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Microstructure studies on the effect of the alkaline activators of fly ash-based geopolymer at elevated heat treatment temperature

Abstract

Fly ash-based geopolymers are new binding materials produced to replace the ordinary Portland cement (OPC) used in concrete. In this research, the effect of alkaline activators on the compressive strength and the microstructure of low-calcium (Class F) fly ash-based geopolymers were studied. Fly ash and the alkaline activator were mixed with alkaline activator to fly ash ratios of 0.30, 0.35, and 0.40 at a constant ratio of water glass (sodium silicate) to sodium hydroxide (NaOH). The alkaline activator solution was prepared by mixing water glass with a 15 M NaOH solution. The samples were cured at a temperature 70 °C for 24 hr and maintained at room temperature until the testing was conducted. The test results indicated that the compressive strength increased when the ratio of alkaline activator to fly ash was increased at 7 days. The ratio of 0.4 produced the maximum compressive strength, which was 8.61 MPa. This was due to high reaction rate between the fly ash and the alkaline activator solution. Morphology studies, conducted by SEM analysis of the geopolymer samples, indicated that geopolymers synthesized at a ratio of 0.4 also had the most homogeneous and less porous microstructures, which was attributed to the high dissolution of the fly ash particles in the alkaline activator solution. The microstructure appearance of geopolymers treated heat temperature of 400, 600 and 800°C, shows a sintering process takes place for unreacted fly ash microspheres. It was observed as an overall, the visible microcracks formed on the surface of the highest compressive strength geopolymers only, was due to loss of water during heating.

Keywords

Alkaline activator; Compressive strength; Geopolymer; Geopolymerization; SEM analysis