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Transalkylation of Toluene with 1, 2, 4-Trimethylbenzene over Zeolites: Effect of Structure, Bi-functional Metal Loading, Hydrogen Pressure and Feed Composition

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The use of aromatics to produce petrochemicals is incentivized by the recent reduction of total aromatics in motor fuels. Benzene, toluene, and xylene (BTX) are the three main raw materials used to produce aromatic derivatives. Xylene isomers (o-, m-, and p-), with their continuous growing global demand over benzene[1], are the starting components for the production of different important polymers such as synthetic fibres.

Transalkylation of toluene with heavy aromatics (C9) aims to produce xylenes (Figure 1). The commercial transalkylation processes include Xylene-Plus (ARCO-IFP) [2], TatorayTM (UOP) [3], and TransPlus (Mobil-CPC) [4]. The catalyst lifetime is a major concern in the transalkylation process resulting in a catalyst deactivation

The influence of different zeolite structures on activity, selectivity and deactivation behaviour during the transalkylation of toluene with 1,2,4-trimethylbenzene was studied in a fixed bed reactor at 400 °C, 1 bar and WHSV of 5 h^{-1}. Zeolite beta showed the highest activity (~45 wt. % of conversion) and selectivity (~30 wt. % xylenes yield) at 6 hours-on-stream and the deactivation behaviour of zeolite beta at temperatures typically between 400 - 500 °C and up to 100 hours-on-stream was also studied. The addition of low loadings of platinum (200 and 400 ppm) resulted in total conversion increasing by approximately 8 and 34 wt. % respectively. Increased pressure (10 bar H_2) over Pt-Beta (400 ppm) showed high stability over 100 hours-on-stream with an overall conversion of ~50 wt. % and xylenes yield of ~30 wt. % in line with current industrial catalysts. Finally, the effect of feed composition was tested using zeolite beta and the conversion of 1,2,4-TMB was significantly higher by 34 wt. % at 100 hours-on-stream when using the 1,2,4-TMB/Toluene mixture (50:50 wt. %) than using pure 1,2,4-TMB as feed.

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