Preparation and Characterization of Geopolymer Composites Containing Fly Ash, Bottom Ash and Rice Husk Ash

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Geopolymers being the synthetic analogues of natural zeolitic materials possess excellent properties, including fire and acid resistance, and mechanical properties. As a result, geopolymers have become an alternative construction material in place of Portland cement. They find structural applications such as sculpture, building repairing and building restoration. In producing geopolymers, the raw materials containing mainly silica and alumina are converted through chemical reactions into aluminosilicate structures in alkali medium. These aluminosilicate structures are composed of a network of randomly arranged silicate and aluminate tetrahedra in conjunction with charge-balancing alkali metal cations. The compressive strength of this resulting inorganic polymer depends on both the ratio of Si/Al and the types of the raw materials utilized. This research focused on the use of fly ash (FA), bottom ash (BA) and Rice husk ash (RHA) as a value addition in the preparation of geopolymer composites and the characterization of composites prepared. The effects of relative amounts of raw materials and the curing time of geopolymers on their compressive strength and water absorptivity were investigated. In sample preparation, a series of samples was prepared by hand mixing of selected amounts of cement, fine FA, BA, fine RHA, prewashed and dried sand, water and NaOH. The other series of samples was prepared by hand mixing of selected amounts of the same raw materials with $Ca(OH)_2$. Further, the cylindrical samples for characterization were prepared by molding using a hydraulic press and demolded samples were kept at 80 °C for 4 hrs. Compressive strength of both series of samples was measured after curing them for 7 days and 14 days. The results showed that the compressive strength of the samples increases with increasing the curing time. At high relative amounts of cement and low amounts of the mixture containing FA and RHA, the compressive strength increases with decreasing the amount of cement and increasing the amounts of the mixture containing FA and RHA with compared to that of the samples in the absence of FA and RHA, regardless of the curing time. The incorporation of $Ca(OH)_2$, has resulted in increase of compressive strength of samples with high relative amounts of cement and low amounts of the mixture containing FA and RHA.

Keywords: Geopolymers, Fly ash, Bottom ash, Cement, Compressive strength