

CHAPTER V

CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

In this study, it was demonstrated that the synthesized HZSM-5 catalysts with SiO₂/Al₂O₃ ratios of 90 and 185 could be preliminarily employed for the vapor phase alkylation of toluene with methanol to *p*-xylene. Based on several parameters including hydrothermal condition for synthesizing HZSM-5 catalysts, weight hourly space velocity (WHSV), toluene-to-methanol (T/M) ratio, SiO₂/Al₂O₃ ratio, and reaction temperature significant findings obtained from this study can be concluded in the following. At a given SiO₂/Al₂O₃ ratio, the synthesized HZSM-5 catalysts via hydrothermal synthesis at higher temperature and crystallization time gave a higher *p*-xylene selectivity. The synthesized HZSM-5 catalyst with lower acidity (a higher SiO₂/Al₂O₃ ratio) yielded a lower toluene conversion but yielded a higher *p*-xylene selectivity. The self-aromatization of methanol was estimated to be higher for the synthesized catalyst with higher SiO₂/Al₂O₃ ratio. Increasing WHSV (reducing the contact time) resulted in increasing the toluene conversion and the selectivity to *p*-xylene. Additionally, a change in T/M ratio exhibited similar results to that of WHSV. In summary, for methylation of toluene with methanol using the synthesized HZSM-5 catalyst from hydrothermal conditions at 180 °C for 72 h with a SiO₂/Al₂O₃ ratio of 185, the optimal parameters were observed to be a WHSV of 24 h⁻¹, a T/M ratio of 4:1 at temperature of 400 °C resulting in the selectivity to *p*-xylene of up to 80%.

5.2 Recommendations

In order to improve the catalytic activity of the synthesized HZSM-5 catalysts for this reaction, the variations of calcination temperature and heating rate on catalyst preparation should be further considered. The metal incorporation into HZSM-5 catalysts should be considered as one of the methods to tailor the acidity.