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REVIEW PAPER

A comprehensive review of the application of waste tire rubber in concrete/mortar as fine aggregate replacement

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Abstract

With the tremendous increase of automobiles nowadays, the disposal of waste tire rubber has become a prime environmental concern, presenting a vast ecological hazard in all parts of the world. One of the potential solutions is using waste tire rubber into concrete/mortar to replace fine aggregate, which reduces the consumption of raw materials, resulting in increased economic efficiency and long-term growth in the construction industry. Based on previous research, this paper reviews and summarizes waste rubber's fresh properties, mechanical properties, durability, and electrical resistivity as the partial fine aggregate substitution in mortar/concrete. The results indicate that concrete containing crumb rubber (CR) reduces workability and fresh density. However, it can be improved by adding large sizes of rubber particles. Concrete's mechanical properties tend to decrease as the CR concentration rises. Therefore, treated CR particles, fibers, and additional binders can increase the mechanical properties of concrete materials. Moreover, the proper CR concentration exhibits high freeze–thaw resistance, water absorption and permeability, concrete shrinkage, electrical resistance, abrasion resistance, carbonation, chloride ion resistance, and resistance to acid and sulphate attack. Additionally, the chemical treatment of rubber aggregates has proved to be an effective and practical means of compensating for the loss of durability and mechanical strength of concrete containing rubber.

Keywords Crumb rubber concrete · Rubberized concrete, waste tire rubber, fine aggregate · Fresh properties · Mechanical properties · Durability

Introduction

For more than a century, after water, concrete has been the most extensively used building material on the planet[1]. It is estimated that each person consumes three tons of concrete per year [2]. Over the last century, global concrete production has increased dramatically, and the demand for concrete is expected to increase in the future[3]. According to a report from Chatham House, the globe currently generates 4.4 billion tons of concrete per year. But as developing countries become more urbanized, that amount is projected to rise to nearly 5.5 billion tons by 2050 [4]. As the market for concrete increases, the demand for the necessary concrete ingredients will be higher, and the raw materials will have to be taken from the environment, such as fine and coarse aggregates[5]. Due to rapid urbanization and massive infrastructure projects, the requirement for natural sand in developing countries is higher to meet the rapid expansion of infrastructure [6]. For generating concrete, sand is the

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