CHAPTER V

CONCLUSIONS

SBA-15 was synthesized by conventional hydrothermal method, exhibited only one phase of pure hexagonal mesoporous structure. Al-SBA-15 was synthesized by post synthesis method also Ni, Pt, Pd and Ru metal supported SBA-15 materials were prepared by wetness impregnation.

The XRD patterns of all samples indicated the hexagonal structure of SBA-15. N_2 adsorption-desorption isotherms exhibited a type IV pattern which showed typical shape of mesoporous structure. All calcined samples were aggregated particles with rope-liked structure from SEM images. The TEM image of Al-SBA-15 showed the well-ordered hexagonal array of one-dimensional mesoporous channels of SBA-15 which all Al atoms were into porous material framework which this result corresponded to NMR technique. In case of metal supported SBA-15 samples were presented in the form of metallic particles about 10-20 nm in size which metals could not enter exclusively into SBA-15 tubes.

The catalytic cracking of pure glycerol over various types of SBA-15 catalysts showed no significant difference in liquid fraction. The gas fraction yields were in the range of 4-14% while that of liquid fractions were about 79-84%. The distribution of product yield depends on type of metal on SBA-15. The Pd-SBA-15 catalyst exhibited the highest conversion about 93%, which composed of 14% yield of gas, 79% yield of liquid and small amount of residue. Among gaseous products, formation of CO, CO_2, and propene were favored meanwhile distillated liquid profiles showed 2-propen-1-ol and 1-hydroxy-2-propanone as two main products.

Al-SBA-15 catalyst was used to study the effect of the reaction temperature on its activity in glycerol waste cracking. The catalytic cracking showed higher %conversion than thermal cracking about 3-5%. The conversion increased when reaction temperature was raised. Types of product yield depend on starting material, which changed from pure glycerol to glycerol waste from biodiesel production. The major gas products were CO, CO_2, C5+, 1,3-butadiene and methane. The distillated liquid products were mainly 2-cyclopenten-1-one and 2-propen-1-ol.

The catalytic cracking of glycerol waste over metal-supported SBA-15 catalysts provided higher conversion with increasing the reaction temperature. At highest reaction temperature of this study (800°C), it was a good condition as highest conversion and lowest residue were obtained similar to reaction temperature at 650°C but at 800°C consumed larger amount of energy. Then, reaction temperature at 650°C was chosen. When compared with the reaction at 650°C, Pd-SBA-15 showed higher CO selectivity in gas fraction than other catalysts. The optimum catalyst amount to glycerol waste should be 10 wt% of Pd-SBA-15 based on starting material. Furthermore, Pd(NPs)-SBA-15, which some Pd particles were in SBA-15 tubes, could not increase gas product comparing to using Pd-SBA-15, which Pd metal existed on the external surface. When phase contact between starting material and catalyst was changed from liquid to vapor, reaction showed gas fraction less than liquid phase reaction but catalyst could be recycled for the next batch. The used catalyst could be regenerated easily by simple calcination. After calcination, the first and second regenerated Pd-SBA-15 catalysts still exhibited hexagonal structure and amount of Pd loading nearly the same as the fresh one. As a result, the cracking activities of regenerated catalysts performed no significant difference in product distribution when compared to the fresh catalyst.

The suggestions for future work

1. To study the optimum condition of the vapor phase catalytic cracking of glycerol waste using Ru-AlSBA-15 for highest distillated liquid product.
2. To investigate the efficiency of mixed catalyst, combination of Al-SBA-15 and Ru-SBA-15, for catalytic cracking of glycerol waste for highest distillated liquid product.