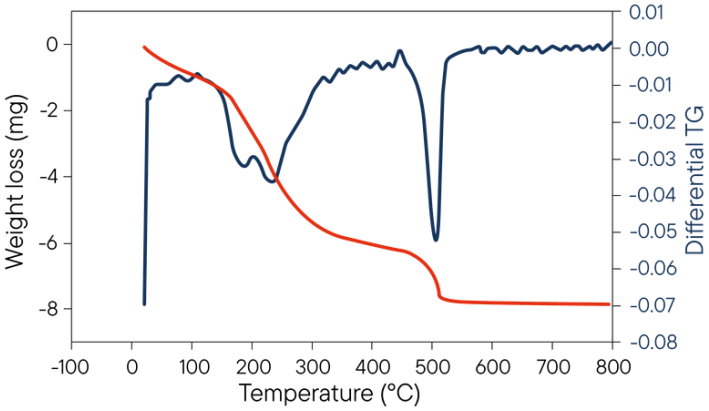
Thermal Stability of an Encapsulated Urea-Kaolinite Nanocomposite

TG-DTG characterization of a controlled-release fertilizer formulation using the STA L82

Controlled-release fertilizers are designed to provide nutrients over an extended period while reducing losses caused by rapid dissolution and volatilization. In this study, urea was intercalated into kaolinite and subsequently encapsulated with gum arabic to form a controlled-release nanocomposite (KPDMUG). Thermogravimetric analysis provides valuable information on the individual degradation processes and the thermal stability of such complex formulations.

Measurement Setup

- Instrument: LINSEIS STA L82
- Material: Encapsulated Urea-Kaolinite Nanocomposite (KPDMUG)
- Temperature Range: RT–800 °C
- Heating Rate: 5 K/min
- Atmosphere: Nitrogen
- Measurement: Thermogravimetric Analysis (TG/DTG)
- Application: Controlled-Release Fertilizer Materials



The TG-DTG measurement reveals distinct thermal degradation stages of the encapsulated urea-kaolinite nanocomposite.
Key observations include:

- First degradation region between approx. 48 and 425 °C
- Moisture loss and degradation of the gum arabic coating
- Removal of interlayer and coordinated water
- Kaolinite dehydroxylation at approx. 475–550 °C

The results demonstrate the characteristic thermal behavior of the encapsulated controlled-release fertilizer formulation.

Interpretation

The observed behavior can be attributed to:

- Moisture and interlayer water removal
- Gum arabic degradation
- Kaolinite dehydroxylation

This results in:

- Distinct degradation stages
- Reliable thermal stability assessment
- Characterization of the encapsulated formulation

Industrial Relevance

Simultaneous Thermal Analysis supports:

- Controlled-release fertilizers
- Fertilizer formulation development
- Functional nanocomposites
- Encapsulation technologies
- Thermal stability assessment
- Agricultural material development

Conclusion

The LINSEIS STA L82 enables reliable characterization of the thermal degradation behavior of encapsulated urea-kaolinite nanocomposites. The TG-DTG measurement clearly distinguishes the thermal processes associated with moisture and water removal, degradation of the gum arabic coating and dehydroxylation of the kaolinite structure. These insights provide valuable information for evaluating thermal stability and optimizing controlled-release fertilizer formulations.

Source:
S. I. Sempeho et al., Encapsulated Urea-Kaolinite Nanocomposite for Controlled Release Fertilizer Formulations, Journal of Chemistry, 2015, Article ID 237397.
Measurement originally performed using the LINSEIS STA PT 1000, today LINSEIS STA L82.