ScienceDirect

Materials Today: Proceedings

Volume 65, Part 2, 2022, Pages 871-876

A literature review on the effect of using ceramic waste as supplementary cementitious material in cement composites on workability and compressive strength

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Available online 4 April 2022, Version of Record 16 August 2022.

https://doi.org/10.1016/j.matpr.2022.03.453
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Abstract

This study reports the amalgamation of ceramic waste procured from various sources such as waste from ceramic products manufacturing, construction and demolition waste etc. as an alternative of cement up to certain substitution percentage. The prime motive of this study is to evaluate the effect of ceramic waste on fresh and mechanical properties of various cement composites like cement paste, cement mortar, hardened concrete and self-compacting concrete. Previous studies prove the promising pozzolanic behaviour of ceramic waste, thus defending the feasibility of its utilization in cementitious materials. The consumption of ceramic waste at smaller replacement levels displays suitable workability. At higher incorporation ratios, the water content required to maintain the necessary workability increased for both vibrated and self-compacting concrete. Based on the surface area of the ceramic waste particles, the cement pastes developed can have higher or lower yield stress. With regard to mechanical properties, compressive strength of the mixes up to a substitution level of 10 to 20% is either higher or nearly equal to reference mix. White ceramic waste has shown better pozzolanic properties when compared to red ceramic waste. When combined with other alternate supplementary cementitious materials like rice husk ash and fly ash, compressive strength improved further. On examination of the microstructure using scanning electron microscopy, X-ray diffraction etc., ceramic wastes' pozzolanic properties were retrospectively proved. Utilization of ceramic waste beyond the 20% level led to the dilution of CSH forming compounds and hence retardation in setting and hardening of the cement composites. This was also accompanied by a fall in compressive strength was noted. Assessing the utilization of ceramic waste presents a sustainable approach in the construction industry while simultaneously comprehending ecological benefits. As a future scope of work, combination of ceramic waste along with nano particles shows a promising domain that can be explored.

Introduction

India is known as a developing country. Lots of construction work is going on and many projects will be coming in future for the infrastructure development of our country [1]. For the infrastructure purposes, concrete and steel are the widely used man made materials. Both materials deteriorate with time. So, it is very important to give the emphasis on producing durable concrete which increases the lifespan of the structure. There were many previous studies held by using supplementary ingredients which affect the durability of the concrete and also impact on the environmental benefits [2]. Concrete is made up by using coarse aggregate, fine aggregate, cement and water. Cement particles take only 10 to 15 percent space of the total concrete mix. But as per the cost wise it takes up to 45 % of the total concrete cost [3]. It is the