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Flow Chemistry Highlights

A CHIMIA Column

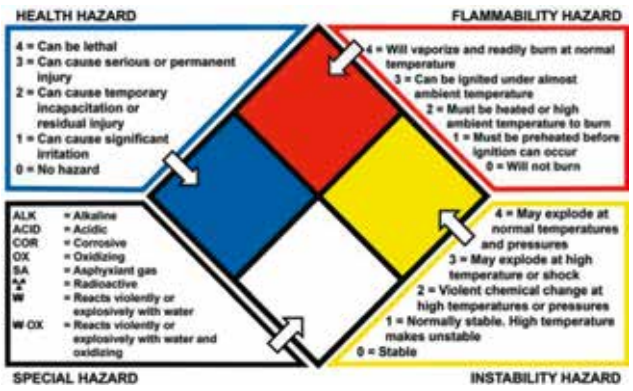
Review of recent literature on flow chemistry. Selected topic: **Safety**

Safety Assessment in Development and Operation of Modular Continuous-flow Processes

N. Kockmann, P. Thenée, C. Fleischer-Trebes, G. Laudadio, T. Noël, *React. Chem. Eng*. **2017**, *2*, 258–280, https://doi.org/10.1039/C7RE00021A

Safety has the highest priority in the chemical industry, and process chemists use safety assessment methodologies such as HAZOP (HAZard and OPerability study). Microreactors are regularly employed for hazardous chemistry, and despite the ability to broaden the safe operating window, they cannot be considered as inherently safe. In this minireview the authors guide the reader through the chemical engineering fundamentals underpinning four key areas, with particular focus on the particular hazards and risk-mitigation strategies. The sections are filled with examples pulled from lab- and plant-scales, and particular reference is made as to how microreactors can enable safer operation through their unique architectures, materials of construction & capability to quench and separate in-line. Both standard and hazardous gases are covered in the section on gas-liquid reactions. This is followed by those reagents which can be generated in flow and immediately consumed within the microreactor in a follow-up reaction. Extreme reaction conditions (high temperature and high pressure) are thoroughly explored, and finally the advantageous use of organometallic reagents is highlighted.

Author's comments:
"One of the main drivers to implement continuous processes into chemical manufacturing is the potential to minimize the associated safety risks. In this review, we wanted to put all the different safety aspects of continuous manufacturing in perspective".

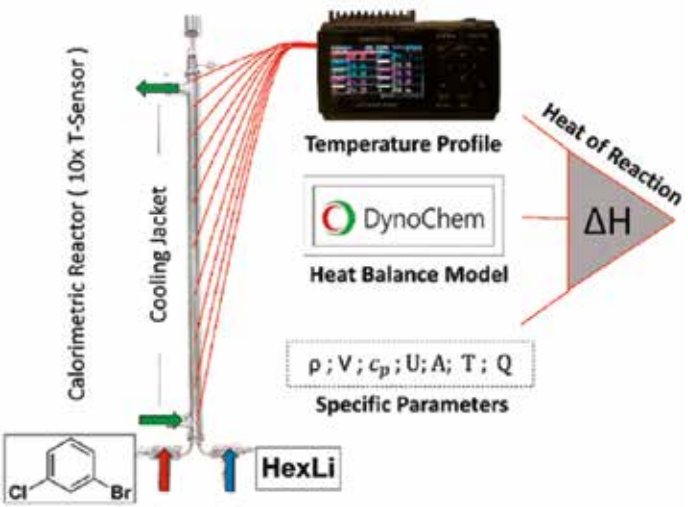


Reaction Calorimetry in Continuous Flow Mode: A New Approach for the Thermal Characterization of High Energetic and Fast Reactions

F. Mortzfeld, J. Polenk, B. Guelat, F. Venturoni, B. Schenkel, P. Filipponi, *Org. Process Res. Dev.* **2020**, *24*, 2004–2016, https://doi.org/10.1021/acs.oprd.0c00117

Safe scale-up of chemical processes from bench- to plant-scale requires calorimetric characterization to ensure safe operation. Typically, those investigations are performed in batch equipment. However, as authors of this contribution demonstrate, this may lead to overestimation of the reaction enthalpy due to occurrence of side reactions. Reactions performed in flow benefit from excellent heat and mass transfer, leading to increased yields and reaction quality when compared to batch equipment. In order to avoid overengineered safety features on continuous equipment, the authors developed a flow calorimeter, enabling reaction characterization in conditions close to the actual run parameters (see Figure). The authors demonstrated successful scale-up of lithiation of 3-chloro-bromobenzene to 500 ml/min throughput. Most importantly, calorimetry measurements with the flow device predicted the heat released on scale with excellent accuracy.

Author's comments:
"The time and the material consumed to make a flow process working in a batch calorimeter is not necessary anymore. A scale-down mimic of the continuous production plant is now available in the lab and it can be used to identify and control both quality and safety relevant parameters".



Would you like to propose a Flow Chemistry Highlight topic here?
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