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Spectroscopic studies of fly ash-based geopolymers

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Abstract

In the present work fly-ash based geopolymers with different contents of alkali-activator and water were prepared. Alkali-activation was conducted with sodium hydroxide (NaOH) at the SiO_2/Na_2O molar ratio of 3, 4, and 5. Water content was at the ratio of 30, 40, and 50 wt. % in respect to the weight of the fly ash. Structural and microstructural characterization (FT-IR spectroscopy, ^{29}Si and ^{27}Al MAS NMR, X-ray diffraction, SEM) of the specimens as well as compressive strength and apparent density measurements were carried out.

The obtained geopolymers are mainly amorphous due to the presence of disordered aluminosilicate phases. However, hydroxysodalite have been identified as a crystalline product of geopolymerization. The major band in the mid-infrared spectra (at about 1000 cm^{-1}) is related to Si–O(Si,Al) asymmetric stretching vibrations and is an indicator of the geopolymeric network formation. Several component bands in this region can be noticed after the decomposition process. Decomposition of band at 1450 cm^{-1} (vibrations of C–O bonds in bicarbonate group) has been also conducted. Higher NaOH content favors carbonation, inasmuch as the intensity of the band then increases. Both water and alkaline activator contents have an influence on compressive strength and microstructure of the obtained fly-ash based geopolymers.