Evaluation of the use of alum sludge as hydraulic barrier layer and daily cover material in landfills: a finite element analysis study

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ABSTRACT

In this study, the uses of alum sludge (AS) as hydraulic barrier (HB) layer and daily cover (DC) material were investigated using two-dimensional finite element analysis. In the analyses, typical landfill geometries were carried out for two different side-slope steepness (2H:1V and 3H:1V), two different HB materials (compacted clay (CC) and AS) and four different DC scenarios (no DC, sand (S), compost, and AS), two landfill heights (20 m and 30 m) and two different municipal solid waste decomposition conditions (freshly disposed waste and old waste), and the effects of these variables on the displacements, and factor of safety (FS) values were investigated. For all the cases studied, FS values higher than 1.5 were obtained which indicated that the landfills were stable against sliding, and the displacement values were within the limits reported in the literature. The results of the finite element analysis also showed that AS used as HB and DC material yielded compatible results with the ones for the CC and S, which are widely used materials as HB and DC in landfills, respectively. Therefore, it can be said that, considering its low hydraulic conductivity, high shear strength, high contaminant removal abilities, and easy availability at no cost, AS can be used as an efficient alternative HB and DC material for landfills.

Keywords: Landfill; Alum sludge; Hydraulic barrier; Daily cover; Finite element analysis

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