CHAPTER V
CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

The catalytic dehydration reaction of bio-ethanol to light olefins was carried out over the modification of SAPO-34 and HZSM-5 catalysts in the isothermal fixed bed reactor at 400 °C under atmospheric pressure. The liquid hourly space velocity (LHSV) was fixed at 0.5 h^{-1} and the reaction time was held for 420 minutes. Effect of oxides mixed with SAPO-34 catalysts was investigated in this work. Nine catalysts were studied in the first part; that are, pure SAPO-34, GeO_2, Ga_2O_3, SnO_2, and Sb_2O_3 mixed with SAPO-34 catalyst with various percentages: 3%, and 5%. Furthermore, the catalytic performance of HZSM-5 treated with KOH solutions: 0.1 M, 0.5 M, and 0.9 M were studied in this research as well.

For the effect of oxides mixed with SAPO-34 catalyst can be summarized in Figure 5.1. The bio-ethanol can be converted to form many hydrocarbon products. As can be seen, the highest gas composition of ethylene was up to 98.73 wt% over SAPO-34 catalyst. The 3SbSA34 catalyst produced the highest concentration of ethane (8.57 wt%), and 5GaSA34 yielded the highest butane in the gaseous product (5.87 wt%). In addition, 5SnSA34 was found to give the high production of propylene (15.26 wt%), propane (15.0 wt%), and cooking gas (propane and butane; 21.83 wt%). Moreover, the TBP curves of oils obtained from the modified SAPO-34 catalysts were cut into the petroleum fractions. The derived oils from all catalysts highly consisted of gasoline, which is higher than 74.0 wt %. It was found that the 3GaSA34 gave the highest gasoline (98.2 wt%). However, kerosene, gas oil, LVGO and HVGO were slightly produced from using the 5GeSA34 catalyst.

The catalytic performance of HZSM-5 treated with various KOH solutions may be summarized as shown in Figure 5.2 as well. As a result, the highest concentration of ethylene (94.27 wt%) was observed at the treatment with 0.9 M of KOH solution. In addition, the highest concentration of propylene (3.49 wt%) and butylene (0.83 wt%) in the gas products was observed at the treatment with 0.1 M of KOH. A 0.5 M of KOH treatment was appropriate for the transformation of ethylene

to cooking gases (propane and butane; 9.45 wt%). Furthermore, the TBP curves of oils obtained from treated and untreated zeolite catalysts were cut into the petroleum fractions. As a result, the derived oils from all catalysts are mainly gasoline. In addition, 0.1 M of KOH treated HZSM-5 catalyst gave the highest kerosene. Moreover, the obtained oils from all catalysts were highly composed of m-xylene and p-xylene as compared with untreated zeolite catalyst. In summary, it can be concluded that the loading amount of 5% Sn in SnO_2 to SAPO-34 catalyst gave the highest concentration of propylene. Moreover, the highest concentration of propylene (3.49 wt%) in the gas products was observed at the treatment with 0.1 M of KOH solution. Thus, the doping the oxides to SAPO-34 catalyst and the alkaline treatment of HZSM-5 catalyst by using KOH solutions can enhance the propylene production from bio-ethanol dehydration.

5.2 Recommendations

For the future work, the SAPO-34 catalyst shall be modified with bimetallic promoters, and the effect of treatment time with 0.1 M of KOH solution shall be investigated in order to enhance the production of propylene.

