences between plant species for the response of Mo, Cu and S concentrations to increased soil Mo levels.

Keywords: Molybdenum, Mo tailings, copper, heavy metal accumulation

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MODELING OF GROUND-WATER FLOW ALONG A CROSS SECTION THROUGH A RECLAIMED SURFACE COAL MINE IN WESTERN PENNSYLVANIA[1]

By David A. Saad[2] and Charles A. Cravotta III[2]

Abstract. A cross-sectional (two-dimensional) ground-water flow model was developed to demonstrate the direction and rate of ground-water flow in mined and unmined sections through a reclaimed surface coal mine in the bituminous field of western Pennsylvania. Modeling was performed using a steady-state option of MODFLOW, a finite-difference computer program. The water-table configuration and vertical hydraulic gradients were determined from static water levels measured in 10 wells screened at 1 of 3 horizons along the cross section. The water table was simulated as either a constant-head or constant-recharge boundary, and the lower and lateral extent of the local flow system as no-flow boundaries. Hydraulic conductivities (K), boundaries, and recharge rate were varied in a series of simulations to evaluate simple to complex hydrogeologic conditions and flow-system geometries. Ranges of values of K (in feet per day) for spoil, coal and sandstone, and shale and underclay lithologies were modeled (K_{MODEL}) considering estimates from textbook tabulations (K_{TB}), published aquifer-test results (K_{AQ}), specific-capacity data using a form of the Theis equation (K_{SC}), and site-specific slug tests (K_{SL}) as follows:

LITHOLOGY	K_{TB}	K_{AQ}	K_{SC}	K_{SL}	K_{MODEL}
Mine spoil	--	10^{0} -10^{2}	--	--	10^{1} -10^{2}
Coal and sandstone	10^{-5}-10^{1}	10^{-3}-10^{2}	10^{-2}- 10^{3}	10^{-1}- 10^{1}	10^{0} -10^{1}
Shale and underclay	10^{-8}-10^{-4}	10^{-6}-10^{-2}	10^{-2}- 10^{2}	10^{-2}- 10^{-1}	10^{-2}-10^{-1}

Values for K_{TB} are relatively low, because they reflect the low primary porosity of the sedimentary bedrock, whereas values of K_{SC} are greater, because they reflect results of pumping tests at water-supply wells that typically are completed in zones where secondary fractures and joints and bedding planes predominate. Values of K_{MODEL} are generally within the range of values for K_{AQ} and K_{SL}, which were obtained from aquifer tests of strata underlying the study area and vicinity. Models were calibrated by adjusting values of K_{MODEL} to match the measured water levels.

When the water table was simulated as a constant-head boundary, resultant recharge distributions were unrealistic, thus subsequent models were constructed whereby recharge was specified as a constant or a variable flux distributed across the water table boundary. The varied recharge simulation accounts for effects of two leaky aquitards (underclays) that cause seepage at the toe of spoil--thus reduced vertical percolation and increased downslope recharge. The model results indicate that flow paths are predominantly horizontal through transmissive units (spoil, coal, and sandstone) and vertical through confining units (shale and underclay). The average linear velocities generally are greater in transmissive units (10 - 650 feet per year) than in confining units (0.1 - 10 feet per year), assuming porosities of 25, 15, and 10 percent, respectively for spoil, coal and sandstone, and shale and underclay. These results add to the understanding of the hydrogeology and geochemical evolution of ground water at the mine. Such information on flow paths and velocities also is useful in the planning of ground-water monitoring schemes, specifically sample spacing and timing intervals.

