Integrated design and control of a catalytic packed-bed tubular reactor

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A model-based strategy is suggested for integrated design and control of a catalytic packed-bed tubular reactor. Due to the complicated relationships among various factors, such as reactor size, manipulated and controlled variables (MVs and CVs) and disturbances including catalytic deactivation, the integrated design and control problems may not be solved by simple optimization techniques. However, the strategy uses a mathematical reactor model so that dynamic characteristics and size effects of a reactor are reflected through model identification. In this work, it starts from a mathematical model of the 4-meter tubular reactor. After defining MVs, CVs and disturbances, the reactor model is identified and corresponding control objectives of MVs are selected to maintain the reactor performance at or above a desired level. If the controller fails to achieve the objective because of decreased catalytic activity, the reactor size is increased by one meter. Subsequently, the controller is also tuned for the updated model. Consequently, the minimum length of the tubular reactor with a successful control can be defined by this iterative process during a reasonable time.