INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

Name of the Student : Srikanth Vadlamudi

Roll Number : 11610420

Programme of Study : Ph.D.

Thesis Title: Engineering behavior of sand-bentonite mixtures and the influence of particle size of sand

Name of Thesis Supervisor(s) : Dr. Anil Kumar Mishra

Thesis Submitted to the Department/ Center : Civil Engineering

Date of completion of Thesis Viva-Voce Exam : 2-6-2017

Key words for description of Thesis Work : *Sand-bentonite mixtures; Sand particle size; Bentonite content; Swelling pressure; Swelling potential; Hydraulic conductivity; Consolidation parameters; Shrinkage*

SHORT ABSTRACT

Sand-bentonite mixtures are playing a greater role as geotechnical barrier materials in waste disposal schemes around the world. Therefore, a comprehensive understanding on the engineering behavior of a geotechnical barrier becomes a necessity. Literature review indicated a host of variables influencing the engineering behavior of a barrier to various degrees, including and not limited to mixing water content, compaction effort, mineralogy of the soil, size and shape of particles, interactions among the soil particles, interactions with water, interactions with any other pore fluid that may exist in the soil, pH, temperature, cation exchange capacity and concentration of cations in the soil pore fluid. Upon scrutiny, it has been observed that most of the studies conducted were primarily focusing on the role of bentonite in the sand-bentonite mixture. Studies highlighting the contributions of sand particle size, sand gradation etc. were very few, though sand formed the major component in most of the sand-bentonite mixtures being employed around the world. This study sheds some light on the influence of sand particle size and sand composition on the engineering characteristics of sand-bentonite mixtures with varying bentonite proportions.

In the current study, locally available sand has been washed and sieved for different particles sizes (fine sand and medium sand). Two commercially available bentonites with different swelling capabilities were used in the study. Fine sand-bentonite (FS-B), medium sand-bentonite (MS-B) and fines sand-medium sand-bentonite (FS-MS-B) mixtures were made with bentonite proportion varying from 10 to 50 percent by dry weight in the mix. These mixes were tested for Atterberg limits, standard compaction characteristics, consolidation characteristics, hydraulic characteristics, unconfined compressive strength behavior and shrinkage characteristics.

Liquid limit results indicated, for a given bentonite content, FS-B, MS-B and FS-MS-B mixes exhibited different liquid limits. Moreover, between FS-B and MS-B mixes, FS-B mixes exhibited relatively higher liquid limit and the difference is pronounced in mixes with higher bentonite contents. From the results of FS-MS-B mixes, it has been seen that sand gradation/composition has little influence on the liquid limits. Compared to liquid limit, shrinkage limit results indicated a higher sensitivity towards particle size distribution of the soil mixture. Standard compaction characteristics

revealed that medium sand-bentonite mixtures exhibited higher dry density while fine sand-bentonite mixtures exhibited higher optimum moisture content, for the same bentonite content. Moreover, sand-bentonite mixtures exhibited highest dry density with 70-80% sand content in the mixtures.

Consolidation data indicated that, for a bentonite content, a wide range of swelling potential and swelling pressure can be observed by changing the sand composition in the mixtures. It has also been observed that apart from the magnitude of swelling pressure/potential, sand particle size and composition plays a major role in time taken for initial, primary and secondary swelling of a soil.

Fine sand-bentonite mixes exhibited lower hydraulic conductivities compared to medium sand-bentonite mixtures. While sand composition has some influence on the hydraulic behavior of sand-bentonite mixtures, the influence is seen to be more pronounced in the mixtures with bentonite content less than 30 percent. As the swelling nature of bentonite in the mixture is improved, benefits obtained by varying sand composition were seen to diminish.

Apart from being dependent on bentonite content, bentonite quality and initial compaction state, shrinkage behavior of sand-bentonite mixtures is seen to be particularly sensitive to sand composition. Bentonite content being constant, a variability to the tune of 75-100 kPa has been observed in the UCS behavior by varying the sand composition.

Sand composition has a definitive role to play on the geotechnical behavior of sand-bentonite mixtures, as has been seen in this study.