

## **Calorimetry und Thermal Analysis in the Product Life Cycle**

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At dsm-firmenich, calorimetry and thermal analysis have a critical role in defining process safety through hazard analysis, product stability, understanding physical properties and ensuring quality control throughout the product life cycle. During the research phase, new reactions are studied in our safety lab using reaction calorimetry to determine key parameters such as reaction enthalpy, heat flow, heat capacity and thermal accumulation of the intended reaction. Following this, the thermal stability of the reaction mixture and starting materials is assessed with thermal analysis such as differential scanning calorimetry (DSC) to identify and characterise decomposition reactions. The data obtained is used to calculate the Time to Maximum Rate under Adiabatic conditions based on conservative assumptions. Additional methods are being used such as kinetics modelling based on isoconversional method (using AKTS software) or microcalorimetry for storage assessment, where adiabatic conditions are not realistic. The information gained on both the intended reaction and unintended phenomena are used as a basis for our Chemical Hazard Assessment, where normal process and process deviations will be assessed to identify and describe relevant hazards. These will serve as input for HAZOP studies, for scale-up projects in the development phase.

Thermal analysis is also widely used in our physical properties lab, with techniques such as Thermogravimetric Analysis (TGA) combined with infrared spectroscopy (FT-IR) or mass spectroscopy (MS) helping to understand decomposition or to assess drying conditions. Together with our solid lab, these techniques are also used for crystallisation characterisation with for example DSC combined with microscope.

By leveraging all these thermal analysis techniques in our competences lab we can support product development from research to production by making informed decisions on process safety, understanding product stability and ensure consistency in manufacturing, ultimately leading to safer, more reliable products.