Development of Material and Compaction Requirements for a Mixed Clay/Sand Tailings Impoundment Liner

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ABSTRACT

A laboratory study was performed to support the design of a compacted clay liner (CCL) for a proposed tailings storage facility in an arid region of the western United States. The objectives of the study were: (1) to evaluate the index, compaction, and hydraulic properties of blended mixtures of two on-site borrow soils (i.e., fine sand and high plasticity clay) for potential use as CCL material; and (2) to develop material and compaction requirements for a CCL mixture to achieve a field hydraulic conductivity (k_F) ≤ 10^{-9} m/s upon construction. Three candidate mixtures (40%, 50%, and 60% borrow clay by dry wt.) were characterized and subjected to laboratory compaction and hydraulic conductivity (k_L) testing to establish appropriate design mixture proportions and an acceptable compaction zone (ACZ) based on the line-of-optimums method. Measured plasticity index (PI) values for the mixtures (PI = 16 to 24) all meet the minimum PI required for the CCL (PI ≥ 10) and are considerably lower than the PI of the borrow clay alone (PI = 36 to 49). Thus, the mixtures are more suitable than the borrow clay for limiting shrinkage potential upon drying. Test results also indicate that: (1) the compaction behaviour of all three mixtures can be represented adequately by a common line of optimums; and (2) all test specimens exhibited k_L ≤ 10^{-9} m/s. Based on these results, a mixture containing 55±5% of the on-site borrow clay is recommended for the CCL. The proposed ACZ for the design CCL mixture encompasses only those test specimens that exhibited k_L ≤ $2x10^{-10}$ m/s in order to accommodate potential differences between k_L and k_F due to scale effects. A robust field testing program is recommended to verify that the material and compaction requirements have been achieved and that k_F ≤ 10^{-9} m/s for the constructed CCL.

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