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Effect of Magnetized Water on the Mechanical Properties of Concrete Containing Recycled Waste Glass Aggregate

Ben U. Ngene[1,a], Oluwarotimi M. Olofinnade[1,b*] and Chidiebere E. Agomo[1,c]

[1]Department of Civil Engineering, Covenant University, Ota, Nigeria

[a]ben.ngene@cu.edu.ng, [*b]rotimi.olofinnade@covenantuniversity.edu.ng, [c]tetra.ca@gmail.com

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Abstract. Concrete use is fundamental to most infrastructural development plan of humanity today. This underscores the need to understand the strength characteristics of concrete made with crushed glass aggregate as partial replacement for fine aggregate and mixed with magnetic field treated water (MFTW). This study investigates the mechanical properties of concrete mixes prepared and cast into cubes of varying constituents such as concrete mixed with normal water, concrete mixed with MFTW, concrete with varying degree of crushed glass as replacement of fine aggregate from 15 to 45% with or without MFTW. The cubes were thereafter crushed after 7, 14, 28 and 56 days of curing to determine their compressive and tensile strengths. From the results obtained, it was observed that the optimum percentage partial replacement of sand with crushed glass aggregate is 15% to attain a suitable using MFTW in the mixing of the concrete. At this percentage replacement, it was observed that both the compressive and tensile strengths of the concrete mixed with MFTW improved by 25-30% relative to the conventional concrete. The study therefore recommend the use of MFTW in place of normal water in concrete production and use especially when partially replacing fine aggregate with crushed glass aggregate.

1. Introduction

The search for the development of sustainable concrete with low energy consumption that will reduce greenhouse emission, reduce the use of raw material resources and lower impact of cement production on the environment has led to the development of alternative materials for high quality concrete structures. It was observed by Ngene *et al*. [1] that the deterioration of structures arising from increased pollution of the environment in urban and industrial areas affects the strength and durability of built infrastructures. This situation calls for sustainable use of locally available materials of construction especially in developing nations such as Nigeria where challenges of high cost of construction materials is progressively becoming an issue of concern. Concrete is a man-made composite, that is, man-made stone which is a homogenous blend of cement, water, aggregates and some admixtures as well as added substances (to change the new and solidified property). Moreover, the real constituent of concrete which makes 70% - 80% of aggregate includes rock or crushed rock and sand. The other constituents are cement, admixtures and water. Concrete is utilized basically for structures such as building sections, shafts, chunks, shells, spans, and sewage treatment plants, railroad sleepers, cooling towers, dams, harbors, seaward structure and others [2].
Building materials as noted by Meyer [3] is one of the most important parts of a building that have the greatest positive natural effect and influence on the nature of both the internal and external appearance. Therefore, damage to concrete by environment polluting materials has been noted by Ngene *et al*. [1] to include carbonation and ingress of chlorides from urban, industrial and marine environments which affects the long term strength of concrete materials to withstand design loads. To reduce the impact of such environment polluting substances, green construction is advocated. Green construction is the use of materials whose production and use generate low amount of greenhouse gases such as oxides of carbon, chlorides and sulphates in the construction industry.
Furthermore, green building materials has been identified by [4] to include those materials that are local, recyclable, non-toxic and have low volatile organic compounds (VOC) assembly (which