Effect of Preparation of Pt-Sn Catalyst on Mixed-paraffin Dehydrogenation

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Abstract

Polypropylene and polybutadiene are high demand materials produced from propylene, 1, 3-butadiene. Currently, propylene and butadiene are produced either by dehydrogenation or by steam cracking of individual paraffins (propane and butane). But, paraffins are available as mixture from fluidized catalytic cracking and require separation before dehydrogenation. The products of dehydrogenation need to be separated again, due to their wide range. Feed separation, dehydrogenation and product separation result in high capital and operational cost. Hence, mixed-paraffin dehydrogenation is proposed. Platinum was reported to be a promising catalyst for paraffin (individual) dehydrogenation and suffers from coking. Promoters like tin were added to suppress coking. Further, the type of Pt-Sn alloy has a significant role on the extent of dehydrogenation, which is attributed to catalyst synthesis methodology, especially during reduction process. There are no studies in the literature on mixed-paraffin dehydrogenation. In this study, mixed-paraffin dehydrogenation was carried out using a Pt-Sn supported on Al_2O_3 catalyst. The catalyst was synthesized using impregnation method from platinum and tin precursors and was reduced by two different methods a) Liquid phase $NaBH_4$ and b) Hydrogen. The catalyst samples were characterized using SEM-EDX, XRD and XPS to confirm the formation of Pt-Sn alloy. The dehydrogenation was carried out in a packed bed reactor at 700 °C and 10 psi. The products were analysed using GC-FID detector. A conversion of 85 % and 38 % for propane and n-butane respectively with 225 % olefin selectivity was observed for catalyst reduced with $NaBH_4$. In comparison, the conversion for propane and butane for hydrogen reduced catalyst was observed to be 37 % and 62 % respectively with 407 % olefin selectivity. It was also observed that, the product profiles during mixed-paraffin dehydrogenation were different from individual paraffin dehydrogenation.