

Área: FIS

Assessment of Setting Time in Glass-Based Geopolymer with Supplementation of Reactive Aluminosilicates

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Highlights

Setting time analysis (NBR 16607) in glass powder based geopolymers. 6% HES CP-V cement induced the cure (initial set 33 min), unlike metakaolin and silica fume, which were unfeasible.

Abstract

Portland cement production is responsible for a significant share of global CO₂ emissions, while the improper disposal of glass waste represents an environmental challenge. In this context, geopolymers emerge as a sustainable alternative, representing a class of inorganic polymers formed by the reaction of precursor materials with an alkaline activator. This work evaluates the feasibility of ambient temperature curing of glass powder-based geopolymers. The geopolymerization was initiated by activating the glass powder with a sodium silicate solution, produced with a 2:1 weight ratio of silica to NaOH, using silica crystals from pet litter as the source of silicon dioxide. The hardening was validated by determining the setting times using a Vicat apparatus (NBR 16607 standard). The objective was to investigate the impact of partial replacement with different reactive aluminosilicate precursors – metakaolin (MK), High Early Strength cement (HES CP-V), and silica fume (SF) – using a liquid/solid (L/S) ratio of 0.5 for MK and SF, and 0.57 for the HES cement. As a reference material (control sample), pure HES CP-V cement (L/S of 0.3) showed an initial set at 180 minutes and a final set at 205 minutes. In the geopolymers, samples with 12% silica fume and metakaolin showed no setting. In contrast, the 12% HES cement addition promoted an accelerated setting (initial set at 23 min, final set at 53 min). By optimizing the mixture and reducing the HES cement to 6%, the initial setting time increased to 33 minutes and the final to 65 minutes, demonstrating the potential to control the reaction. This research shows that partial replacement with HES cement is a promising path for developing glass-based geopolymers suitable for ambient temperature curing.

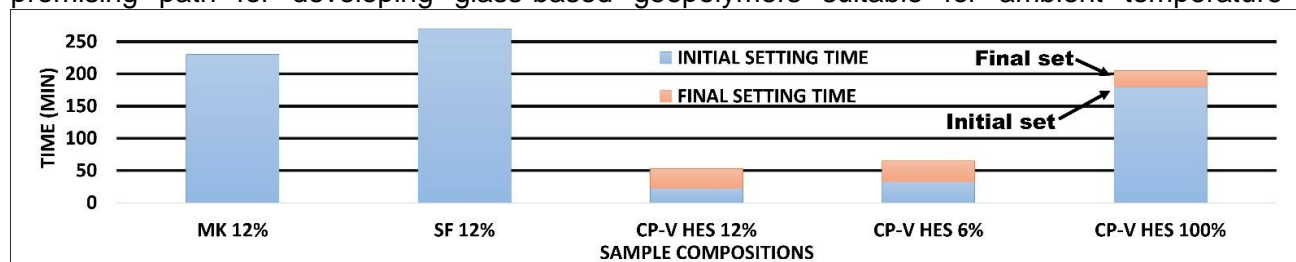


Figure 1. The effect of supplementation on Vicat initial and final time of setting.

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