

EFFECT OF SINGLE-SPECIES SALT SOLUTIONS ON GEOTECHNICAL PROPERTIES IN BENTONITE

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The importance of bentonite in engineered barrier systems is well recognized. This naturally occurring clay has unique properties of swelling on contact with water and very low hydraulic conductivity to liquids. In addition to these, its high cation exchange capacity (CEC), large specific surface area and ability of self-healing has made it a necessary component for the liner system of the modern engineered landfills. However, leachate produced in the landfill due to the biodegradation of waste can react with bentonite chemically and may affect its engineering characteristics. The increase in hydraulic conductivity can cause leachate to enter subsurface and pollute the subsurface environment including ground water table. On the other hand change in liquid limit is an indicative of change in other geotechnical properties including shear strength and swelling behavior of bentonite. Therefore, it is necessary to analyze the effect of chemicals present in landfill leachate on geotechnical properties in bentonite.

This study investigated the individual effect of such chemicals using single-species salt solutions of different cations, concentration and valance on the liquid limit and hydraulic performance of bentonite. A total of thirteen solutions including de-ionized water and three different solution concentrations (0.01M, 0.1M, and 1M) of four major exchangeable cations Na^+ , K^+ , Ca^{2+} and Mg^{2+} were used in this study.

Liquid limit tests were carried out using all the thirteen type of solutions on sodium bentonite. It was observed that liquid limit decreases with increase in salt concentration. At very high and very low concentrations, both monovalent (Na^+ , K^+) and divalent cations (Ca^{2+} , Mg^{2+}) showed similar liquid limit. However, there is a large difference in liquid limit values for monovalent and divalent cations at intermediate concentrations. Effect of concentration and valance on hydraulic conductivity of bentonite was analyzed using different concentrations of NaCl and intermediate concentrations (0.1M) of all the four cations. It was observed that both concentration and valance have little effect on hydraulic conductivity of bentonite. The results suggested that hydraulic conductivity is likely to be highly controlled by the effective porosity and effective void ratio of bentonite. The tests were run upto 100 days to investigate the effect of time on hydraulic performance of bentonite and it was observed that hydraulic conductivity does not change significantly with time.

Keywords: Bentonite, Hydraulic Conductivity, Liquid limit, Landfill leachate, Effective void ratio, Effective porosity