The Effect of the Catalyst (NaOH) on the Processing of Waste Used Oil Into Liquid Fuel

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ABSTRACT
The use of lubricating oil is increasing every year the resulting waste is also increase. Based on the waste criteria issued by the Ministry of Environment, used oil is included in the category of B3 waste. Although used oil can still be used, if not managed properly, it can be dangerous for the environment. The result of this is higher energy prices and decreased oil supply. The process in this research is to treat the used oil waste with heat treatment methods and compare the results and the process of treating used oil waste using a catalyst and without using a catalyst. Then the sample results were tested and compared with existing fuel standards. The catalyst has been shown to affect the process and the resulting results in the used oil processing process. It can be seen in the discussion of the process using a catalyst to produce oil products faster than from the process without using a catalyst, and also the product produced in the process using a catalyst is more and of better quality than the product produced without using a catalyst. There it proves that the function of the catalyst works well, namely as an accelerator of the reaction rate and increasing the desired reaction results.

Keywords: *lubricating, oil, B3 waste, catalyst*

1. INTRODUCTION

The use of lubricating oil surged every year, so the waste produced will also increase. Waste from lubricating oil is included in the B3 waste that needs special handling. Based on waste criteria issued by the Ministry of Environment, used oil belongs to the b3 waste category. Although used oil can still be utilized, if not managed properly, it can harm the environment. In line with the development of cities and regions, the volume of used oil continues to increase in line with the increasing number of motor vehicles and motor machinery. In rural areas though, there are already small workshops, one of which wastes used oil. In other words, the spread of used oil is already very wide from major cities to rural areas throughout Indonesia

On the other hand, reliance on petroleum at the same time will continue to increase due to population growth and industrial and development activities. The consequences of this are higher energy prices and declining oil supplies.

Therefore, the author will analyze the effect of the addition of catalysts where here the author uses a fire soda catalyst (NaOH) on the process and results on the processing of used oil into liquid fuel.

The purpose of this research is to findout what kind of fuel can be produced from the treatment of used oil waste, design used oil processing equipment and know the effect of catalysts on liquid fuel characteristics as well as processes on the treatment of used oil waste into liquid fuels.

2. LITERATUR REVIEWS

The result of the study (Mardyaningsih & Leki, 2014), "Base Oil Analysis Result of Adsorption and Pyrolysis Process on Waste Engine Oil" is adsorption and pyrolysis of used engine oil producing base oil with the following physical properties: clear yellow, smells stinging, flammable, weighs 0.8 ml/g, viscosity 5.14 g/cm second to 5.39 g/cm second, calorific value 16,800 J/g, and flash point 80-98 °C. (Suparta et al., 2015), shows that used oil recycling using 5% of H_2SO_4 has properties closest to diesel engine fuel. The viscosity and flash point values of recycled are within the standard solar fuel range, the density is slightly lower and the fuel calorific value is about 14% lower than the solar standard. Then, from the GC-MS test results conducted (Putra, 2017), showed that the gasoline fraction dominated the results of non-isothermal pyrolysis bio oil products using a catalyst of 69.82% when using kaolin catalyst with a ratio of 1 : $^{1}/_{2}$. Meanwhile, heavy weight fraction is no longer present in bio oil products. This shows that adding catalysts to the non-isothermal pyrolysis process will improve the yield of bio oil products when compared to non-isothermal pyrolysis. The result of the study (Dewi et al., 2014), proving that the speed of production and percent of gasoline fraction increases with the higher the temperature, while the percent of kerosene and diesel fractions are lower, and the weight value of the type remains, not affected by the temperature.

