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Exploring engineering properties of waste tire rubber for construction applications - a review of recent advances

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ABSTRACT

A sizeable amount of tire rubber waste is generated due to the increasing number of road automobile users all over the world. The accumulation of this waste in the open area poses environmental threats and therefore requires suitable treatments. The use of waste obtained from tire rubber as a construction material could contribute to a circular economy, while at the same time be an eco-friendly method of minimizing the depletion of raw materials used for the development of building materials. This study aims to show the impact of crumb rubber (CR) on the properties of concrete. This review covers the environmental consideration of fresh and hardened properties of composites developed using waste tires. The results show that the plastic nature of CR with suitable admixture led to increasing slump value and consequently enhanced the CR concrete workability.

Selection and peer-review under responsibility of the scientific committee of the 11th Solid State Surfaces and Interfaces conference.

1. Introduction

Day by day, a sizeable quantity of consumed tires are buried or burnt around the globe which poses serious environmental problems [1,2]. Elimination of consumed-tire rubber without suitable treatment has an adverse impact on the environment [3]. Generally, waste tires are disposed of by various methods, such as landfilling[4], burning [5], as a modifier in the asphalt binder, as aesthetic material too and in the sports grounds [6]. Accumulation of tire waste leads to serious environmental and health problems, resulting in pollutions of the soil, water, and air [4]. Since the construction industry is the largest in consuming the materials, therefore, the researchers used waste tires as concrete materials instead of consuming the raw materials [7]. The use of tire waste as cement or natural aggregates in concrete production is the best solution to avoid potential environmental issues. In concrete production, crumb rubber (CR) has good flexibility [8], low stiffness [9], also the CR concrete was affected by cleanliness [10], particle size [11], shape [12], content [13], and surface' quality [12,14]. The properties of concrete containing tire waste were studied by many researchers [15–20]. But, there is no adequate information on the behavior of concrete at different replacement levels of CR as cement or aggregates [16,17]. Fig. 1 depicts the waste tire.

Issa and Salem [22] concluded that the CR has many advantages in concrete mixtures, such as getting a suitable compressive strength value with CR contents less than 25% as fine aggregates and can be used in non-structural applications such as curbstone, blinding, and manholes. Reducing the density up to 8% with 25% CR as fine aggregates. Thomas and Gupta [15] investigated some of the aspects the splitting tensile strength of CRC. Besides that, few studies examined the microstructure of CR concrete through XRD and scanning electron microscopy (SEM) tests.

But the existing review papers did not cover all the reports addressed the CR and waste-tire published. Therefore, this paper came to cover all the essential properties of CR concrete and behavior of CR as construction materials in concrete manufacturing. Although massive investigations were conducted, however, there is no comprehensive review to observe the concrete properties in detail due to the use of the CR in concrete mixtures. This study aims to conduct a comprehensive review to show the effect of crumb rubber (CR) on concrete properties. In this paper, the composition and classification of CR and the concrete properties in both cases (fresh and hardened) properties of CR concrete were

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