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Abstract

A rigorous kinetic model has been established for the co-reaction of methanol and C_3-C_6 olefins over a HZSM-5 catalyst with a high Si/Al ratio of 200, a practical reaction occurring in a methanol to propylene process. This model is based on a methylation-cracking pathway taking into account methanol methylation with the lighter olefins to the higher ones and the higher olefins cracking back into the lighter ones. On the basis of our previous work (Huang et al., 2015) regarding olefin cracking reaction, this work gives special emphasis on olefin methylation. The experimental results reveal that the elementary methylation reactions obey the Rideal-Eley (R-E) mechanism, and propylene undergoes both double and triple methylation and butene double methylation other than the mono methylation. With the integration of our previous work for the olefin cracking kinetic model, the overall kinetic model fits the experimental data excellently under the investigated feed composition and reaction temperature conditions. Parameter studies show that increasing reactant partial pressure increases methylation rate linearly with the effect limited under the higher pressure, and methanol dehydration to DME is away from equilibrium.

Keyword: methanol to propylene; HZSM-5; kinetic modelling; methylation