ALCHOLYSIS OF CORN OIL (Zea Mays (L)) USING NaOH CATALYSIS AT 1 ATM PRESSURE

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ABSTRACT- The increasing use of fuel oil makes the availability of fuel oil depleted, this is a challenge that must be anticipated by looking for other alternative energy sources as a renewable energy source. One of the alternatives that can be used is vegetable oil which can be used as raw material for making biodiesel. Biodiesel is an alternative energy obtained from animal fat or vegetable oil which can be used as fuel. One of them is corn oil. The manufacture of biodiesel from corn oil uses an alcoholysis process, where the triglyceride groups breakdown using alcohol to form esters and glycerol as a by-product.

The process of making biodiesel in this study uses corn oil, ethanol and NaOH as a catalyst. Performed using a three neck flask equipped with, heater, thermometer and magnetic stirrer as a stirrer. Samples were taken every 10 minutes, then the lower layer was analyzed for glycerol content by acetine to determine the conversion rate per part.

In this study the optimum conditions, found in 60 minutes, temperature 110 ° C, catalyst percentage 2.5%, stirring speed 350 ppm, and alcohol-oil ratio 5mg / mg. In that situation the conversion reached 0.7736 parts.

Keywords: alcoholysis, biodiesel, corn oil, NaOH catalys

INTRODUCTION

One of the crucial problems faced by the Indonesian nation today is energy. The increasing use of fuel oil by the community and industry has made the availability of petroleum fuel increasingly depleted. Increasingly higher petroleum imports and the increase in world oil prices will certainly be followed by an increase in fuel prices, which will have an impact on the increase in the price of basic necessities in society. To overcome this, it is necessary to develop renewable alternative energy. One of them is Biodiesel.

Biodiesel is a renewable alternative fuel produced from vegetable oil or animal fat. Vegetable oil derived from plants is very abundant in Indonesia, both in terms of quantity and variety. Such as coconut oil, palm oil, soybean oil, corn oil, rubber seed oil, sunflower oil and corn oil. Biodiesel or methyl ester is obtained from the alcoholysis process of oil or fat, using a transesterification or esterification reaction with an alkaline or acid catalyst and ethanol.

One of the sources of vegetable oil in Indonesia is corn oil. Corn oil is a triglyceride composed of glycerol and fatty acids. The high triglyceride composition makes corn oil suitable as a raw material for making biodiesel. Given this, this study will examine the use of corn oil in the biodiesel manufacturing process.

In this study using corn oil as raw material with an alkaline catalyst (NaOH) with the alcoholysis process. The equipment used is a three-neck flask, back cooler, thermometer, heater (hot plate), stirrer, test tube and sampling.

The catalysts used are generally homogeneous catalysts such as KOH or NaOH. The use of different catalysts will affect the quality of the biodiesel produced. Other factors that affect the methyl ester content and the quality of biodiesel produced from the transesterification reaction apart from the type of catalyst are: the molar ratio between triglycerides and alcohol, stirring time, reaction temperature, water content, and free fatty acid content in the raw materials that inhibit the reaction (Joko Santoso et al, 2016)

By looking at similar research, it turns out that a chemical reaction occurs in fasecair. Therefore, the equation for the speed of the reaction can be written as:

$$r = kC_{AL}C_{BL} \quad (1)$$

If CBL is constant, and then kCBL is expressed by k ', then:

$$r = -\frac{dC_{AL}}{dt} = k'C_{AL} \quad (2)$$

Then, by entering the Xa conversion, and after it has been adjusted and internalized, equation (4) changes to:

$$-\ln(1 - X_a) = k't + b \quad (3)$$

If the relationship between –ln (1 – Xa) of the research results is painted against t, and it turns out that a straight line is obtained, then the value of k 'is the same as the tangent of that line.

MATERIALS AND METHODS

A. Material

Corn Oil is obtained from the online market in Indonesia. After analysis, it turns out that the oil density is 0.918-0.925g / mL.

Ethanol is obtained from the market around Palembang, South Sumatra. and the density is 0.7779 g / cm and the 3-109 list (Ferry and Green, 1984: 3-89) obtained levels of 95.54%.

Solid white crystalline NaOH catalyst is obtained from the Indonesian online market.

B. Equipment

The series of tools used can be seen in Figure 1. The reactor to be used is a three-neck flask equipped with a stirrer, heater, thermometer, and back cooler.

