INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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SHORT ABSTRACT

Soil bioengineered structures are comprised of soil for stability and vegetation for protection. These structures are commonly adopted because of their multiple beneficial impacts. The stability and performance of these structures depend on the soil engineering properties and vegetation performance. Further, the vegetation performance i.e., the vegetation growth and health status are interrelated to the soil engineering properties. The vegetation in these structures provides additional stability and protection from erosion and failure. The vegetation roots act as soil reinforcement by anchoring or bridging the soil particles together through mobilization of its tensile strength. The root water uptake by the roots induces suction in soil that in turn increases soil shear strength or stability in terms of apparent cohesion. Further, the above ground mass of vegetation protects the soil surface from erosion along with the aesthetic view. Therefore, suitable growth and health status of vegetation are utmost important for the effective functioning of bioengineered structures. Many a times soil does not provide suitable condition for the growth and health status of vegetation and therefore several amendments have been adopted for improving the vegetation performance. Among these amendments, biochar has been regarded as more suitable soil amendment due to their stable structure i.e., microbial non-degradable and organic nature. Biochar is a carbon-rich material obtained after pyrolysis of biomass under oxygen deficit condition. The conversion of biomass into biochar is also the sustainable way of managing wastes, mitigating climate change and producing energy. Biochar as soil amendment is often used for soil carbon sequestration, improving the soil fertility as well as crop growth and yield, and removing the organic and inorganic pollutants from soil. Application of biochar as soil amendment majorly focused on loose agricultural soil. Soil in bioengineered structures is different from the agricultural soil i.e., often compacted for achieving stability and subjected to a prolong drying due to the irregular irrigation pattern. Therefore, the engineering properties of biochar-amended soil (BAS) and the vegetation performance in BAS need to be investigated under compacted state for ensuring effective stability and performance of bioengineered structures. In the present thesis work, the engineering properties i.e., the hydro-mechanical and physicochemical properties of biochar-amended compacted soil and the vegetation (grass species) growth and health status in biochar-amended compacted soil have been investigated for potential application in bioengineered structures. The results revealed that the amendment of biochar improved the soil engineering properties by increasing the soil pH, CEC, water retention capacity, shear strength and load bearing capacity, and decreasing the dry density, infiltration rate, saturated hydraulic conductivity, unsaturated hydraulic conductivity and desiccation crack potential. Further, the biochar amendment found to be improved the vegetation performance by increasing the vegetation (roots and shoot mass) growth, delaying the wilting (higher

permanent wilting point), decreasing the stomatal conductance (pathogen resistance or good health) and allowing complete photosynthetic activity at relatively large suction. The amendment of different types biochar found to be exhibited variable responses on the soil engineering properties and vegetation performance. Adversely, the undrained shear strength or UCS of the soil was found to be decreased after biochar amendment which needs to be further investigated. However, the magnitude of UCS obtained for 5% (w/w) biochar amendment rate was found to be higher than the minimum (200 kPa) required strength for most of the bioengineered structures and suggested by the united state environmental protection agency (USEPA). Based on the present thesis work, it is suggested to use 5% BAS in bioengineered structures; however, considering field trials before application would add more reliability.