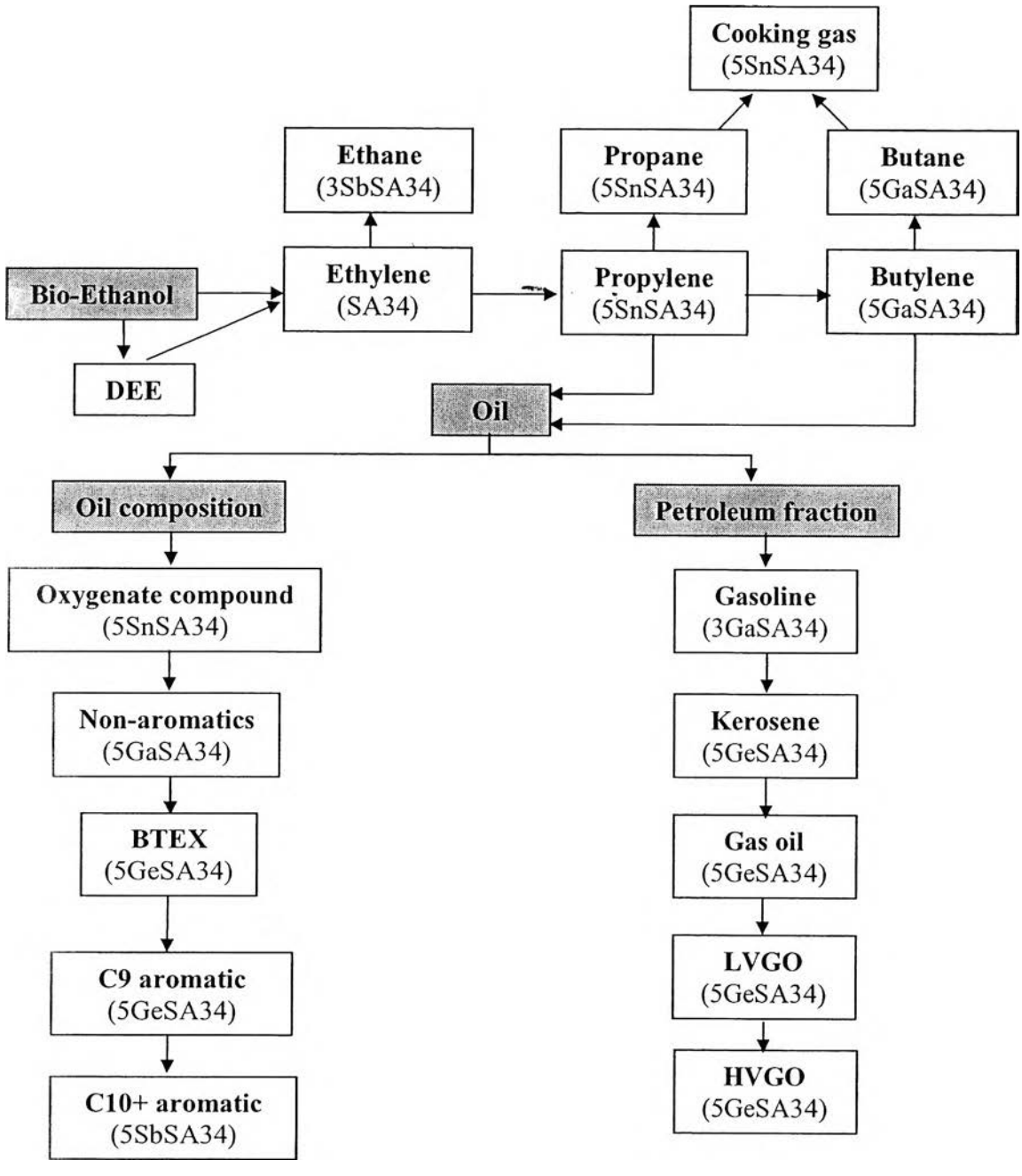

Figure 5.1 Selectivity of the SAPO-34 catalysts doped with various types of oxide.

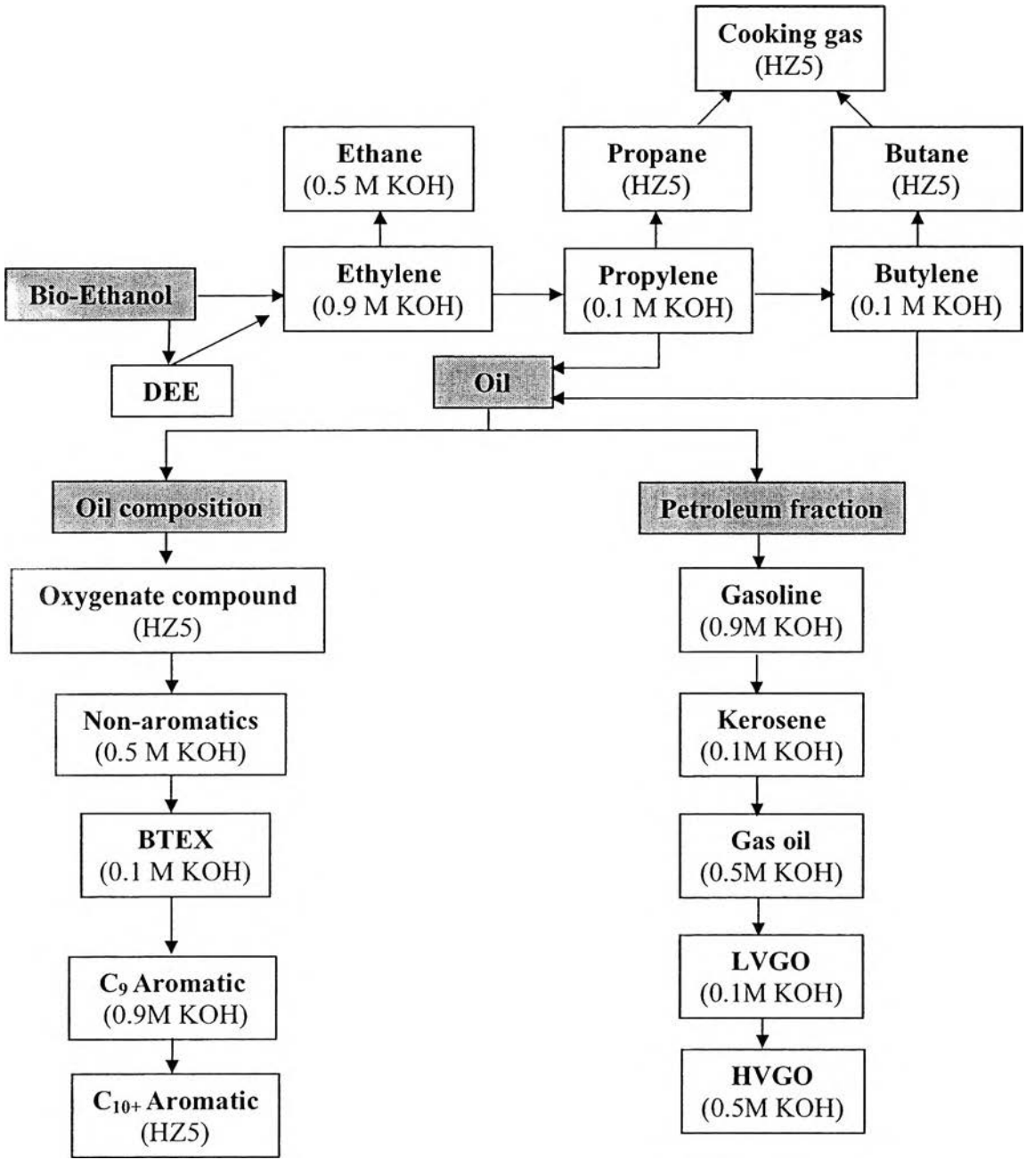

Figure 5.2 Selectivity of the HZSM-5 treated with various KOH concentrations.