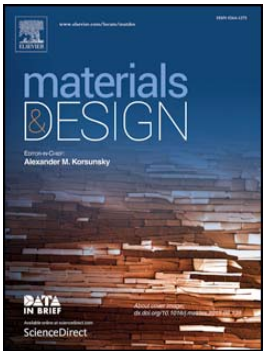

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Effects of epoxy resin on the mechanical performance and thickening properties of geopolymer cured at low temperature

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Abstract

The research objectives were to investigate the influence of waterborne bisphenol-A epoxy resin on mechanical performance and thickening properties of metakaolin-slag based geopolymer at 10℃. Test results showed that the epoxy resin has ability to decrease the thickening time, while the benzyl glycidyl ether diluent can prolong thickening time. Hydration heat test was performed to explain the different consistency increasing trend of pure geopolymer and hybrid composite samples. Epoxy equivalent analysis was carried out to explain the mechanism of dilution effect on thickening time. The 1-day compressive strength of geopolymer was reinforced by doping epoxy resin, but the 3-day strength was lower than pure geopolymer when the doping amount of epoxy resin was below 50%. The morphology and quantitative element results revealed that the homogenous and high degree of miscibility led to dense and uncracked morphology. In order to enhance the durability of cement sheath under deep water strata stress wave condition, we should increase the dosage of ER to achieve low Young's modulus. The benzyl glycidyl ether diluent is recommended to make thickening time adjustable and to reinforce the compressive strength. This novel material makes the geopolymer-based composites applicable for oil wells cementation at low temperatures.

Keywords: Epoxy resin; Geopolymer; Compressive strength; Thickening time; Low temperature; Dilution effect

1 Introduction

Geopolymers are typically used as an alternative to ordinary Portland cement in construction industry [1]. These materials have many excellent characteristics, including environmental sustainability, the ability to provide high compressive strength at room temperature, acid resistance, high temperature and fire resistance, low shrinkage, as well as low manufacturing energy consumption [2-4]. Geopolymers are usually obtained from inexpensive materials, such as metakaolin, clay, coal fly ash and metallurgical slag [5]. For these reasons, the application of geopolymer-based materials covers many fields like applied as fire resistant materials, as foam tiles with low energy consumption, as corrosion-resistant coatings on steel, etc.

Nevertheless, in the field of oil well cementation, geopolymer-based materials are seldom used due to two main reasons: First, the high reactivity of geopolymer leads to nonadjustable thickening time at room temperature, let alone high temperatures [6-8]; Second, at low