

Setting Time Dependence Morphological, Compression Strength and Formation of Fly Ash Geopolymer

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Structured Abstract

Background: The increasing usage of fossil fuels for energy generation such as coal is harming the environment and producing fly ash (FA). Geopolymers, which are aluminosilicates activated by alkali solution, have the potential to minimise FA abundance at the ash pond, resulting in cost savings, land conservation, and economic advantages. The major goal of this study is to determine the effect of curing time on fly ash geopolymer (FAG) formation and to discover new chemical linkages, morphological characteristics, and compressive strength using Fourier Transform Infrared Spectroscopy (FTIR), scanning electron microscopy (SEM), and compressive strength tests.

Methods: The FA was dried at 60°C for 48 hours, then mixed with sodium hydroxide (NaOH), sodium silicate (Na₂SiO₃) solution to synthesized FAG samples. The mixture was activated at a 0.35 fly ash-alkaline activator ratio. The slurry was poured into PVC molds, cured in an oven with temperature of 70°C, and aged for seven days. The FAG samples were then tested for compressive strength and physical and chemical properties.

Results: The study examined the physical stability of FAG samples that were cured for 1, 3, 5, and 7 days, revealing that the samples retained their shape and height, with uneven geopolymer surfaces due to excessive air entrapment during mixing which can rise to the surface if not managed properly. The FTIR analysis of raw FA and FAG samples demonstrated a decrease in wavenumber in the Si-O-Si/Al-O-Al asymmetric stretching bands, indicating the creation of an amorphous aluminosilicate gel phase. Next, the SEM analysis revealed morphologies of FAG samples cured for various days with the addition of alkali activator, demonstrating agglomeration and reduced particulate FA particles. The FAG samples with various curing days were then presented using a compressive test. FAG Day 3 sample was chosen as the best because it had the highest compressive strength (0.111 MPa) among the FAG samples tested. Thus, curing days are critical for determining the geopolymer properties.

Conclusion: In conclusion, the study successfully determined the effects of curing day on FAG formation and elucidated new chemical bonding, morphological properties, and compression strength of FAG using FTIR, SEM, and compressive strength. The best preparation condition is FAG cured for 3 days

Keywords: Fly ash, geopolymer, alkaline activator, sodium hydroxide, sodium silicate

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