Investigation of the Use of Waste Mixed Color Glass as Substitute of Natural Sand in Concrete Production

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Abstract

Sustainable construction material is now a prerequisite for the construction industry. Several approaches could be adapted to embrace the sustainability concept and contribute in reducing the environmental impact of construction sector, especially concrete production. Large variety of recycled and waste materials are now being used in cement-based materials as a secondary material in a partial or even a full replacement of virgin and non-renewable material. Glass is known as a non-biodegradable material. Waste glass if not collected and properly recycled could severely affect the environment and our quality of life. In developed countries, efficient Glass recovery and recycling systems are well implemented to avoid waste glass landfilling and its disastrous environmental and economic effects. Yet no effective glass recycling system is established in Oman and many other developing countries which lead to huge amount of waste glass landfilled and thrown out in the ground. This causes a considerable economical loss and environmental issues.

The present study investigated the use of waste glass collected from local workshop, crushed to a size of fine aggregate and used at various replacement levels of natural sand in concrete production. The results indicate a great potential of using waste glass as a fine aggregate in concrete with little or no negative impact on concrete performances. Workability was improved as the glass content increased and saving in the Superplasticizer demand and cost was obtained. Strengths (compressive, flexural and splitting tensile) did not generally suffer from any significant reduction even some improvements were recorded. Porosity, water absorption were remarkably reduced and ultrasonic pulse velocity revealed a denser glass concrete compared to the control. Durability related properties such as acid and sulphate attack, cyclic wetting and drying did not affect the concrete performance even chloride permeability was reduced with glass.

Keywords: crushed recycled waste mixed color, fine aggregate, mechanical properties, porosity, sustainable concrete, thermal conductivity.