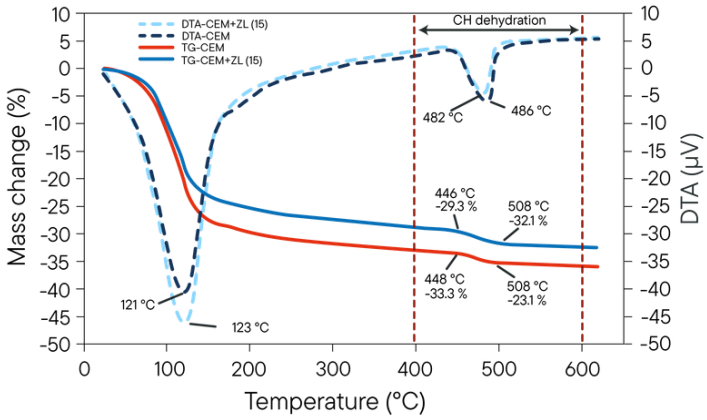
Cement Hydration Characterization Using Simultaneous Thermal Analysis

STA L81 Investigation of Early Hydration Reactions in Zeolite-Modified Portland Cement

The hydration behavior of cement has a significant influence on the mechanical performance and durability of construction materials. Accurate characterization of hydration reactions is essential for understanding cement chemistry and optimizing sustainable binder formulations. In this study, simultaneous thermal analysis was performed using a LINSEIS STA L81 to investigate the influence of natural zeolite on the early hydration behavior of Portland cement. The results provide valuable insight into hydration mechanisms and support the development of high-performance cementitious materials.

Measurement Setup

- Instrument: LINSEIS STA L81
- Method: Simultaneous Thermal Analysis (TG-DTA)
- Material: Portland Cement with 15 vol.% Natural Zeolite
- Temperature Range: Room Temperature to 1000 °C
- Heating Rate: 10 K/min
- Atmosphere: Air



The simultaneous thermal analysis reveals clear differences in the hydration behavior of zeolite-modified cement.

Key observations include:

- Enhanced low-temperature dehydration reaction
- Distinct calcium hydroxide decomposition region
- Increased bound water content
- Accelerated early hydration behavior

The results demonstrate the effectiveness of natural zeolite in promoting early cement hydration.

Interpretation

The observed behavior can be attributed to:

- Accelerated hydration reactions
- Increased formation of hydration products
- Enhanced pozzolanic activity
- Modified dehydration behavior

This results in:

- Faster cement hydration
- Improved microstructure development
- Enhanced material performance

Industrial Relevance

STA measurements support:

- Cement formulation
- Supplementary cementitious materials
- Sustainable concrete development
- Quality control of cementitious binders
- Construction materials research
- Hydration process optimization

Conclusion

The LINSEIS STA L81 enables precise characterization of hydration reactions in cement-based materials. Understanding the thermal behavior of zeolite-modified Portland cement provides valuable insight into hydration mechanisms and supports the development of more sustainable and high-performance construction materials.

Source:
Kriptavičius, D., Girskas, G., Skripkiūnas, G.
Influence of Natural Zeolite on Portland Cement Hydration Processes and Properties of Hardened Cement Paste.
Ceramics – Silikáty, 2021.
Adapted from simultaneous thermal analysis measurements performed using a LINSEIS STA L81 (formerly designated as STA PT 1600).