

CHAPTER V

CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

The ethylation of benzene with ethanol over various synthesized HZSM-5 catalysts was demonstrated as the catalysts which have $\text{SiO}_2/\text{Al}_2\text{O}_3$ ratios of ca. 169 provide high selectivity to EB and benzene conversion. The HZSM-5 catalysts synthesized by various an initial $\text{SiO}_2/\text{Al}_2\text{O}_3$ ratios and a crystallation time provide different features of catalyst especially morphology, textural properties, acidity, and $\text{SiO}_2/\text{Al}_2\text{O}_3$. As the small crystal size, low M/T ratio, and proper acidity will provide positive catalytic activity on EB selectivity.

In addition, the reaction temperature 400 and 500 °C provided the highest benzene conversion and EB selectivity, respectively. Moreover, with increasing the B/E feed molar ratio from 2 to 6 resulted in decreasing the benzene conversion, whereas, it increased the selectivity to EB (except B/E molar ratio = 6) and the coke formation, similarly to WHSV, the increment of WHSV from 15 to 20 h^{-1} seem to provided low benzene conversion and high EB selectivity. In conclusion, it is suggested that for ethylation of benzene with ethanol when high EB selectivity is the preference, so using the synthesized HZSM-5 catalyst obtained from synthesized temperature 140°C for 72 h with an initial $\text{SiO}_2/\text{Al}_2\text{O}_3$ ratio of ca. 195, the optimal parameters be a temperature of 500 °C, a B/E feed ratio of 4:1, and WHSV of 20 h^{-1} .

5.2 Recommendations

From the goal of this research is to gain more or less complete EB selectivity. However, this research had overcome the target only 93.41% EB selectivity. In the author's notion, it is the challenge to overcome 5% remaining and pass up to 100%. However, all problems always have solutions, but the author observed that the solution of play in initial $\text{SiO}_2/\text{Al}_2\text{O}_3$ ratios and time of synthesis is no longer a key of problem solving to success in the purpose of 100% of EB

selectivity. Moreover, it is impossible to avoid many secondary reactions. The effect of modified catalyst by boron and magnesium compound and others should be further studied. In addition, the other parameters of reaction condition such as pressure should be considered.