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Research

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Effect of Eggshell Powder Application on the Early and Hardened Properties of Concrete

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ABSTRACT

In this study, the role of eggshell powder and its effect on concrete's mechanical properties and to achieve the optimum percentage of eggshell utilization for higher strength and durability were investigated. The eggshell was grounded and heated to 950°C for 2 hours, and by XRD test, the chemical analyses were carried out and compared with Portland cement. Experimental tests including water absorption percentage, the specific gravity of concrete, electrical resistance test (indicating corrosion and permeability), flexural strength, and compression strength were performed on samples with 0, 10, and 20 wt% cement replacement eggshell. The tests were carried out at 3, 7, and 28 day age on 15 cm cube specimens. Flexural tests were carried out on prisms 100x100x500mm. The results of tests on concrete showed that replacement of 10% eggshell causes 12% slump reduction, 1% increase in compressive strength, 21% decrease in water absorption, 2% increase in concrete, specific weight, and 90% increase the electrical resistance in comparison with 0% eggshell (control specimen). 20% cement replacement eggshell causes 24% decrease in a slump, a 17% decrease in compressive strength, and 4% enhanced in water absorption, a 1% increase in specific gravity, and a 90% increase in electrical resistance in comparison with control specimen. Corrosion in the control specimen is fairly certain, while with 10% and 20% eggshell in both mixes, corrosion is less possible. The results of the compression test are compared to other research work in order to present the different %eggshell on concrete strength. The results of this study suggest that the use of eggshell substitutes an appropriate proportion replaced cement gives a suitable quality and also causes a safer environment.

Keywords: Compressive strength, Eggshell powder, Water absorption percentage, Specific gravity, Concrete electrical resistance.

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1. INTRODUCTION

Nowadays, the use of by-product materials in concrete is of great importance due to the reduction of environmental hazards and the prevention of wastage of primary resources, and cost reduction. The design and production of various cement-based products have led to various additives to the mix design of this product. In the concrete sustainable development industry, those materials can be used to produce cement-based products that have a little environmental impact. Based on the rare properties of concrete, it has been widely used throughout the world in the present century, and the demand for concrete is in progress. What is certain is that concrete research and development must be done to meet the needs of the

industrial community [1,2]. The research presents by AlaaJaber et al. [3] is presented an experimental investigation of eggshell powder (ESP) addition influence on the Portland cement mortar performance. Two different eggshell powders states were prepared. These include untreated eggshell powder (UESP) and treated eggshell powder (TESP). The TESP consists of heating the ESP to 750 °C for one hour in an electric furnace. Cement mortar of ordinary Portland cement with [4, 5], (cement to sand) ratio, were mixed with each of two ESP states (UESP and TESP) at different percentages ranged from (0 to 20) wt. % of the total weight of the cement mortar mixture. They concluded that the better thermal insulation of mortar samples was obtained from the