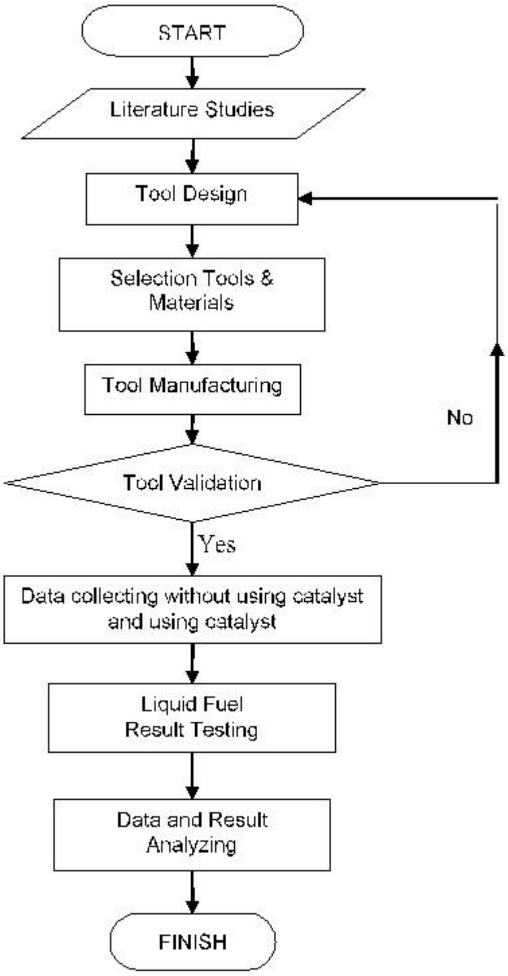

Figure 1 Diagram Flowchart of the Research

3. RESULT AND DISCUSSIONS

3.1. Data Retrieval Results

The data retrieval process was carried out at Sriwijaya State Polytechnic mechanical engineering welding workshop. The data retrieval process uses 5 liters of used oil with a catalyst mixture of as much as 10% of the base material used and carried out at an initial temperature of 30°C until the temperature is raised continuously with maximum stove heat until it reaches the highest temperature of 335°C. The following is a comparison graph of the process when using a catalyst and without using a catalyst (Figure 2).

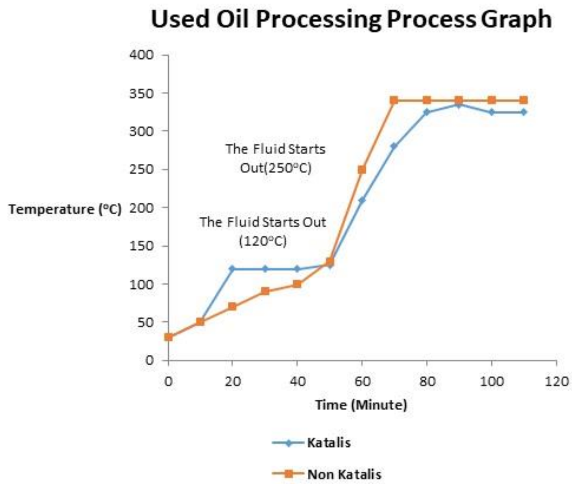

Figure 2 Used oil Processing Graph

3.2. Amount of Fuel Produced

It can be seen from the table 1. the product results in used oil processing using more catalysts than from used oil processing without the use of catalysts. Products produced on Faucet A are more used during the processing process of used oil using catalysts while products produced on Faucet B more during the used oil processing process without the use of catalysts.

No.	Types of Raw Materials	Products Produced	
		Faucet A	Faucet B
1.	Used Oil without Catalyst	1300 ml	1700 ml
2.	Used Oil with Catalyst	1900 ml	1600 ml

Table 1. Amount of Fuel Produced

3.3. Physical Characteristic Testing

The composition of new lubricating oils that have not been used contains hydrocarbons with carbon chains of more than 25 (C25). After use, hydrocarbon components change to approximately 84.42% C25 and 16% C12-C25 produced due to heating in the machine allowing bonding between hydrocarbon molecules. Liquid pyrolysis products have a carbon composition of C6–C20, of which C5-C11 is a component of gasoline's volatile hydrocarbons (47%) and C12-C25 which is the carbon figure of diesel oil (52%) (Askaditya, 2010). Testing of the physical properties of used lubricating oil liquid products is carried out to determine the characteristics of products produced from used lubricating oil pyrolysis. Testing of physical properties performed is IBP, density, viscosity, flash point, pour point and specific gravity. Subsequent test results were compared to the standard fuel value on the market.

