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Effect of Boric Acid on the Hydration of Rice Husk Ash Blended Cement

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Abstract

In the last decade, the use of supplementary cementing materials has become an integral part of high strength and high performance concrete mix design. These can be natural materials, by-products or industrial wastes, or the ones requiring less energy and time to produce. Some of the commonly used supplementary cementing materials are fly ash, Silica Fume (SF), Ground Granulated Blast Furnace Slag (GGBFS) and Rice Husk Ash (RHA) etc. Rice husk ash (RHA), produced by the controlled burning of the rice husk, is used as a highly reactive pozzolanic material. RHA additions in cement improve the properties of both fresh and hardened concretes. When the RHA is incorporated in the concrete, there are two possible reasons for the change in the hydration process, namely, the pozzolanic reaction of the amorphous phases in the RHA as a result of which more C-S-H gel may be formed in RHA concrete due to the reaction that probably occurs between the silica in RHA and the Ca^{2+}, OH^- ions, or $Ca(OH)_2$ in hydrating cement and the filler effect. Chemical admixtures modify the process of hydration of RHA blended cement. Effect of boric acid on the hydration of RHA blended cement has been studied by using number of techniques. Results have been discussed.

Selection and Peer-review under responsibility of INTERNATIONAL CONFERENCE ON MULTIFUNCTIONAL MATERIALS FOR DEVICE APPLICATIONS(ICMDA-2016).

Keywords: Nanoscience; Nanotechnology; Cement; Concrete; Nanosilica; Compressive strength; Heat of hydration

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1. Introduction

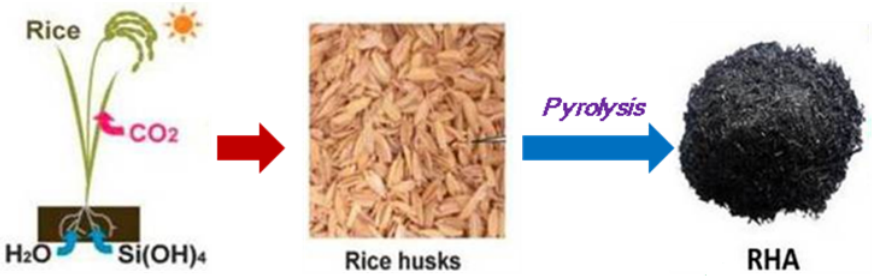
Since the first Portland cement with the present definition was produced in 1843 by William Aspdin, there has been a continuous process of evolution in cement process technology and cement itself. Recently, the demand of production of cementitious materials has been vastly increased because of having significant applications in the construction of bridges, building, dam etc. Consequently, a substantial amount of CO_2 is being directly released into the environment that is responsible for global warming and also energy requirement for producing the OPC is critically increased. However, since some years there has been a significant increase in the development rate of new cementitious binders. The main reason for this development is to reduce global CO_2 emission. To date the most effective way to reduce CO_2 emission of cement production is to reduce the clinker content by blending cements with Supplementary Cementitious Materials (SCMs). These SCMs typically are ground granulated blast furnace slag, fly ash, silica fume, limestone and others [1]. In addition to reduction of cement clinker content by blending cements with SCMs a couple of other alternative ideas to reduce the CO_2 footprint of cements exist. There are binary or ternary cementitious materials composed of SCMs and activators (geopolymers, sulfate containing slag cements etc.

Rice husk ash (RHA), an agricultural waste, produced by the controlled burning of the rice husk, is used as a highly reactive pozzolanic material. RHA represents a significant improvement on the properties of both fresh and hardened concretes. RHA can contribute to the properties of concrete and mortar significantly by both filler and pozzolanic actions. It is reported that RHA replacement of cement increases the compressive strength of concrete, decreases the pore size and the amount of Ca(OH)2 in concrete, improves the microstructure of the interfacial transition zone (ITZ) between the cement paste and the aggregate in high-performance concrete, C-S-H gel is increased due to the reaction that probably occurs between the silica in RHA and the Ca2+ , OH- ions, or Ca(OH)2 in hydrating cement. However, until now, no direct evidence for such a reaction has been observed. Resistance to acid attack, carbonation, and penetration can be improved. RHA incorporation also decreases chloride penetration and permeability and improves the corrosion resistance properties [2-5].Further the hydration of RHA blended cement is affected by chemical admixtures. Amongst different admixtures Boric acid has been used as a retarder during cement hydration. The objective of this research paper is to understand the effect of boric acid as retarder on the physical and chemical properties of rice husk ash blended cement and also to have an idea about anti corrosion properties of RHA blended cement on the surface.

2 Experimental Methods

2.1. Materials

Ordinary Portland cement (OPC) obtained from Jaypee Cement India was used for hydration studies. Rice husk was obtained from Sagar rice mills and burnt in open air. This was then heated at 600^{o}C for 4 hours in a muffle furnace to have rice husk ash (RHA) (Scheme 1) and stored in a polyethylene bag. Boric acid (CDH) was used as an admixture.



Scheme 1. Preparation of Rice husk ash