C. Research Methods

Corn seed oil, ethanol, and solid catalyst are put into a three-neck flask, then closed tightly. The heater and stirrer stirrer are turned on. The temperature and stirring speed are kept constant by adjusting the respective powerstats, and the temperature is observed using a thermometer.

After a constant temperature of 110°C is reached, samples are taken every 10 minutes, then left to stand until precipitation occurs. Then the glycerol precipitate formed is analyzed using acetine to determine the conversion value.

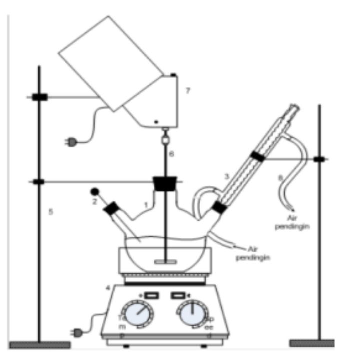
D. Variable

To determine the kinetics of the reaction, the effect of the catalyst ratio, stirring speed, reaction temperature and ethanol-oil ratio was studied for a period of 10 - 60 minutes.

E. Analysis of the Result

The samples taken were weighed at intervals of 10 minutes to determine the glycerol content by means of acetine (Griffin, 1955). The sample is weighed and then put into a rotating device to separate the upper layer from the lower layer. When the boundary between the two layers is clear, the top layer is taken with a pipette, and the lower layer is weighed again, and the remaining ethanol is evaporated. Then, approximately 1.3 grams of the liquid is taken, put in erlemeyer, then added 3 grams of sodium acetate, and 7.5 mL of acetic acid anhydrid. The mixture is simmered for 1 hour by putting the cooler back on the erlemeyer. After boiling, the mixture was cooled to a temperature of about 50 ° C, then 50 mL of the same temperature distilled water was added through a reverse cooler, and cooling was continued.

The cooled mixture is neutralized with 3N NaOH using a phenolptalin indicator until a much red color is formed. Then add another 10mL of 1N NaOH, then boil for 15 minutes, and then cool down. After cooling, the mixture was titrated with 1N HCl until the red color disappeared. The blank titration is carried out in the same manner, but without samples



Picture 3.2 Series of Alcoholysis Research Tools

Information :

1. Three neck rounded flask
2. Thermometer
3. Condenser

4. Heater
5. Stative and Clamps
6. Stirring rod
7. Stirring motor
8. Cooling water hose

RESULTS AND DISCUSSION

Effect of reaction temperature

In Table 1, it can be seen that, the glyceride conversion increases with the increasing speed of the stirrer rotation, because the motion of the reactant molecules becomes larger, so that the collision between them also increases. However, the increase in conversions was not large. It can be said that it is the chemical reaction that determines the speed of the overall reaction.

The graph of the relationship -ln (1-xA) with time, t minutes, shows that the points obtained do not deviate much from the straight lines formed (Figure 2). It can be concluded that the alcoholysis reaction of whale seed oil with a solid catalyst is controlled by a pseudo-order chemical reaction to glyceride.

Table 1. The effect of stirring speed

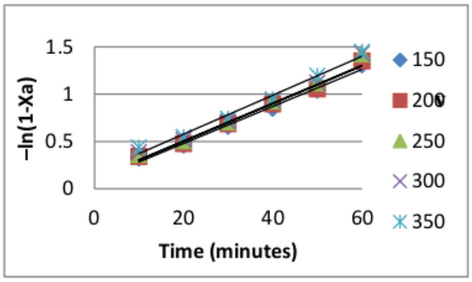
(Temperature 100 ° C, catalyst 1% by weight of oil, ethanol / oil = 1 mg / mg)

Time in minutes	Conversion, at stirring speed ratio		
	150 rpm	**200 rpm**	**250 rpm**
10	0,2775	0,2885	0,3029
20	0,3696	0,3806	0,3968
30	0,4826	0,4975	0,5076
40	0,5719	0,5923	0,6035
50	0,6472	0,6521	0,6734
60	0,7297	0,7406	0,7595
k'(10^2)	1,96	2,0	2,05
b	0,0893	01028	0,1672

Table 1. The effects of stirring speed (continued)

Temperature 100 ° C, catalyst 1% by weight of oil, ethanol / oil = 1 mg / mg)

Time in minutes	Conversion, at stirring speed ratio	
	300 rpm	350 rpm
10	0,3217	0,3542
20	0,4023	0,4219
30	0,5085	0,5241
40	0,6065	0,6113
50	0,6743	0,6978
60	0,7606	0,7646
k'(10^2)	2,07	2,11
B	0,1251	0,1028



Graph 1. The relation between –ln (1-Xa) with the stirring speed

With the variation of stirring 150 ppm, 200 pmm, 250 ppm, 300 ppm, 350 ppm, within 10-60 minutes the most biodiesel was obtained at a stirring speed of 350 rpm with a reaction time of 60 minutes resulting in the highest biodiesel conversion of 76.46%.

