

CHAPTER V

CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

The ethylation of toluene with ethanol to produce *p*-ET was investigated over the commercial HZSM-5 catalysts with various SiO₂/Al₂O₃ molar ratios at different reaction conditions. At a given reaction condition, the HZSM-5 with SiO₂/Al₂O₃ molar ratio of 280 showed the highest *p*-ET selectivity of ca. 71 %. The optimal reaction conditions for such a catalyst in terms of *p*-ET selectivity were obtained at 350°C, WHSV of 20 h⁻¹, toluene-to-ethanol molar ratio of 3:1.

It is interesting to note that at high temperature (500 °C) its toluene conversion was declined due to the fact that the rates of decomposition of the reactants and/or of the products prevailed the rate of coke formation.

The suitable HZSM-5 with SiO₂/Al₂O₃ molar ratio of 280 was modified by CLD treatment to eliminate the undesired reactions taking place at the external surface. The results showed that the CLD treatment could improve the *p*-ET selectivity up to ca. 85% with the optimum amount of TEOS of 1 ml/g cat. Moreover, the multiple CLD treatment could further improve the *p*-ET selectivity to ca. 89%, and yet the loss of toluene conversion was to be compensated due to the deactivation of external acid sites as well as the narrowed and/or blocked pore opening of the catalyst.

5.2 Recommendations

To achieve a higher *p*-ET selectivity after deactivation of external acid sites by CLD treatment, an impregnation of basic metal oxide to eliminate the strong acid sites should be considered.