Recycled crushed glass in road work applications

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A B S T R A C T

A comprehensive suite of geotechnical laboratory tests was undertaken on samples of recycled crushed glass produced in Victoria, Australia. Three types of recycled glass sources were tested being coarse, medium and fine sized glass. Laboratory testing results indicated that medium and fine sized recycled glass sources exhibit geotechnical behavior similar to natural aggregates. Coarse recycled glass was however found to be unsuitable for geotechnical engineering applications. Shear strength tests indicate that the fine and medium glass encompass shear strength parameters similar to that of natural sand and gravel mixtures comprising of angular particles. Environmental assessment tests indicated that the material meets the requirements of environmental protection authorities for fill material. The results were used to discuss potential uses of recycled glass as a construction material in geotechnical engineering applications particularly road works.

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1. Introduction

Waste material has been defined as any type of material by-product of human and industrial activity that has no lasting value (Tam and Tam, 2006). The growing quantities and types of waste materials, shortage of landfill spaces, and lack of natural earth materials highlight the urgency of finding innovative ways of recycling and reusing waste material (Arulrajah et al., 2011). Additionally, recycling and subsequent reuse of waste materials can reduce the demand for natural resources, which can ultimately lead to a more sustainable environment.

Recycled glass is a mixture of different colored glass particles and is often comprised of a wide range of debris (mainly paper, plastic, soil, metals, and food waste). The presence of different colored glass particles and diverse types of debris are the primary obstacles in reusing recycled glass in bottle production industries. Recycled glass particles are generally angular shaped and contain some flat and elongated particles. It is believed that the waste stream from which the glass particles have been produced controls the quality of the material, especially the amount of debris in the mixture (Landris, 2007). Furthermore the production process and the crushing procedure play the most important roles on maximum particle size, debris level and flakiness index of recycled glass which consequently influence other geotechnical characteristics (Landris, 2007). This causes variation in the geotechnical characteristics of recycled glass from one supplier to another.

Geotechnical engineering applications of recycled glass include using it as backfill material in embankments, drainage blanket, filter media, and road pavement material (Wartman et al., 2004). Depending on the nature of the application of recycled glass, specific geotechnical parameters are of paramount importance. At the same time, certain factors affect the geotechnical characteristics of recycled glass. Insufficient knowledge on geotechnical characteristics of recycled glass is still the most important obstacle in its sustainable application in geotechnical engineering projects.

Three different sample types of recycled glass obtained from recycling industries in Victoria were studied in this research work. The recycled glass types were named Fine Recycled Glass (FRG), Medium Recycled Glass (MRG) and Coarse Recycled Glass (CRG) based on their maximum particle size which is 4.75, 9.5 and 19 mm respectively. The main difference between these three samples is their gradation curve which influences other geotechnical properties. A comprehensive suite of laboratory tests were conducted on recycled glass samples to fill in the knowledge gap on the geotechnical characteristics of recycled glass in general and particularly on the one produced in Australia. The chemical and environmental tests were also executed to determine pH value, debris level, organic content and also to assess the Total Contamination (TC) level and the leachate concentration of recycled glass samples.

2. Sampling and general observations

Approximately 850,000 tons of glass is used in Australia each year, with 350,000 tons recovered for recycling (Austroads, 2009).