

Effect of Dipotassium Hydrogen Phosphate and Calcium Nitrate on Strength and Microstructural Properties of Geopolymer Mortar

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Abstract

Adoption of coal fly ash (Class C) as the main source material for geopolymers would cause rapid setting to the fresh geopolymer mortar or concrete. This behaviour explained the limited application of this material in the construction industry. On the other hand, calcium nitrate ($\text{Ca}(\text{NO}_3)_2$) and dipotassium hydrogen phosphate (K_2HPO_4) are alternative admixtures that known to extend the setting time of fresh geopolymers. However, their effect on the strength and microstructural properties remain unclear due to the limitation of relevant literature from previous studies. Therefore, this study aims to investigate the effect of these admixtures in fly ash based geopolymer system, particularly to its strength performance. The effects of adding $\text{Ca}(\text{NO}_3)_2$ and K_2HPO_4 were evaluated at dosages of 0.5%, 1.5%, and 2.5% (by fly ash weight) in the geopolymer mixture, and samples were cured at room temperature. Hardened geopolymer specimens were measured for their compressive strength, porosity, and microstructural characteristic. The inclusion of 0.5% of alternative chemical reagents was found as the optimum proportion and able to enhance the compressive strength of the geopolymer mixtures. However, efflorescence was detected on the surface of the hardened specimen when K_2HPO_4 was included in its mixture. This phenomenon is influenced by the presence of monovalent and trivalent anions in the system namely nitrates and phosphates. In this study, each anion had a particular role in each stage of geopolymerisation, and determined the quality via crystal growth control and influenced the development of aluminosilicate structures.

Keywords: Geopolymer, Strength, Microstructure, Calcium Nitrate, Dipotassium Hydrogen Phosphate

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