P13.11 Reaktionstechnik

Forced periodic reactor operation: Analysis of process and forc-ing parameters exploiting the nonlinear frequency response method

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DOI: 10.1002/cite.202055082

Continuous chemical reactors are mostly operated under steady-state conditions. However, theoretical studies reveal that forced periodic operation (FPO) can lead to better performance. To predict and optimize FPO, the nonlinear frequency response (NFR) method provides an analytical approach [1].

The NFR is applied to spot optimal FPO conditions for the hydrolysis of acetic anhydride performed in a CSTR. The focus is set on exploiting two simultaneously modulated inputs and evaluating the effect of phase shifts φ and input function shapes. To validate the predictions, an automated experimental setup was developed consisting of a double-jacketed glass reactor with a conductivity sensor. The anhydride concentration and the volumetric flow rate were selected as modulated inputs applying the same forcing frequency. The NFR method predicts an optimal φ to maximize the time-average molar product flow. Experimental results proved higher yields compared to steady-state operation.

Uncertainties in the kinetic, thermodynamic, and process parameters were analyzed with respect to their influence on FPO. These results reveal the importance of a correct description of the reaction kinetics.

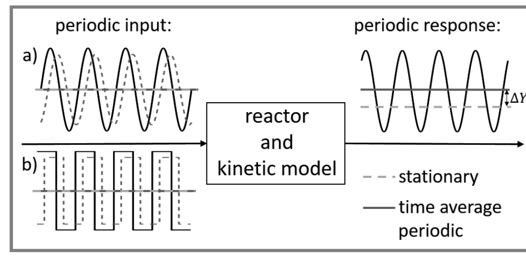

Figure. Schematic illustration of simultaneous modulation of two input parameters with a phase shift for: (a) sinusoidal and (b) square wave functions. ΔY describes the change of a performance criterion (e.g., molar product flow) with respect to steady-state operation.

[1] M. Petkovska, A. Seidel-Morgenstern, in *Periodic Operation of Reactors*, 1st ed. (Eds: P. L. Silveston, R. R. Hudgins), Butterworth-Heinemann,Woburn, MA **2013**, 387. DOI: 10.1016/C2010-0-67302-0

P13.13 Reaktionstechnik

Investigation of chemical reactions on wire cloth micro heat exchangers

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DOI: 10.1002/cite.202055255

Efficient heat removal or supply in chemical reactions is critical to achieve the desired yields and selectivities. In order to meet the requirements of small construction volumes with high performance, wire cloth micro heat exchangers offer a promising concept. These are open mesh structures consisting of capillary tubes interwoven with wires to form a grid structure (see figure). When a fluid medium flows through these wire cloths, high heat transfer coefficients and mass transfer coefficients can be expected due to flow phenomena such as vortex formation and the resulting intensive contact between the flow medium and the geometry.

This contribution deals on the one hand with a numerical modeling and on the other hand with the experimental investigation of a chemical reaction on the coated cloths. With experimental investigations on carbon dioxide methanation, a reaction kinetic from the literature was adapted for this model. Based on these investigations, a model-based analysis of the applications for the wire meshes will be presented.

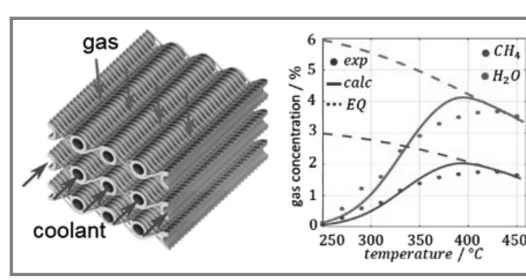

Figure.