Table 2. Testing of Physical Characteristic of Used Oil Processing Results

No.	Physical Characteristic	Test Results		Fuel Specification Standards		
		Non Catalyst	Catalyst	Pertamina Dex	Solar	Bio Solar
2.	Viscosity (mm^2/s)	6,3242	5,7185	2,0 – 4,5	2,0 – 4,5	2,0 – 4,5
3.	Water Content (%)	20,5632	24,3371	0,5	0,5	0,5
4.	Calorific Value (cal/g)	10.437,068	10.291,903	10.401,000	8.591,291	8.426,486
5.	Flash Point (°C)	34,3	34,9	Min 55	Min 60	Min 65

3.4. Density Value

Density is the density of a substance, i.e. the comparison between the mass of the substance and the volume of the substance. Density is measured using a piknometer. Oil samples that use catalysts have a density of 830.7 kg/m^3. while un catalyst samples have a density of 825.7 kg/m^3. pyrolysis results obtained product density of 840 kg/m^3. Thus, the product density value meets pertamina dex and solar oil density standards.

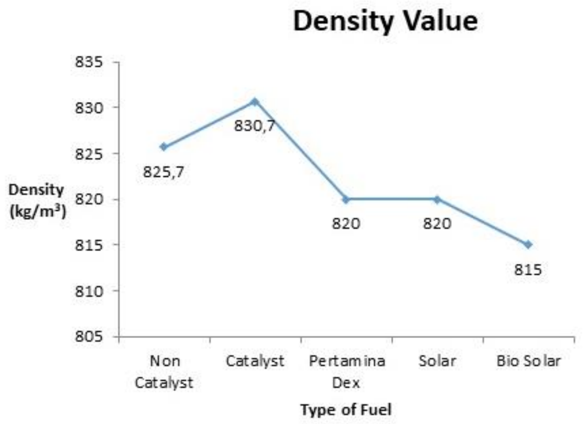

Figure 3 Density Value Comparison Graph

3.5. Viscosity

Viscosity is the inecity of fluid and gas flow caused by friction between parts of the liquid and causes viscosity. Viscosity is also a measure of the fuel resistance to flow. If the temperature rises the viscosity will drop so it will be easier to flow. Kinematic viscosity in used oil processing oils using catalysts is obtained at 5.7185 mm^2/s while the yield of oil not added catalysts is 6.3242 mm^2/s. This value does not meet the standard kinematic viscosity limit of 4.5 with a minimum limit of 2.0 mm^2/s.

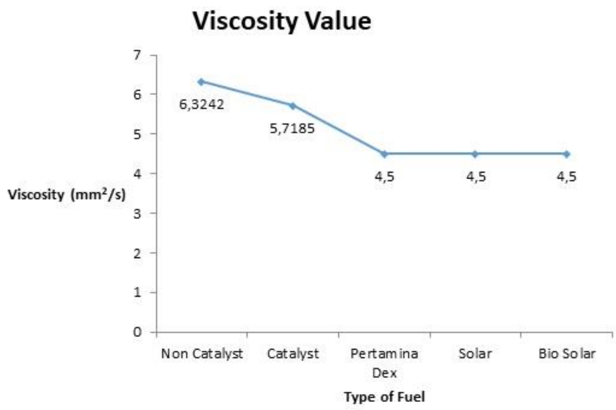

Figure 4 Viscosity Value Comparison Graph

3.6. Water Content

Water content that is too high in fuel can make the combustion process on the engine not last the maximum. If the water content reaches into the engine burn chamber and into the oil tank, it will cause engine. The water content obtained in used oil processing oil using catalysts is 24% while in the process without catalyst by 20%. The value passes the quality standard for all 3 types of fuel.

