INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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Thesis Title: Attenuation and Fate of Harmful Waste Contaminants using Clay Minerals and Bio-Polymerized Clays for Containment Applications

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SHORT ABSTRACT

The geosynthetic clay liners (GCLs) completely replaced the compacted clay liners (CCLs) in municipal solid waste (MSW) landfills and mine waste containment applications due to ease in transportation, installation, and less dust pollution. The presence of inorganic salts influences the osmotic potential of the granular bentonite to perform as a liner in the landfill application. The presence of heavy metals in mine tailing ponds and biomedical waste along with the MSW in landfills is thus threatening due to the easy escape of these harmful contaminants into the environment under reduced osmotic conditions. An understanding of the role of grain sizes on the hydraulic and volume changes for GB under critical chemo-mechanical loadings is not available. Non-conventional GCLs have been explored very recently and contain polymer-amended granular bentonite. However, the biopolymers for amendment of GCLs are not significantly explored. In this study, hydraulic and volume change characteristics of granular bentonite amended with the biopolymers such as xanthan gum, guar gum, agar-agar gum, and acacia gum were studied under mechanical loading while exposed to different high ionic strength pore-fluids. An effort was made to understand the volume change and hydraulic behavior of biopolymer-amended GB, under thermo-chemo-mechanical loading conditions. The kaolin was also accessed for application as a compacted liner system after amending with the polymers. The biopolymer-amended kaolin improved its hydraulic and diffusion characteristics with salt solutions and heavy metals from the mine tailing facilities. Further, the fate and attenuation ability of different viral pathogens with different clay minerals, their mechanisms, and the role of granulation and salt environment are not explored. The present work evaluated the role of clay minerals, interaction time, and solid-to-liquid ratio on clay-virus interaction. The mechanism governing the attachment of the virus to the bentonite clay was also understood based on changing exchangeable cation types in two bentonite clays. Further, the role of grain sizes of the granules of GB was also understood in the sorption and hydraulic characteristics of the viral pathogens from Japanese encephalitis and H1N1 influenza viruses. Biomedical waste disposal protocols were proposed for the design of an exclusive BMW containment facility.