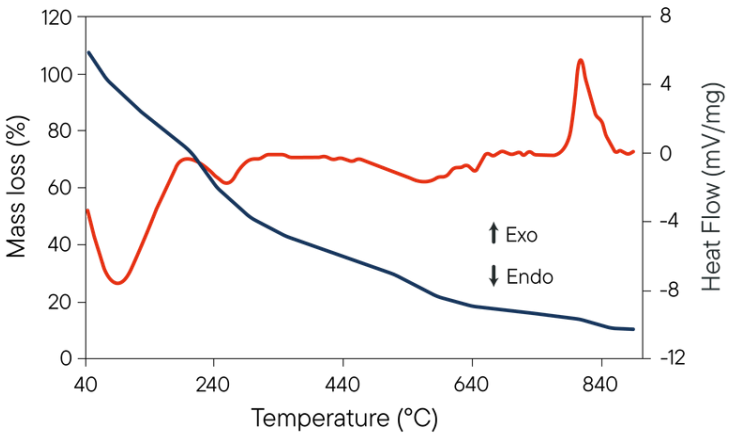
Thermal Stability and Phase Transformation of Calcium Silicate Hydrates

Simultaneous Thermal Analysis with the Linseis STA L82

Simultaneous Thermal Analysis (STA) enables the combined measurement of mass change and heat flow under controlled temperature conditions. In this application example, a calcium silicate hydrate system containing chromium ions was investigated using the former instrument designation STA PT 1000, now known as the Linseis STA L82.
The measurement demonstrates the thermal stability and decomposition behavior of the synthesized material over a wide temperature range.

Measurement Setup

- Instrument: Linseis STA L82 (former designation: STA PT 1000)
- Atmosphere: Nitrogen
- Heating rate: 15 °C/min
- Temperature range: 40 °C to 840 °C
- Measured signals: Mass loss and heat flow



The STA measurement reveals the thermal decomposition behavior of the investigated calcium silicate hydrate system.
Key observations include:

- Initial mass loss below 200 °C due to dehydration
- Continuous decomposition between 200 °C and 700 °C
- Strong exothermic peak above 800 °C caused by recrystallization processes

The simultaneous measurement of heat flow and mass loss provides valuable insights into thermal stability and phase transformations.

Interpretation

The observed thermal behavior can be attributed to:

- Dehydration of hydrate phases
- Decomposition of nitrate-containing compounds
- High-temperature recrystallization

This results in:

- Continuous mass reduction
- Distinct thermal transition peaks
- Formation of stable crystalline phases

Industrial Relevance

STA measurements are widely used for:

- Catalyst and ceramic material characterization
- Thermal stability analysis
- Inorganic material development
- Process optimization and quality control
- High-temperature material evaluation

Conclusion

The measurement performed with the Linseis STA L82 demonstrates the suitability of simultaneous thermal analysis for investigating decomposition behavior and phase transformation processes in calcium silicate hydrate systems. The combination of heat flow and mass loss measurement provides comprehensive insights into material stability and thermal behavior over a broad temperature range.

Source:
Niuniavaite, D., Baltakys, K., Dambrauskas, T., Eisinas, A., Rubinaite, D., Jaskunas, A. "Microstructure, Thermal Stability, and Catalytic Activity of Compounds Formed in CaO-SiO2-Cr(NO3)3-H2O System"
Nanomaterials 2020, 10, 1299
DOI: 10.3390/nano10071299
Adapted and extended with measurements performed on a Linseis STA L82 (former designation: STA PT 1000).