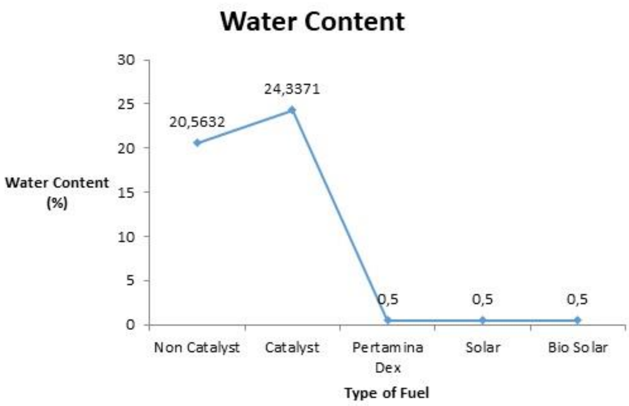

Figure 5 Water Content Comparison Graph

3.7. Calorific Value

Calorific Value (Calorific Value or Heating Value) is one of the important parameters in fuel quality. A calorific value is the amount of energy released when a fuel is perfectly burned in a steady flow process. The calorific value in used oil processing products with catalysts is obtained at 10,291,903 cal/g while the resulting product without the use of catalysts is 10,437,068 cal/g. The value is sufficient to meet the standard specifications of diesel type fuel.

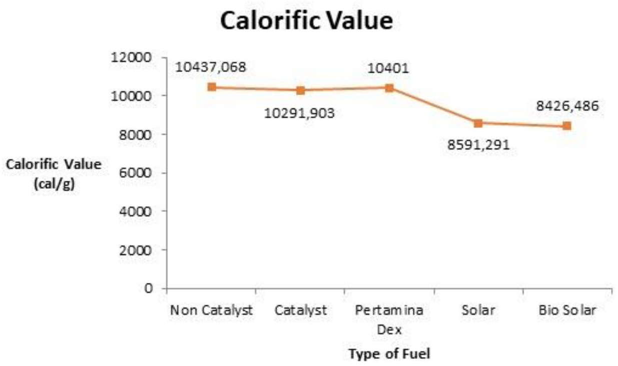

Figure 6 Calorific Value Comparison Graph

3.7. Flash Point

A flash point is the temperature at which a fuel forms a flammable vapor if given a trigger. Low flash points cause problems in fuel storage. Flash points that are too high cause fuel to burn at low temperatures or in cold engine conditions. The flash point on the oil yield from the used oil processing with the catalyst is at 34.9°C while the resulting flash point of the un catalyst process is at 34.3°C. The flash point value of this pyrolysis result is below the flash point of Pertamina Dex & Solar fuel.

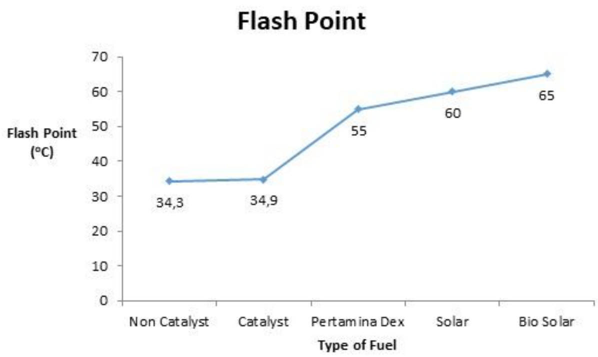

Figure 8 Flash Point Comparison Graph

4. CONCLUSION

Based on the results of the research and discussion that has been carried out as well as the testing of samples the results of the process of processing used oil can be drawn the following conclusions:

1. Catalysts are proven to affect the process as well as the results produced in the used oil processing process. It can be seen in the discussion of the process by using catalysts faster to produce oil products than from the process without the use of catalysts, and also products produced in the process using catalysts more and better quality than products produced without the use of catalysts. There proves that the catalyst function works well i.e. as a speed up the reaction rate and improves the desired reaction result.

2. Judging by the test results of the physical properties of oil used oil treatment results both using catalysts and not masiih many have deficiencies such as still high viscosity value and high water content. But for other physical properties it already meets standards for other types of fuel.

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