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An Experimental Study on Modified Concrete Using Partial Replacement of Gravel and Admixtures

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Abstract: This study aims to test a concrete specimen with replacement partially of 15 % of the coarse aggregate by pieces of tires and volcanic aggregates and reduce 5% of the water/cement ratio by substituting with 4% percentages of styrene butadiene rubber (SBR) and 1% of superplasticizer. The main concrete components (cement: sand: gravel) were used in weight ratios (1:1.5:3) and a water to cement 0.45 was used and it was considered as a reference sample (Mix1). A water to cement ratio 0.40 was depended for the modified mixtures. Samples were cast for testing the compression strength with sizes 150 ×150 ×150 mm for ages 7 and 28 days. the absorption rate, with a size of 100 ×100 ×100 mm at age 28 days. Moreover, 150 ×150×150 mm for depth of penetration test at the age of 28 days.

Briefly, the observed results exhibited that the partial replacement of normal aggregate in concrete with volcanic aggregate affects negatively on the workability, so 4% of the polymer SBR and 1% of the superplasticizer have improved the workability. The improvement in the workability of concrete contributed to reducing the ratio of water to cement required for mixing compared to ordinary concrete, and this in turn led to an improvement in performance of hardened concrete. In addition, the reduction of the permeability level. The results also illustrated that the replacement of the gravel in the modified mixtures (Mix 3 and Mix 2) reduces the weight of hardened concrete by (10-12%) and (7-9%) compared with conventional concrete, respectively, which makes it suitable for use in mediumweight concrete applications.

Moreover, it can be concluded that the strength properties of the modified mix with volcanic aggregate improved by 19-20% compared to that of the unmodified concrete. While the modified concrete by cutting tires showed significant deterioration in the concrete's resistance of 21% despite the reduction of concrete permeability.

Keywords: Rubber tires, permeability, aggregate; polymer.

1. Introduction

Recently, the production of rubber tires has increased on large scale due to increased vehicle demand. One of the main Global Warming hazards facing environmental organizations around the world is the disposal of expendable tires. Scrap tires are non-biodegradable in nature, therefore, major problems in the environment have been created. Many industries used it as a fuel which is not environmentally friendly Structural researchers worldwide are in the study of new alternative materials, which are required for economical and effective solutions as well as for saving natural raw material resources like aggregates etc. Partial replacement of the coarse aggregate by waste materials such as rubber tire pieces has already the advantage of saving on natural constituent which is used in the production of lightweight environmentally friendly concrete [1], [2].