STUDY THE DEGRADATION REACTION OF GLYCEROL IN WATER (SUPERCRITICAL/ SUPERCRITICAL) AND THE USE OF SONOCHEMICAL TECHNOLOGY

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ABSTRACT

The development of biodiesel industry both in Indonesia and other countries have given opportunity for side product such as glycerol. Previous research showed that glycerol can be converted into other chemical product and fuel through various method. Some factors which gives impact to the transformation process process of glycerol among others are the method and the operational condition applied such as temperature, pressure, and the use of catalyst. Some previous researchers had used water glycerol degradation media both in subcritical and supercritical condition. Anyhow this process needs very large energy so that other alternative glycerol degradation technology should be made to reaction with less energy. Technology that can be chosen is by means of ultrasonic waves.

The aimed of this research is to study the glycerol degradation process by means of hydrothermal technology (with water media in subcritical/ supercritical condition) and sonochemical (with ultrasonic waves) as well as to study the kinetic of glycerol degradation reaction. The experiments were carried out using a batch reactor and the degradation of glycerol into other products was performed both with sulphate salt catalysts and without catalyst. Operation variables observed are the batch time, temperature, and mole ratio of catalyst-glycerol. In all process, the reactant was made from glycerol and water with the mass ratio of 1:10. In sonochemical process was used bath ultrasonic and operational variables of glycerol degradation process are sonication time, bulk temperature, and wave frequency. Products were analyzed by Gas Chromatography

The results of the experiment showed that the glycerol degradation reaction can be done by using hydrothermal technology and sonochemical. The glycerol degradation product without catalyst at the liquid phase are acetaldehyde, methanol, and ethanol. Temperature and batch time are variables that have impact on the process. The higher temperature, the higher the glycerol degradation conversion in the limit of critical point of water and after that glycerol conversion will decrease. That is caused by the change reaction direction from ionic to radical, where molar yield acetaldehyde also decrease significantly but the molar yield of methanol and ethanol increase. Reaction rate constants can be approximated by the Arrhenius equation with $k = 161 \exp(-49096/RT)$ for the temperature range 200-350^{o}C.

For temperature in near critical water was developed in complex reaction. Model I can be applied to estimate the reaction mechanism at 350^{o}C and Model II

at 400^{o}C. In Model II can be proved that on above critical point can produce gases beside liquid product. The use of sulphate salt as catalyst has high selectivity to acetaldehyde and still allows the formation alcohol product in small quantities. Conversion of glycerol on catalytic reaction showed a higher yield when compared with the reaction performed without catalyst.

The glycerol degradation reaction using ultrasonic waves produces methanol in tracer. The higher the bulk temperature, sonication time, and frequency will increase glycerol conversion. Conversion of glycerol on sonochemical process reaction showed a higher when compared with hydrothermal process reaction. In the application of ultrasonic with frequency 37 kHz, the glycerol degradation follows the Arrhenius equation k = 1,23 x10^{8} exp (-57059/ RT) and for 42 kHz is k = 33 exp (-15829/ RT).

Keywords : glycerol, degradation, hydrothermal, sonochemical