

CHAPTER V

CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

In this work, we have investigated the influences of the two consecutive layers of Ga₂O₃-modified HZSM-5 (the first layer) and one of H-X, H-Y, and H-Beta zeolite (the second layer) and the HZSM-5 catalysts modified with P₂O₅, Sb₂O₅, and Bi₂O₅ on the catalytic dehydration of bio-ethanol to liquid hydrocarbons.

For the first part, the highest acid density of H-X and the highest acid strength of H-Beta promoted the conversion of BTX, initially formed from bio-ethanol dehydration, to heavy aromatics (C₉ and especially C₁₀+ aromatics) because of their large-pore size and high acid properties that can promote disproportionation and transalkylation reactions of toluene and xylenes. Hence, it resulted in the transformation of BTX to C₉ and C₁₀+ aromatics. This is consistent with the decline of gasoline and the increase of kerosene formation.

For the second part, the moderate acid strength of P₂O₅/HZSM-5 favored the formation of p-xylene, and gave the highest ratio of p-xylene/xylenes. On the other hand, the high acid strength of Bi₂O₅/HZSM-5 gave the most selective to C₁₀+ aromatics because Bi₂O₅/HZSM-5 has acid strength that is high enough to further protonate BTX and C₉ aromatics to C₁₀+ aromatics, which was also confirmed by the decrease of gasoline and the increase of kerosene formation.

5.2 Recommendations

According to the results, the system of the two consecutive layers of Ga₂O₃-modified HZSM-5 (the first layer) and one of H-X, H-Y, and H-Beta zeolite (the second layer) gave high yield of aromatic hydrocarbons. However, the obtained aromatics highly produced C₉ and C₁₀+ aromatics, but did not significantly enhance xylenes because of their high acid properties. Therefore, in order to enhance xylenes, the second layer catalyst shall be changed to other catalysts that have less acid properties than that of these catalysts. For the modified HZSM-5 with P₂O₅, Sb₂O₅, and Bi₂O₅, the HZSM-5 catalyst shall be modified with other oxides, or these oxides shall be modified on other supports in order to maximize the xylenes yield.