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A systematic reactor design approach for the synthesis of active pharmaceutical ingredients

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Abstract

Today's highly competitive pharmaceutical industry is in dire need of an accelerated transition from the drug development phase to the drug production phase. At the heart of this transition are chemical reactors that facilitate the synthesis of active pharmaceutical ingredients (APIs) and whose design can affect subsequent processing steps. Inspired by this challenge, we present a model-based approach for systematic reactor design. The proposed concept is based on the elementary process functions (EPF) methodology to select an optimal reactor configuration from existing state-of-the-art reactor types or can possibly lead to the design of novel reactors. As a conceptual study, this work summarizes the essential steps in adapting the EPF approach to optimal reactor design problems in the field of API syntheses. Practically, the nucleophilic aromatic substitution of 2,4-difluoronitrobenzene was analyzed as a case study of pharmaceutical relevance. Here, a small-scale tubular coil reactor with controlled heating was identified as the optimal set-up reducing the residence time by 33 % in comparison to literature values.

Keywords: Active pharmaceutical ingredients, Continuous pharmaceutical

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