THERMAL PROCESS SAFETY BASED ON REACTION KINETICS AND REACTOR DYNAMICS

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Nowadays, the chemical industry needs increasingly faster time-to-market as well as economically efficient and safe processes. In addition, the growing product variety requires more versatile production plants able to produce from small amounts up to several hundred tons per year. As a result, shorter time is devoted to process development and the use of multipurpose plants is necessary. This last aspect shows that a given process can run in different reactors where the reacting system behaviour can change from one equipment to another and from laboratory to industrial scale [1, 2].

In terms of safety and at any scale, one of the problems generally encountered is the lack of controllability due to the accumulation of non-converted reactants. This accumulation can remain undiscovered under nominal operating conditions. In case of failure, however, it can suddenly be revealed, as it leads to an uncontrollable reactor state [3, 4]. Understanding and controlling this aspect becomes a matter of great importance.

The solution to the raised issues is the result of a perfect match between two dynamics: the reaction dynamics (governed by the kinetics) and the dynamics of the reactor temperature control. For that, a novel approach focusing on a combination of dynamic models, safety issues and calorimetric measurements has to be developed [5] in order to answer the three following key questions:

1. Is the industrial reactor able to control the temperature of the reactions mass?
2. What are the safety relevant parameters to govern the reaction system in a given industrial reactor?
3. How can the reactor be brought into a safe state in case of malfunction?

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