

Practicable experiences regarding Thermal Process Safety - Rules of thumb –

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Exothermic chemical reactions running in process plants contain eminent potential hazards accompanying the triggering of undesirable and non-controllable operating conditions.

TRAS 410 provides a basis for the safety assessment of exothermic chemical reactions and gives advice on how to recognise and manage such operating conditions and to prevent them. Occurring hazards are systematically identified and evaluated, and the selection and scope of measures to prevent such incidents are derived.

A series of characteristic physico-chemical parameters of the substances and equipment involved are used to identify the thermal hazard potential, e.g:

- Heat of reaction Q_R of the primary and secondary reactions
- Heat production rate (dQ_R/dt , reaction power)
- Heat release rate of the system (dQ_K/dt)
- Limit temperature $T_{Exo...}$

These parameters can be determined with various calorimetric methods and equipment. Due to different detection limits of the equipment (e.g. DSC, VSP2, ARC...), varying measuring values and thus different characteristics are to be expected.

The most important aspects for the derivation of the characteristics from these measuring values as well as for the evaluation and clarification of the scale-up from laboratory to industrial scale are as follows:

- Safety-conservative selection of boundary conditions (physical material values, process parameters...),
- Understanding of interactions between measuring data and characteristics and measures.

This contribution is intended to provide a bridge between a conservative view of safety, an understanding of the interactions and a certain degree of pragmatism in the evaluation of chemical reactions. Based on different reaction systems, practical experiences, so-called rules of thumb, are to be presented, which are appropriately proven in Evonik in the evaluation of chemical reactions.

The focus is on adiabatic reaction calorimetry as well as the characteristics of temperature rise rate and time-to-maximum rate.

Likewise, this contribution should also serve as an inspiration for others to share their experiences in order to develop a common understanding of safety engineering among stakeholders in a project.