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AVIFAUNAL USE OF A CONSTRUCTED WETLAND RECEIVING MINE WATER DRAINAGE[1]

by

Lacki, Michael J.[2], Joseph A Hummer[3] and Harold J. Webster[4]

Abstract. Birds were surveyed at the Simco #4 wetland near Coshocton, Ohio, during May and June of 1988, 1989 and 1990, as part of an overall assessment of the wildlife habitat suitability of a mine reclamation project. The constructed wetland was established in November 1985 to serve as a treatment system for a deep mine discharge, and was composed of a series of three cattail *(Typha latifolia)* cells totalling 0.3 ha in size. Comparison surveys were also completed at three nearby natural wetland sites similar in size and dominant wetland vegetation. Data were evaluated at the species and guild level and examined for patterns of abundance, richness, dominance, evenness, and diversity. Results demonstrated that the constructed wetland exhibited the fewest number of bird feeding guilds per survey but an intermediate level of bird abundance relative to all sites examined. Significant differences in species diversity and feeding guild diversity patterns were not detected among sites; however, the constructed wetland supported a bird community with a significantly lower species evenness index, suggesting a more harsh and variable habitat relative to the natural wetlands. We attribute this response to some species gaining a competitive advantage over others and occupying the constructed wetland in greater numbers. Our data suggested that the availability of adequate nesting habitat strongly influenced the patterns for avian diversity observed.

[1]Paper presented at the 1991 National Meeting of the American Society for Surface Mining and Reclamation, Durango, CO, May 14-17, 1991.

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UTAB: A NEW COMPUTER DATABASE FOR INFORMATION ON HEAVY METAL DATA IN PLANTS[1]

by

Nellessen, J.E.[2] and J.S. Flectcher[3]

Abstract. The UTAB database currently contains information on the uptake, translocation, and accumulation of xenobiotic organic chemicals by vascular plants. UTAB is now being expanded to contain data on the uptake of heavy metals by plants. UTAB can be used to estimate the accumulation of toxic metals in vegetation and their subsequent movement through the food chain. Presently, it contains 2550 bibliographic references on metals covering the period 1976-1989. This covers a wide variety of topics but at least 100 papers deal with heavy metal uptake by plants in unreclaimed or reclaimed mine lands. Twenty metals have been included, involving all 13 metals on the US EPA's list of priority pollutants. Each record in the data file will contain information on a single plant specied, metal, and dose combination. Other information will identify the plant parts accumulating the metals, the amount accumulated, and the period of exposure. The parameters data field can identify studies as reclaimed or unreclaimed mines, the use of sludge, pollution from ore refineries, and even normal metal content in vegetation. Thus the database can be used to obtain specific data on a plant species or metal wihout a time consuming library search.

[1]Paper presented at the 1991 National Meeting of the American Society for Surface Mining and Reclamation, Durango, CO, May 14-17, 1991.

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PASSIVE TREATMENT FOR HEAVY METAL REMOVAL BY CONSTRUCTED WETLANDS[1]

by

Machemer, S.D.[2], J.S. Reynolds, J.L. Bolis, T.R. Wildeman, R.R. Cohen, R.W. Cohen, R.W. Klusman and E. R. Bates[3]

Abstract. A pilot constructed wetland was designed and built for passive treatment of the heavy metal mine drainage at the Big Five Tunnel, one of several CERCLA sites within the Idaho Springs-Central City mining district in Colorado. The objectives were to raise the pH and remove the heavy metals from the mine drainage. In addition, much was expected to be learned about competing removal processes in a wetland. Constructed wetlands can be designed to maximize one or two processes over all of the processes that occur in a natural wetland. The Big Five wetland was designed to maximize sulfate reduction followed by sulfide precipitation as the major metal removal process. Since the original construction in 1987 and subsequent modifications in 1988 and 1989, removal of metal contaminants has been consistently achieved. Some treatment cells were designed to operate in either an upflow or a downflow configuration. The removal efficiencies of the two flow systems appear to be similar with nearly complete removal of Fe, Cu, and Zn, approximately 25% removal of Mn, and an increase in pH from below 3 to above 6.

[1]Paper presented at the 1991 National Meeting of the American Society for Surface Mining and Reclamation, Durango, CO, May 14-17, 1991.

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