ABSTRACT

Global demand of OPC is growing in terms of billion of tons year by year. The increase in cement demand may be curtailed by the use of sustainable binders. This will help to reduce the adverse impact made on the environment and cost benefits. Now-a-days industrial wastes, such as blast furnace slag, fly ash, and silica fume are being extensively used as supplementary cementing material. Rice husk ash (RHA), which is derived from agricultural waste, has excellent pozzolanic characteristics provided the incineration is carried out under controlled conditions. The reactivity of silica in rice husk ash is dependent on complex and interlinked factors, such as temperature and duration of incineration. A number of studies have been reported on the production methodologies to obtain reactive rice husk ash. However, a devoted and comprehensive study on this subject has not been made yet.

In the present study, locally available rice husk was burnt into ash in an electric box furnace (laboratory type) under various combinations of temperature and duration of incineration. Twenty five samples of RHA were produced. After a number of trials on various parameters that control the efficiency of grinding, an optimum grinding condition was evolved. All the RHA samples were ground under the optimum grinding condition. Apart from various physical properties, amorphous silica content of RHA samples was determined by analytical and conductometric techniques. Reactivity of ash has been established by various instrumental techniques, such as X-ray diffraction (XRD), scanning electron microscopic study (SEM) along with elemental analysis. Energy
consumption has also been examined in this study. RHA-OPC reactivity has also been studied from the compressive strength of mortar. Based on the above investigations, incineration condition namely, “500°C-120minutes” is found to be the optimum combination for production of ash with maximum pozzolanicity, the least production energy, maximum amorphous silica content and maximum fineness. The ash sample produced at optimum condition possessed the maximum density.

Apart from the above studies on the production conditions, the performance of RHA on concrete was evaluated. Performance studies, such as compressive strength, chloride permeability, water absorption, and sorptivity were carried out. It was found that every dose of RHA addition up to 20 percent in partial replacement of OPC lead to increased compressive strength of concrete. Compressive strength of RHA concrete more than 90MPa has been achieved in this work. Performance characteristics, such as chloride permeability, saturated water absorption, and sorptivity of RHA-concrete mixtures show significant improvement with increase in RHA content. A linear relationship is found to exist between water absorption and sorptivity properties of RHA blended concrete. The outcome of the present study reveals that RHA produced under specified conditions possess excellent pozzolanic properties (relative strength more than 125 percent) beneficial to produce high-strength and high-performance concretes. The cost benefit analysis of RHA vis-a-vis micro-silica reveals that the use of RHA may reduce the cost of supplementary cementitious material by about 40 percent.