

CHAPTER V

CONCLUSIONS

The pyrolysis of polyethylene using commercial and synthesized superacid catalyst ($\text{SO}_4^{2-}/\text{ZrO}_2$) and superbasic catalyst ($\text{KNO}_3/\text{ZrO}_2$) was studied in a semi-batch reactor. The reaction was performed from room temperature to 500 °C with the heating rate of 10 °C/min and held at 500 °C for 1 hour under nitrogen atmosphere.

The catalytic degradation of polyethylene using $\text{SO}_4^{2-}/$ commercial ZrO_2 as a catalyst was studied and investigated for the product yield, gas composition, liquid composition and oil fractions in liquid product by varying the percentage of sulfate from 0% to 8% with the catalyst to polymer ratio of 1:6 to 2:6. It was clearly found that the higher percentage of sulfate, the higher lighter fractions in gas ($\text{C}_1\text{-C}_4$) and liquid product were obtained. For the oil fractions no significant change was observed with the increasing percentage of sulfate. The major fraction was gas oil that slightly increased with the increasing percentage of sulfate. The $\text{SO}_4^{2-}/$ synthesized ZrO_2 gave the higher catalytic activity than the commercial one. The gas and liquid products consisted of lower lighter hydrocarbons as compared with the $\text{SO}_4^{2-}/$ commercial ZrO_2 when the percentage of sulfate was increased. The higher amount of oil fraction was resulted from drastically decrease in amount of heavy vacuum gas oil and increase in kerosene and gas oil fractions.

In the case of superbase, using $\text{KNO}_3/$ commercial ZrO_2 , more lighter fraction was obtained with increased percentage of KNO_3 . The major fraction of gas product was ethylene while the major fractions were, instead, C_4 and C_6 when $\text{SO}_4^{2-}/$ commercial ZrO_2 was used. In the liquid composition, using the catalyst to polymer ratio of 1:6, the higher percentage of KNO_3 , the larger amount of light fractions was obtained. For the catalyst to polymer ratio of 2:6, the higher percentage of KNO_3 , the larger amount of heavy fraction in oil was observed.

Pyrolyzed products from using $\text{KNO}_3/$ synthesized ZrO_2 were different from those obtained from superacid due to the nature of superbasic catalyst that can catalyzed polymerization and oligomerization reactions. Polymerization can take place when short chain hydrocarbons occurred from long chain cracking recombine, resulting in heavy portion in pyrolysis products.

From the results above, the synthesized catalysts gave the higher catalytic activity possibly due to the tetragonal crystal structure of synthesized zirconia that played important role in increasing surface area, superacid and superbasic strength, and finally in pyrolysis activity.