# CHAPTER V
# CONCLUSIONS AND RECOMMENDATIONS

## 5.1 Conclusions

In this research, the used lubricating oil was used to convert to light oil product by hydrocracking catalysts. To achieve this objective, the reaction conditions were varied in terms of reaction temperture, hydrogen pressure, reaction time and percentage of catalyst. The following conclusions from this study have been drawn:

### 5.1.1 Ni-Mo/$Al_2O_3$ catalyst.

This work aims to study the hydrocracking of used lubricating oil by using Ni-Mo on alumina in microreactor, the temperature was varied from 400-470 $^0$C, 0-200 psi of initial hydrogen pressure,30-120 minutes of reaction time and 0-5% w/w of Ni-Mo/$Al_2O_3$ catalyst. Analysis of products was performed using DGC. It may be concluded that the optimum conditions: reaction temperature 450 $^0$C, initial hydrogen pressure 100 psi, reaction time 90 minutes and 1.0% w/w of catalyst, with percentage yield of oil was 85.64%.

The distribution composition of oil product from the optimum conditions were 36.15% of naphtha, 11.49% of kerosene, 11.21% of light oil, 8.77% of heavy gas oil, 18.02% of long residue, 13.15% of gas products and 1.21% of solid.

### 5.1.2 HZSM-5 catalyst

This work aims to study the hydrocracking of used lubricating oil by using HZSM-5 catalyst in microreactor, the temperature was varied from 400-470 $^0$C, 0-200 psi of initial hydrogen pressure, 30-90 minutes of reaction time and 0-0.6% by weight of HZSM-5 catalyst. Analysis of products was performed using DGC. It may be concluded that the

optimum conditions: reaction temperature 450 $^{0}$C, initial hydrogen pressure 100 psi, reaction time 60 minutes and 0.5% w/w of catalyst, with percentage yield of oil was 85.46%.

The distribution composition of oil product from the optimum conditions were 34.87% of naphtha, 11.03% of kerosene, 11.49% of light oil, 8.73% of heavy gas oil, 19.34% of long residue, 12.33% of gas products and 2.21% of solid.

5.1.3 Comparison efficiency of catalyst in hydrocracking process for changed to products

To comparison efficiency of catalyst Ni-Mo/$Al_2O_3$ and HZSM-5 using to convert used lubricating oil to light oil by hydrocracking process was found that HZSM-5 shows better efficiency catalyst than Ni-Mo/$Al_2O_3$. Because it was used less reaction time and percentage of catalyst, while it gave nearly the same yield of light oil and % recovered of naphtha.

5.2 Recommendations

1. The type of used lubricating oil that used in this research can be changed to another type such as Jet lube oil, train lube oil, to compare percentage of light oil product that achieved from reaction.

2. The effect of catalyst on reaction condition and pore size of catalyst can be studied because they have more important effect on catalyst activity, on product distribution composition.

3. The type of catalyst that used in this resarch can be changed to another type such as other zeolites or changed ratio of Si/Al, to compare percentage of light oil product that achieved from reaction.