

# THE ORIGIN OF THE ACCELERATION PERIOD IN ALKALI-ACTIVATED FLY ASH

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The identification of different reaction phenomena occurring at early and later stages provides important information regarding the performance and applicability of alkali-activated materials. The present work investigated the existence and influence of the acceleration period in alkali-activated fly ashes, correlating the changes from the early-stage phase assemblage to mature hardened microstructures, as a function of binder chemistry and curing temperature. Synthetic glasses with chemical compositions resembling siliceous and calcareous fly ashes – fixed Si/Al of 1.5, and CaO contents of 12 wt% and 19 wt%, respectively – were prepared for activation using NaOH and waterglass solutions. Dissolution experiments in highly-diluted conditions [1] were used to identify reactions occurring in the initial stages, while the characterization of 7-day cured pastes was performed to evaluate secondary reactions and subsequent phase transformations in similar alkaline environments. Isothermal calorimetry tests indicated an absence of acceleration periods for pastes cured at 20 °C with both activators, while elevated temperature curing at 60 °C resulted in noticeable changes in the heat flow of the pastes. The characterization of the residual material from dissolution experiments, via differential thermogravimetric analysis, proved that elevated curing temperature promotes the nucleation of stable gel-like structures even from the initial moments of dissolution. Comparison of X-ray diffraction patterns of hardened pastes with dissolution residues confirms the correlation of acceleration periods with phase transformations at 60 °C. In NaOH-based systems, the initially formed disordered structures convert to zeolite phases [2], while structure changes are less visible in pastes activated with waterglass. Glass dissolution at room temperature resulted in the formation of unstable precipitates that are easily prone to carbonation [3], proving the correlation between the delayed nucleation of stable reaction products and the low heat flow of alkali-activated fly ash in these curing conditions.

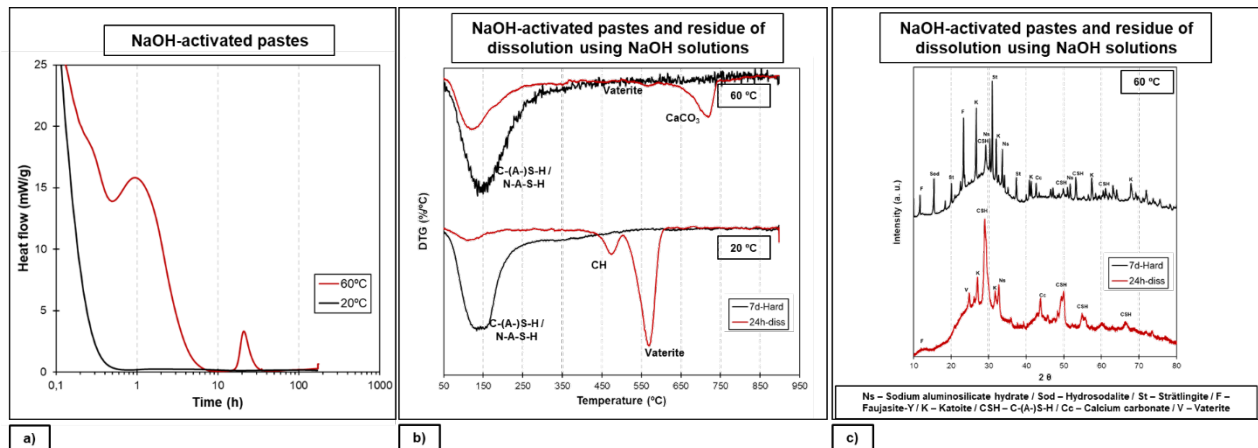


Figure 1 – Characterization of glass simulating siliceous fly ash: a) Isothermal calorimetry at different temperatures; b) DTG analysis of hardened pastes and residual material after dissolution experiments; c) XRD patterns of hardened pastes and residual material after dissolution experiments.

## References:

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