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EVALUATION OF THE HYDRAULIC CONDUCTIVITY OF COVER SYSTEMS FOR MINERAL WASTE CAPPING PROJECTS

FRANCIS D. UDOH

Department of Chemical & Petroleum Engineering, University of Uyo, Uyo - Akwa Ibom State, Nigeria

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ABSTRACT

Laboratory tests and simulations were performed to evaluate the effectiveness of various capping systems in reducing drainage from mineral stockpiles. ASTM soil testing standards were used to evaluate the physical properties of the materials in order to establish a cover system that produced the highest soil density and lowest soil permeability when compacted at optimum moisture content. After laboratory tests were completed, four barrier materials were selected for further evaluation. The laboratory hydraulic conductivity of the selected materials were all less than or equal to 2×10^{-6} cm/sec., the maximum value allowed by Minnesota Pollution Control Agency (MPCA). The effective hydraulic conductivities of the barriers were estimated using the EPA HELP (Hydrologic Evaluation of Landfill Performance) model. Model results indicated that the major water loss occurred through evapotranspiration and the single most important design parameter affecting infiltration was, not surprisingly, the hydraulic conductivity of the barrier. An analysis of key input parameters in the HELP model showed that design parameters such as soil type, hydraulic conductivity, cover thickness and slope of the drainage layer affected infiltration rate to a certain extent. However, for a given barrier, the hydraulic conductivity of the cover system was the most critical design parameter affecting water infiltration. Based on the results obtained, a cap design consisting of a three-layer soil barrier was recommended for final capping of any mineral stockpile capping project.

INTRODUCTION

Lean ore and waste rock stockpiles, unless controlled, may pose significant environmental problems. Precipitation which enters a mining stockpile is a potential source of surface and groundwater contamination. Minerals present in the stockpile will dissolve in the presence of oxygen and water. Precipitation which percolates through the rock subsequently transports the dissolved minerals from the stockpiles downstream. The degree of transport of the dissolved minerals is dependent upon the chemistry of the component released, the chemistry of the transporting solution and the solids and biota which come in contact with the flow.

Often drainage from mineral wastes can be reduced by proper sitting or diversion of surface and groundwater. Further reduction can only be achieved

***Address for correspondence - Email :** fdudoh@yahoo.com