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The effect of three different types of rice husk ash as Ad mixture for ordinary Portland Cement

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Abstract: The effect of three different types of rice husk ash which distinguish by color, pink, grey and white ashes were used as admixture to ordinary Portland cement paste was studied. Six batches of cement paste was prepared by adding 0-50 wt % RHA. The chemical and mineralogical characteristics of RHA were first analyzed. The characteristic of cement paste was investigated using IR, TGA and XRD. Hydration temperature also recorded. Chemical analysis shows higher amount of silica in RHA which is in range of 95-98wt. %. XRD and IR confirmed the white RHA is amorphous silica. The optimum amount of RHA addition was 10 wt. % which produced comparable properties with cement paste control. Based on Calorimetry Studied, IR, TG and hydration temperature results, white silica was found the most reactive silica but plays limited role as admixture in OPC paste.

1. Introduction

Pozzolans from industrial and agricultural by-products such as rice husk and fly ash are receiving more attention now since their uses generally improve the properties of the blended cement mortar; the cost and the reduction of negative environmental effects. Pozzolanic material when used in conjunction with a Portland cement, the calcium hydroxide produced by cement hydration reacts with pozzolan and produces additional calcium silicate hydrate (C-S-H) gel, blocking existing pores and altering the pore structure. The hydration reactions particularly during the setting and early hardening period are exothermic, and measurement of the rate of heat output at constant temperature is a direct indication of the rate of reaction. The products of reactions are primarily calcium silicate hydrate, calcium hydroxide and ettringite according to the following equations:

$$\begin{aligned} \text{C}_3\text{S} + \text{Water} &\rightarrow \text{C-S-H} + \text{CH} + \text{Heat} & (1) \\ \text{C}_2\text{S} + \text{Water} &\rightarrow \text{Gypsum} \rightarrow \text{Ettringite} + \text{Heat} & (2) \\ \text{C}_4\text{A} + \text{Water} &\rightarrow \text{Ettringite} \rightarrow \text{Monosulfaluminate} & (3) \end{aligned}$$

Where C₃S is tricalcium silicate, C₂S is dicalcium silicate, C₄A is tetracalcium aluminate, C₃A_F is tetra-calcium aluminum ferrite, and CH is calcium hydroxide.

The advantage of using rice husk ash in concrete such as increased compressive and flexural strengths [1,2,3], reduced permeability [1,4], increased resistance to chemical attack [5] and increased durability [6]. Based on unique and important contribution of RHA in cement and concrete research, this paper evaluates the effect of different type of rice husk ash (RHA) and the limitation role it plays to properties of cement paste during hydration.

Even though a lot of researches have been reported on using RHA and ordinary Portland cement (OPC), but the limitation of RHA is able to be used as admixture is still far from clear. In this paper we are studied the effect and the limitation role of RHA as a cement admixture.

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