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Investigating the Effect of Rubber Powder and Nano Silica on the Durability and Strength Characteristics of Geopolymeric Concretes

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ABSTRACT

In this research, the effect of adding different percentages of nano-silica and rubber powder on the compressive strength of the geopolymeric concrete specimens is investigated. The set of performed tests includes the compressive and tensile strength tests of the geopolymeric concretes. Due to the high rate of consumed concrete and the daily increase of the need for cement production, it is essential to consider environmental defects of this material and present new replacement products to move towards sustainable development. Low shrinkage, high compressive, and tensile strengths are among the main properties of produced concrete. Also, the application of nanoparticles, due to their specific physical and chemical properties, in many respects, are very good candidates for producing novel materials with unique capabilities. Hence, the use of nano-silica as one of the nanotechnology products which could play the role of a very active artificial pozzolan in concrete has been under the focus of attention. Replacement of the rubber powder in the construction industry, due to the irresolvability of this type of wastes and also its specific structure such as improved ductility, reduced density, and improved resistance against concrete cracking, has been practiced today. The aim of this research is to implement the two mentioned materials as additives in the concrete mix design and to investigate their effect on the increase of the compressive and tensile strengths in concrete. The results of this research have shown that the use of nano-silica powder and rubber powder results in the increase of the compressive strength of concrete up to 1.45 times that of the control specimen using the nano-silica powder and 1.35 times that of the control specimen using the rubber powder.

Keywords: Nano silica, Geopolymere, rubber powder.

1. INTRODUCTION

In this type of concrete, the use of rubber powder has resulted in the production of environmentally friendly concrete. Application of the geopolymer instead of Portland cement as the main connection between concrete components leads to a reduced amount of carbon dioxide in nature. On the other hand, rubber powder as an additive could help with reducing environmental pollution. The rubber geopolymeric concrete (RGC) with 10% and 20% rubber has replaced natural aggregates, and its impact on the increased strength of concrete is investigated. The effect of GCs on the concrete performance has been investigated by the slump flow, density, compressive, tensile, and flexural strength tests at the 7 and 28-day ages. Aly et al. [1] in 2019 have examined the effect of various percentages of rubber crumbs as partial replacement of geopolymeric material. In this research, the recycled plastics with volumetric percentages of (0%, 10%, 20%, and 30%) have been added to the aggregates, and their effect on the hardened concrete properties (compressive, tensile, and flexural strengths) and also resistance against impact in geopolymeric concrete have been investigated. Abd-Elaal [2] has dealt with refined rubber powder and its application in concrete. In that research, a new approach