World Academy of Science, Engineering and Technology
International Journal of Chemical and Materials Engineering
Vol:18, No:06, 2024

A Rational Strategy to Maximize the Value-Added Products by Selectively Converting Components of Inferior Heavy Oil

Authors : Kashan Bashir, Salah Naji Ahmed Sufyan, Mirza Umar Baig

Abstract : In this study, n-dodecane, tetralin, decalin, and tetramethybenzene (TMBE) were used as model compounds of alkanes, naphthenic-aromatic, cycloalkanes and alkyl-benzenes presented in hydro-diesel. The catalytic cracking properties of four model compounds over Y zeolite catalyst (Y-Cat.) and ZSM-5 zeolite catalysts (ZSM-5-Cat.) were probed. The experiment results revealed that high conversion of macromolecular paraffin and naphthenic aromatics were achieved over Y-Cat, whereas its low cracking activity of intermediate products micromolecules paraffin and olefin and high activity of hydride transfer reaction goes against the production of value-added products (light olefin and gasoline). In contrast, despite the fact that the hydride transfer reaction was greatly inhabited over ZSM-5-Cat, the low conversion of macromolecules was observed attributed to diffusion limitations. Interestingly, the mixed catalyst compensates for the shortcomings of the two catalysts, and a “relay reaction” between Y-Cat and ZSM-5-Cat was proposed. Specifically, the added Y-Cat acts as a “pre-cracking booster site” and promotes macromolecules conversion. The addition of ZSM-5-Cat not only significantly suppresses the hydride transfer reaction but also contributes to the cracking of immediate products paraffin and olefin into ethylene and propylene, resulting in a high yield of alkyl-benzene (gasoline), ethylene, and propylene with a low yield of naphthalene (LCO) and coke. The catalytic cracking evaluation experiments of mixed hydro-LCO were also performed to further clarify the “relay reaction” above, showing the highest yield of LPG and gasoline over mixed catalyst. The results indicate that the Y-cat and ZSM-5-cat have a synergistic effect on the conversion of hydro-diesel and corresponding value-added product yield and selective coke yield.

Keywords : synergistic effect, hydro-diesel cracking, FCC, zeolite catalyst, ethylene and propylene
Conference Title : ICCEA 2024 : International Conference on Chemical Engineering and Applications
Conference Location : Toronto, Canada
Conference Dates : June 13-14, 2024