From the graph, it can be seen that the faster the stirring is used, the more biodiesel is produced. Thus it is known that at 350 ppm stirring is the optimal stirring, because the reaction takes place faster and better. So that more conversion value can be obtained. Conversely, at 150 ppm stirring, the reaction takes longer and is slower resulting in less conversion.

This shows clearly that chemical reactions play a role (Johnstone and Thring, 1957).

Effect of reaction temperature

In Table 2 and Figure 3 it can be seen that the longer the reaction time, the greater the conversion, and the greater the temperature increases the conversion, because the motion of the reacting molecules is greater.

Table 2. The effects of temperature reaction

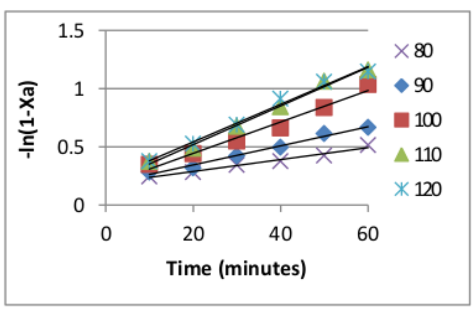
(stirring speed 350 ppm, ethanol / oil = 1 mg / mg, catalyst 1% by weight oil)

Time in minutes	Conversion, at the temperature variable		
	80°C	90°C	100°C
10	0,2180	0,2457	0,2943
20	0,2460	0,2732	0,3572
30	0,2914	0,3454	0,4232
40	0,3134	0,3912	0,4844
50	0,3467	0,4587	0,5676
60	0,4025	0,4865	0,6454
k'(10^2)	0,50	0,80	1,50
b	0,184	0,179	0,172

Table 2. Effects of reaction temperature (continued)

(stirring speed 350 ppm, ethanol / oil = 1 mg / mg, catalyst 1% by weight oil)

Time in minutes	Conversion, at the temperature variable	
	110 °C	120 °C
10	0,3129	0.3136
20	0,3861	0,4094
30	0,4911	0,4981
40	0,5708	0,5987
50	0,6551	0,6534
60	0,6870	0,6821
k'(10^2)	0,160	0,1620
B	0,185	0,218



Graph 3. The relation between –ln(1-Xa) with the time and temperature

With a temperature variation of 80°C, 90°C, 100°C, 110°C and 120°C within 10-60 minutes, the most biodiesel was obtained at a temperature of 110°C at 60 minutes with a conversion of 68.7%. From the graph, it can be seen that the higher the temperature used, the more biodiesel is produced. a lot. Thus it is known that 110°C is the optimal temperature, because the reaction takes place faster and better. So that more conversion value can be obtained.

This also reinforces the notion that the chemical reactions that control the process are in accordance with that proposed by Westerterb (1984).

The influence of catalyst percentage

From Table 3 it can be seen that the conversion of glycerides increases with the increase in the percentage of the catalyst, because more and more reactants are activated, so that the collision that occurs is getting bigger. The value of k 'is the directional tangent the relationship between -ln (1-Xa) and time, t minutes (Table 3 and Figure 4).

Table 3. The effect of percentage catalyst

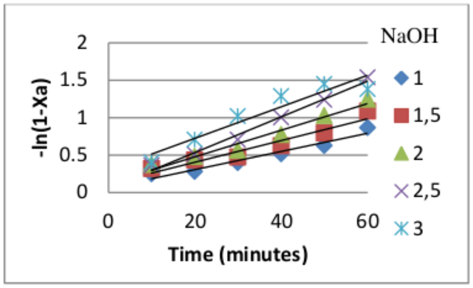
(Temperature 110 ° C, stirring speed 350 ppm, ethanol / oil = 1 mg / mg)

Time in minutes	Conversion at catalyst percentage		
	1 %	**1,5 %**	**2 %**
10	0,2182	0,2721	0,3099
20	0,2439	0,3522	0,3817
30	0,3278	0,3771	0,4289
40	0,4017	0,4628	0,5378
50	0,4656	0,5483	0,6422
60	0,5794	0,6628	0,7122
k'(10^2)	1.22	1,45	1,78
b	0,0298	0,1137	0,1203

