Chapter 5

CONCLUSIONS

The performance of fluid catalytic cracking catalysts was carried out using micro-activity testing (MAT) unit at standard conditions (460^{o}C, cat/oil ratio 3.2, WHSV16 hr^{-1}). Pure feedstock n-octane and n-hexadecane were used to simplify cracking parameter. The role of additive ZSM-5 zeolite on cracking products was the main objective of our study. However, the 2 based zeolite catalysts between REY and USY were also investigated for their catalytic cracking of n-octane.

Catalysts used in our experiments were prepared in our laboratory following the previous procedures of the Department of Chemical Engineering, Prince of Songkla University which were transferred from the Research Institute of Petroleum Processing (RIPP), Beijing, P.R. China.

The catalytic performance of REY was better than USY in % conversion and research octane number. Although the olefins composition was lower, the aromatics composition was higher. USY is less active than REY because of its fewer acid sites due to the lower Al content from the dealumination process. The additive ZSM-5 zeolite was used of enhance the octane catalyst in gas oil catalytic cracking. Its lower activity and lower hydrogen transfer reaction are needed to lower the overcracking reaction and lower paraffins production from hydrogen transfer of olefins. These major advantages of REY zeolite catalyst led us to explore the effects of additive ZSM-5 on it. The 2 based REY catalyst, namely, 25% and 35% REY, were used to study the catalytic effects of various ZSM-5 content of 4, 8 and 12% using n-Octane as the feedstock. The 25% REY catalyst gave the highest research octane number while the 35% REY gave the lowest.

For both mixed catalysts, the higher ZSM-5 zeolite content gave higher % conversion, higher % liquid yield, lower % gas & coke yield and higher research octane number. These results were the same as the prediction from the theory. The ZSM-5 zeolite has a relatively small pore size of 5.1-5.6 angstrom compare to 7.9 angstrom of REY, and it is a shape selectivity catalyst. So, only monomolecular reaction can take place and the interaction between the reactants and the catalyst is higher. Hydrogen transfer is a secondary reaction after primary cracking reaction and is a bimolecular reaction in which one reactant is an olefin. The presence of ZSM-5 zeolite inhibits olefins conversion to paraffins through hydrogen transfer pathway. Moreover, ZSM-5 zeolite has higher acidity than REY which facilitates the oligomerization reaction that transforms the small olefins to the larger olefins and finally aromatics. These result in higher olefins and aromatics fractions. Our experiments using mixed catalysts with higher ZSM-5 content gave higher olefins and higher aromatics composition and resulted in the higher research octane number as expected.

The n-hexadecane catalytic cracking gave the same results as obtained from the n-octane cracking. Except the higher percent conversions that were 2 to 4 times greater than n-octane cracking. This is a normal result because larger molecules are easier to crack.