CHAPTER IX
CONCLUSIONS

Two different groups of metal catalysts; that are, Fischer-Tropsch and Polymerization-type catalysts were examined in the catalytic dehydration of bio-ethanol, aiming to investigate the possibility of ethylene oligomerization and ethylene chain growth. Form our study, it was revealed that all of them had possibility to promote ethylene oligomerization, but they had different ability. As a result, polymerization-type catalysts exhibited higher ability to produce hydrocarbons than Fischer-Tropsch type catalysts. However, both of them also promoted different reaction pathways of ethylene chain growth. The possible pathways of ethylene chain growth can be divided into three important pathways with using two groups of metal catalysts. Fischer-Tropsch type catalysts that are cobalt and iron of both metallic and metal oxide forms; promoted similar pathways of ethylene chain growth; that is, ethylene in the gaseous product might directly convert through aromatization, resulting in benzene formation as a primary hydrocarbon in oil. Furthermore, the obtained hydrocarbons from these metals were totally aromatics. Additionally, polymerization-type catalysts can promote two different pathways along with two groups of metal catalysts. First group consisted of nickel, copper, and palladium of both metallic and metal oxide forms, which promoted ethylene chain growth through ethylene conversion to non-aromatics via cyclization, leading to 1,3-cyclohexadiene formation that then undergoes dehydrogenation to benzene. Moreover, Cr-modified catalysts promoted ethylene chain growth through ethylene oligomerization and cyclization, leading to 1,5-Hexadiene and 1,3-Cyclohexadiene formation as non-aromatics, and then 1,3-cyclohexadiene undergo dehydrogenation, resulting benzene formation. Moreover, benzene can undergo further reactions to form large aromatic hydrocarbons

Additionally, with different oxidation states, it was found that metallic-modified catalysts exhibited higher ability to promote ethylene oligomerization than metal oxide-modified, except for chromium catalysts. In Fischer-Tropsch type catalysts, the hydrocarbon production can be ranked in the order of Fe/Al_2O_3 >

$Co/Al_2O_3 > Fe_2O_3/Al_2O_3 = Co_3O_4/Al_2O_3$. Moreover, the hydrocarbon production in polymerization-type catalysts can be ranked in the order of $Pd/Al_2O_3 > PdO/Al_2O_3 > CrO_3/Al_2O_3 > Cr/Al_2O_3 > Ni/Al_2O_3 > Cu/Al_2O_3 > NiO/Al_2O_3 > Cu_2O/Al_2O_3$.

Furthermore, when noble (1wt% Pd/Al_2O_3) and non-noble metal-modified catalysts (5wt% Ni/Al_2O_3 and 5wt% Cu_2O/Al_2O_3) were compared, it was found that noble metal-promoted catalyst exhibited higher ability to produce hydrocarbons than non-noble metal-modified catalysts. Moreover, metal-modified catalysts exhibited higher ability than metal oxide-modified catalysts as well.

Recommendations

In order to produce hydrocarbons in the catalytic dehydration of bio-ethanol, metallic catalysts or metal oxide catalysts that can be easily reduced during the reaction, such as palladium, should be used. Moreover, alumina is not a suitable support for producing hydrocarbons because it generates a lot of oxygenate compounds.