Table 3. Effect of percentage catalyst (continued)

(Temperature 110 ° C, stirring speed 350 ppm, ethanol / oil = 1 mg / mg)

Time in minutes	Conversion at catalyst percentage	
	2,5 %	**3 %**
10	0,3028	0,3299
20	0,3983	0,5058
30	0,5054	0,6392
40	0,6328	0,7235
50	0,7093	0,7649
60	0,7847	0,7482
k'(10^2)	2,39	2,11
b	0,0554	0,3006



Graph 4. The relation –ln (1-Xa) with time and percentage catalyst

The percentage of the catalyst with variations of 1%, 1.5%, 2%, 2.5%, 2%, 3% within 10 minutes - 60 minutes with a stirring speed of 350 ppm resulted in optimal biodiesel on a 2.5% catalyst at 60 minutes worth a conversion of 74, 8%.

From the graph it can be concluded that the higher the percentage of the catalyst, the more biodiesel is produced. This is because the higher the percentage of the catalyst, the conversion obtained will be stronger because the more reagents are activated so that the collision that occurs is greater.

Thus it is known that the catalyst for the best reaction occurs at 2.5% catalyst. Because the 2.5% catalyst is the optimum catalyst with particles reacting and colliding with each other. This may be due to the acidic nature of the alcohol used.

Thus it is evident that the chemical reactions occur in the liquid phase and pseudo-order to glycerides (Hill., 1977)

The effect of ethanol-oil equivalent ratio

The greater the ethanol-oil equivalent ratio, the greater the likelihood of collisions between reagents (see Table 4).

The relationship between -ln (1-Xa) and time, t, is also straight lines, and the k 'value is shown in Table 4. This indicates that the pseudo-order reaction to glyceride.

Table 4. The effects of comparison of reagents

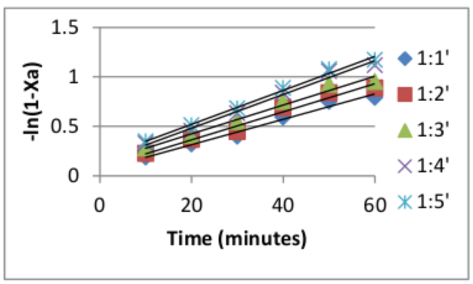
(Temperature 110 ° C, stirring speed 350 ppm, catalyst 2.5% by weight of oil)

Time in minutes	Conversion, at comparison of reagents		
	1 : 1	**1 : 2**	**1 : 3**
10	0,1720	0,2017	0,2451
20	0,2752	0,3076	0,3341
30	0,3295	0,3592	0,4213
40	0,4460	0,4983	0,5279
50	0,5283	0,5670	0,6626
60	0,5469	0,5881	0,7736
k'(10^2)	1,20	1,40	1,43
b	0,057	0,079	0,133

Table 4. The effects of comparison of reagents (continued)

(Temperature 110 ° C, stirring speed 350 ppm, catalyst 2.5% by weight of oil)

Time in minutes	Conversion, at comparison of reagents	
	1 : 4	1 : 5
10	0,2783	0,2932
20	0,3643	0,3992
30	0,4690	0,4941
40	0,5672	0,5872
50	0,6521	0,6589
60	0,6723	0,6896
k'(10^2)	1,70	1,74
b	0,140	0,176



Graph 5. The relation between k' with the comparison of reagent

Comparison of reagents with variations of 1: 1, 1: 2, 1: 3, 1: 4, 1: 5 in 10 minutes - 60 minutes with a catalyst percentage of 2.5%, the optimal biodiesel reagent 1: 5 at 60 minutes is equal to conversion of 77.3%. From the graph above it can be concluded that the higher the reagent ratio, the more biodiesel is produced. This is because the more reagents, the higher the conversion obtained because the more reagents are activated so that the collision that occurs is greater.

Thus it is known that the reagent for the best reaction occurs at 1: 5. Because the 1: 5 reagent is the optimum reagent with particles reacting and colliding with each other.

CONCLUSION

The conclusions obtained in This research is:

1. The alcoholysis reaction of Kepyar castor oil at pressures above 1 atm, with a crude oil cracking waste catalyst, is controlled by a pseudo-order chemical reaction to glyceride, and takes place in the liquid phase.
2. Relatively good conditions are achieved at a temperature of 110 ° C, a percentage of catalyst 2.5% by weight of oil, a stirring speed of 350 ppm, and a reagent ratio of 5

mgek / mgek, the conversion obtained is 0.7736 parts.

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