

ABSTRACT

Koh, Taehoon. Ph.D., Purdue University, May, 2008. Tire Shred-Bottom Ash Mixtures: Mechanical Properties and Use as Construction Material. Major Professors: Rodrigo Salgado and Monica Prezzi.

The important social impacts of recycling waste materials and industrial byproducts are widely recognized. However, sponsored development activities and research on the behavior of these materials in geotechnical engineering applications are still limited, particularly in the case of bottom ash. This study investigates the mechanical behavior of tire shreds and bottom ash mixtures and the use of these recyclable materials in geotechnical engineering applications.

Laboratory tests were performed on the recyclable materials (bottom ash and tire shreds), conventional soil (Korean standard sand), and 50:50 (by volume) mixtures of tire shreds and pure material (bottom ash or sand). The physical properties (grain size distribution and specific gravity) and mechanical properties (compaction characteristics, compressibility, hydraulic conductivity, strength, stiffness, and deformation characteristics) of all the testing materials were evaluated through a systematic experimental program using large-scale and conventional-scale test equipments in order to evaluate their suitability for use as lightweight fill materials.

Based on the experimental triaxial test data produced in this research, a comprehensive assessment of the strength and deformation behavior of the tire shred-bottom ash mixture was made in order to obtain the parameters needed for a state-dependent bounding-surface-plasticity constitutive model. The constitutive model was

used to perform model simulations of the element tests and of a boundary-value problem.

The performance of the tire shred-bottom ash mixture was also assessed in the field (field compaction and in situ stiffness characteristics of the mixtures were evaluated). As a result of this study, geotechnical engineering applications are recommended for the environment-friendly recycling of discarded tires and bottom ash, both of which are currently consuming valuable landfill space, and suggested as solutions to not only the secondary environmental problems caused by these waste materials but also as an answer to the shortage problems of conventional construction materials in many areas of the world. Based on the research findings, tire shred-bottom ash mixture was found to be a suitable alternative construction material for geotechnical engineering applications in which large quantities of materials are needed.