INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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Thesis Title: Behavior of Bentonite and Kaolin Clays at Different Particle Interactions under Chemical, Hydraulic, and Mechanical Loadings.

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SHORT ABSTRACT

Volume change behavior of clays under mechanical, hydraulic, and chemical loadings is of great importance in various applications in the field of Geotechnical and Geoenvironmental engineering. The presence of a rich percentage of clay minerals such as montmorillonite and kaolinite in the clay soils results in heaving and subsidence problems, respectively. On the other hand, compressibility behavior and swelling pressure of bentonites is a significant concern in the Geoenvironmental applications viz., landfills, low-high-level nuclear waste repositories, and impounding facilities. Equilibrium sediment volume is often used as a surrogate compatibility test for assessing the expansiveness of clays and the identification of different clay minerals. In this study, a theoretical model was proposed based on the diffuse double layer theory to estimate the equilibrium sediment volume of clays. Further, a simple technique for routine estimation of the surface area of plastic clays was proposed based on the developed theoretical framework for sediment volume. The method utilizes equilibrium sediment volume measurement of clay soil in 0.1 N NaCl solution and used the theoretical equation for the surface area estimation. A generalized semi-empirical model was proposed for predicting the compressibility behavior of clayey soils of different plasticity over a wide range of consolidation pressures. The proposed model has validated over 114 compressibility datasets from 88 clayey soils and bentonites with different inundation fluids from the literature and the present study. Further, the Stern diffuse double layer model for the constant charge condition was developed for the first time to study the compressibility behavior of clays theoretically. The influence of compaction density and bentonite plasticity on the temporal swelling pressure evolution was analyzed using microstructural analysis. Further, the volume change behavior of air-dry kaolin due to wetting was studied at various compaction densities and under different applied loadings. Surface forces were evaluated at various pore scales at the air-dry and fully saturated state to explain the observed kaolin behavior.