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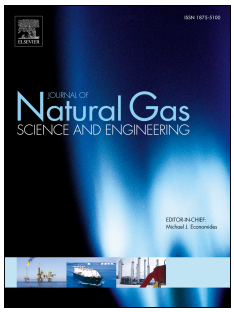

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Sensitivity Analysis of Fly Ash Geopolymer Cement Slurries: Implications for Oil and Gas Wells Cementing Applications

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Abstract

Geopolymers are a new class of binder materials suitable for applications in civil industry and Oil and Gas well cementing. Although these materials are widely applied in civil industry applications, they still need more research and development before they can be fully applied for Oil and Gas well cementing. Specifically, these materials have potential to reduce wellbore isolation problems reported by use of ordinary Portland cement (OPC). The study here first presents a comprehensive literature study of geopolymers and results of laboratory testing of class Fly ash geopolymer mixtures under various experimental conditions. We conducted a sensitivity analysis of various factors on specimen's strength as well as selection of plasticizer type and dosage, the effect of Sodium Hydroxide molarity, the effect of shear mixing and rate, mixing time, and effects of solid to liquid ratio. Study results show a strong impact of temperature and curing time on geopolymer mixture's strength whereas mixing condition were not found as a significant factor. Finally, this paper investigates the effect of drilling fluid's contamination on the performance of geopolymers when compared with ordinary Portland cement.

Introduction

Combustion of coal in a thermal power plant produces a by-product known as Fly ash. Fly ash combines coal minerals, resulting from the combustion process of glass aluminosilicate, to form spheres. Source materials and alkaline liquids are the main compositions of Fly ash geopolymers. Aluminosilicate based geopolymer is rich in silicon and aluminum. The pozzolanic materials are mostly of geological origin in nature, and their reaction with alkali polysilicates produce polymeric Si-O-Al bonds. (Tishmack, 1996; Provis and Jannie, 2009).

Portland cement has been used for different cementing and slurry purposes for decades. However, Mustafa et al. proved that Fly ash is preferred over cement due to increased life cycle expectancy and durability (Mustafa et al., 2011). Pacheco-Torga et al. concluded that improved