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Optimal process for catalytic cracking of higher olefins on ZSM-5

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Abstract

Microkinetic models allow extrapolation out of the experimentally covered reaction conditions, which makes them suitable for reactor design. However, efficiency of a proposed reactor setup is hard to assess without considering the whole process including cost for utilities. Therefore, an optimal process design for catalytic cracking of higher olefins on ZSM-5 is developed within this work. The advantages of complex single-event kinetics available in MATLAB and a profound process simulation software (Aspen HYSYS) are combined via an interface written by the authors which is then used for optimization. The process based on a recycle reactor concept is shown to be a suitable solution to selectively convert 1-pentene to the lower olefins ethene and propene. Two of the key optimization variables are reaction temperature and pressure; these are varied within a range of 360 – 460 °C and 2.1 – 18 bar, respectively. Side product formation is explicitly included to represent realistic operating conditions. The objective function aims at maximizing profits from selling ethene and propene at polymer grade. Four different price scenarios for propene are optimized, accounting for the proposed propene supply gap. One main set of optimal process conditions is identified to maximize profits; this optimum is obtained for propene being at least 25% more expensive than ethene. With this fixed process design, the other price scenarios remain

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