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Dr. John Nelson
Geotechnical Engineering Program
Civil Engineering Department
Colorado State University
Fort Collins, Colorado 80523

Dear Dr. Nelson:

Please consider the enclosed abstracts for the Eighth Annual Symposium on Geotechnical and Geohydrological Aspects of Waste Management. Once the symposium reviewers have decided whether to accept the papers, please contact Michael Weber at telephone extension (301) 427-4746 or at the following address:

U. S. Nuclear Regulatory Commission
Mail Stop 623-SS
Washington, DC 20555

Sincerely,

Original Signed By

Malcolm R. Knapp, Chief
Geotechnical Branch
Division of Waste Management

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ABSTRACT

ESTIMATING CONTAMINANT DISCHARGE RATES FROM
STABILIZED URANIUM TAILINGS EMBANKMENTS

Michael F. Weber, Division of Waste Management,
U. S. Nuclear Regulatory Commission, Washington, DC 20555

Leaching of uranium tailings and percolation of tailings pore fluids may degrade the quality of groundwater resources after tailings stabilization, so minimizing contaminant discharge rates is a goal of tailings stabilization. Contaminant discharge rates are a function of the infiltration rate through embankment covers, the mass and distribution of tailings, and the concentrations of contaminants in percolating pore fluids. These concentrations, in turn, depend on the tailings composition, leachability and solubility of contaminants, geochemical conditions within the embankment, and the flux of groundwater through the embankment. Simple calculations, laboratory and field measurements, and analytical and numerical modeling of groundwater flow through variably-saturated tailings indicate that steady-state groundwater flow may be assumed to estimate long-term (e.g., greater than 50 years) discharge rates after consolidation and dewatering have essentially ceased. Contaminant concentrations in percolating groundwater may be assumed based on maximum reported concentrations, solubility limits, or extrapolations of leaching data considering similarities and differences in tailings composition and geochemical environments. Estimates of contaminant discharge rates are essential in evaluating long-term impacts of uranium tailings disposal and in optimizing designs of disposal alternatives to minimize adverse effects on groundwater resources.

RUNOFF FROM ARMORED SLOPES

(Richard Codell, U.S. Nuclear Regulatory Commission, Washington D.C. 20555)

For "Geotechnical and Geohydrological Aspects of Waste Management",
Colorado State University, February 5-7, 1986

The embankments of impoundments for reclaimed uranium mill tailings in arid climates are often protected from erosion by rock armor. Armor on these slopes must be designed to withstand runoff caused by intense precipitation. Runoff will travel both through and over the top of the rock armor. The runoff caused by intense local precipitation falling on typical embankments has been studied by means of a kinematic finite-difference model in two dimensions. Friction relationships for water flowing through and over rock layers were gathered from the literature on rockfill dams and gravel-bed streams, respectively. The slopes used in these computations had a 2% grade on top and a 20% grade on the sides. A one hour rainfall of 20 cm. with rates as intense as 125 cm./hr. for 2.5 min. was considered.

Peak runoff from the top slope may actually exceed runoff from the side slopes because the rock layer on top is less able to carry the flow, which results in overtopping and an overall reduction in resistance to flow. Embankment slumping and differential settlement cause significant concentrations of flow, and must be taken into account in the design. Factors which reduce peak runoff include larger rock diameter and greater thicknesses of the rock layer. The effects of embankment slumping and differential settlement can be largely eliminated by providing a rock layer of ample thickness. The design of the armor must take rock durability into account, because a reduction in the mean size of the rock over a period of time will increase the peak runoff, and the smaller rock will be more vulnerable to erosion from the flowing water.

The largest sources of uncertainty in the model are related to:
(1) friction relationships for flow over and through the rock,
(2) the stability of the rock layer under the forces exerted by the water, and
(3) the quantification of modes of slumping or differential settlement of the embankments. The Nuclear Regulatory Commission is sponsoring a series of flume experiments at Colorado State University to collect data on items (1) and (2). These data will be used to validate the flow model and propose criteria for the stability of rock layers under intense precipitation.

SELECTION OF SOILS FOR WICK EFFECT COVERS

Daniel J. Goode, Division of Waste Management, U.S. NRC, Washington, DC, 20555

ABSTRACT

At low capillary pressures (dry conditions), fine-grained soils retain more moisture than coarse-grained soils (the wick effect). Since unsaturated hydraulic conductivity is controlled by moisture content, this contrast can be utilized to reduce infiltration through soil waste disposal unit covers by installing a coarse-grained soil beneath a fine-grained soil. The performance of this "capillary barrier" cover system requires that the unsaturated conductivity of the coarse-grained soil remain lower than the conductivity of the fine-grained soil for the hydrologic conditions experienced in place.

The ratio of saturated hydraulic conductivities of the coarse and fine-grained soils has been proposed as a criterion for selecting soils for a wick effect cover. This criterion does not necessarily result in selection of optimum, or even functional soils. This is demonstrated by numerical simulation of two different wick covers using two coarse-grained soils having similar saturated hydraulic conductivities but different moisture retention characteristics. The selection of the optimum soil depends on the hydrologic boundary conditions and the unsaturated hydraulic conductivity of the coarse-grained soil at the interface. Use of the saturated hydraulic conductivity ratio of these soils as a selection criterion is demonstrated to result in an increase in infiltration for some situations.

Unsaturated flow under insitu hydrologic conditions should be evaluated to select soils for wick effect covers. If hydrologic conditions are such that steady-state can be assumed, analytical one-dimensional solutions are available. Numerical solutions are available for simulation of transient and multi-dimensional systems.