CHAPTER V

CONCLUSION

The MCM-22 zeolite was successfully synthesized by using hexamethyleneimine (HMI) as a structure directing agent. All synthesized products were characterized using XRD, ICP-AES, ^{27}Al-MAS-NMR, N_2 adsorption-desorption, and SEM techniques. The MCM-22 catalysts with various SiO_2/Al_2O_3 ratios were prepared. XRD patterns of these catalysts show the characteristic peaks similar to that of MCM-22 reported by Mihalyi *et al.* [41]. The XRD pattern of H-MCM-22(120) reveals the slight decrease in the crystallinity. H-MCM-22(400) shows extreme decreasing in the crystallinity. Hence, gel composition with SiO_2/Al_2O_3 of 400 may not be suitable for synthesis of H-MCM-22. This study suggests that the workable range of SiO_2/Al_2O_3 ratio for synthesis of H-MCM-22 is between 30 to 250.

The del-MCM-22 sample was prepared by swelling and exfoliating the MCM-22 precursor. Comparing the XRD patterns of del-MCM-22 with calcined MCM-22 of similar SiO_2/Al_2O_3 ratio, it can be seen that the diffraction line of del-MCM-22 decreases in intensity and shows broader peaks, which are indicative of a reduction in the size of the crystal. The del-MCM-22 provides the high external surface area.

SEM images of calcined MCM-22 catalysts exhibit aggregates of platelets while del-MCM-22 catalysts show exfoliate shape. ^{27}Al-MAS-NMR spectra show that the most of the aluminum atoms remain in tetrahedral oxygen coordination at framework positions. Adsorption-desorption isotherms of nitrogen on H-MCM-22 and del-H-MCM-22 samples exhibit a pattern of type I which shows a typical shape for microporous. The del-MCM-22 sample provides higher external surface area than H-MCM-22 sample. The NH_3-TPD profiles indicate the number of acidity. The number of acid sites decreases when with decreasing aluminum content.

The catalytic cracking of PP waste is chosen to test catalytic activity of MCM-22 and del-MCM-22 catalysts. The results show the catalytic cracking of the polymer process depended on physical characteristics of the catalysts. % Conversion

and % yield by catalytic cracking are higher than thermal cracking. The H-form catalysts (H-MCM-22) provide more liquid fraction yield and produce less residue than Na-form catalysts (Na-MCM-22) except in case of MCM-22 at SiO_2/Al_2O_3 ratio 30. The value of % conversion increases when reaction temperature increases. The initial rate of liquid fraction formation at 400°C is much faster and higher total volume of liquid fraction than that 380°C and 350°C.

The major component of gas fractions are propene and n-butane from PP waste cracking over HMCM-22 catalysts. The distillated oil components are mainly in the range of C_7 to C_9. The catalytic cracking of PP waste over del-H-MCM-22 catalysts provide n-butane and C_5^+ as main gas product and promote liquid product mainly in the range of C_6 to C_8 due to high external surface area. The carbon number distribution over H-MCM-22 and del-MCM-22 are similar to that for commercial gasoline fraction hydrocarbon based on the boiling point range using n-paraffins as reference.

The regenerated type I and type II of MCM-22(120) catalysts are tested for catalytic cracking of PP at 380°C. They are found that the structures of regenerated catalysts are stable. XRD patterns of the MWW structures are still remained for the regenerated MCM-22(120) catalysts with almost the same crystallinity as the unused catalyst. The regenerated catalysts provide lower yield of gas fraction and higher yield of residue comparing to the fresh catalyst due to lower surface area than the fresh one. The initial rate of liquid fraction formation for regenerated type II is faster than regenerated type I. However, distribution of gas fraction and liquid fraction are not significantly different when using the fresh or the regenerated catalyst.

The suggestions for future work

1. To investigate the hydrocarbon component of liquid fraction such as aromatics, alkanes and alkenes
2. To investigate the efficiency of mixed catalyst, combination of MCM-22 and Al-SBA-15, for catalytic cracking of polyolefins waste