Biofuel Production From Jatropha Curcas Oil As Non-Edible Feedstock And Its Use In Diesel Engine

Muh. Irwan, Firman, Ramli, Mardhiyah Nadir, Marlinda

Abstract: The utilization of domestic biofuell is still very small and has the opportunity to be optimized. Biofuel is a fuel used as an alternative to fuel from diesel engines. The biofuel production through alcoholysis process of triglyceride from jatropha curcas oil using different type of catalyst. This works was conducted determine of the performance diesel engine using jatropha oil fuels biofuel. The biofuel is mixed with diesel are certain level comparison to obtain B10, B20, B30, B40, and B50 (B10 is mixture of biofuel 10 % and diesel 90 %, etc). In this study the rotation is used 1500 rpm. The results of diesel engine performance research show biofuel fuel B40 produces the best engine performance at 1500 rpm. In this round obtained the Brake Specific Fuel Consumption (BSFC) 0.19 % and Brake Thermal Efficiency (BTE) percentage of 30.22 %.

Keywords: Biofuel, Diesel Engine, Fuel, Jatropha Curcas Oil.

1 INTRODUCTION

THE world energy needs majority supplied through petroleum sources, natural gas, coal with the exception of nuclear energy and hydroelectricity. Energy is a basic necessity for development, every sector in Indonesia such as transportation, industry and agriculture all needs energy [1-2]. Of all limited resources and current consumption rates will be used as soon**.** Combustion of petroleum based fuel can generates emissions which are nuisance to environment and adversely affect human health. The Kyoto Protocol calls for a clean environment for human security [3-4]. The growing need for petroleum is a challenge to be expected with alternative energy search. Petroleum is a non-renewable energy source. Vegetable oil and fats currently a very promising alternative to replace of petroleum fuel since they are renewable and have similar properties [5]. Vegetable oils can be biodegradable, non-toxic, less harmful to the environment and available locally, more commonly found as a good alternative to petroleum products. Biofuel, particularly liquid ones like biodiesel has been felt by most of the countries and their governments have been trying to promote these fuel [2]. Biofuels, including biodiesel derived from vegetable oils such as palm oil, corn oil, canola oil, soybean oil, jatropha oil. In view of these, the jatropha curcas oil is suitable and more advantages to converted of biodiesel. Jatropha curcas oil is an acceptable choice for biodiesel production because it non-edible oil and can easily grow in harsh environment [6].

- *Muh. Irwan is currently a lecturer at Chemical Engineering Department, Politeknik Negeri Samarinda, East Kalimantan Province, Indonesia, E-mail: muhirwan@polnes.ac.id*
- *Firman is currently a lecturer at Chemical Engineering Department, Politeknik Negeri Samarinda, East Kalimantan Province, Indonesia, E-mail: firman.kimia@polnes.ac.id*
- *All co-author is currently a lecturer at Chemical Engineering Department, Politeknik Negeri Samarinda, East Kalimantan Province, Indonesi*

The most common method to obtain biodiesel is the transesterification of vegetable oil or animal fats using base catalyst such as NaOH and KOH [10,11]. In the reaction, triglycerides are reacted in presence of a catalyst with an alcohol with short-chain. Methanol is the most used alcohol because it is the least expensive and it shows chemical advantages such as its shorter chain and its polar nature. Almost all biofuel is produced by using alkaline catalyzed alcoholysis process, as it is the simple process and requiring low temperature [7]. The reaction temperature affect the reaction rate and yield of ester (biofuel). Therefore, usually the reaction is conducted close to the boiling point of alcohol. Further increase in temperature is a negative effect on the conversion [8]. Conventionally, the catalyst employed for transesterification reaction are homogeneous alkaline catalyst such as NaOH, KOH, CH_3ON_a and CH_3OK. In this work, jatropha oil is transesterification using a homogeneous catalyst KOH.

2 MATERIALS AND METHODS

2.1 Preparation of biodiesel production

The materials needed in this study include : Refined Jatropha Curcas Oil, some type of catalyst such as NaOH, KOH, CH_3ONa while the equipmment used is ultrasound with frequency 35 kHz.

***Figure 1**. Equipment of Transesterification Process.*

Figure 1 shows the ultrasonic apparatus used in this research of 35 kHz (Pro'sKit Digital) and operate at 160 watt. The catalysts used are sodium hydroxide (NaOH), potassium hydroxide (KOH), and sodium methoxide (CH_3ONa) with a concentration of 1% mass of oil dissolved into methanol using molar ratio 1 : 6. The catalyst was dissolved in to the alcohol prior to addition of jatropha oil and the solution was feed to the ultrasonic reactor. The sample were taken at following reaction time until 30 minutes. After the complete of reaction the sample were immediately quenched in water to stop the reaction and left one night in a separating funnel until two layers are formed.

***Figure 2**. Two Phases Layer in Transesterification Process.*

Figure 2 shows the separation of the biofuel as main product and glycerol as by product. The samples were washed by distilled water conducted 3-4 times until the water layer become clear. Process heating is aim to remove a lot of water in the biofuel product. The final stage of the process is heating of the ester. Finally, the dried of biofuel were saved.

2.2 Engine Performance

In order to study the engine performance of Ignition Cylinder (IC) engine using biofuel and its blends with petro diesel, an experimental study is carried out on a Nissan D-22 IC engine, constant speed 1500 rpm, 47 BHP using jatropha biofuel with diesel blends (B10, B20, B30, B40 and B50) to determine the Brake Spesific Fuel Consumption (BSFC) and Brake Thermal Efficiency (BTE). The experimental set up is as shown in the figure 3. It consists of four stroke single cylinder diesel engine.

***Figure 3**. Overall view of experimental setup.*

***Table 1**. Specification of the engine*

No	Parameter	Specification
1.	Type	Four stroke, single cylinder, water cooled engine
2.	Merk	Nissan, Tokyo Co. Ltd.
3.	Speed	1500 rpm
4.	Made	Japan
5.	Model	DWE – 47 – 50 – HS – AV
6.	Volume	2164 cm^3

3. RESULT AND DISCUSSION

After the engine reached the stabilized working condition for each test were measured from which Brake Specific Fuel Consumption (BSFC) and Brake Thermal Efficiency (BTE) were calculated. The performance of diesel-biofuel blends is tested by comparing the effects of diesel-biofuel blends on various engine parameters. The load and concentration of biofuel in the mixture on engine performance are discussed below:

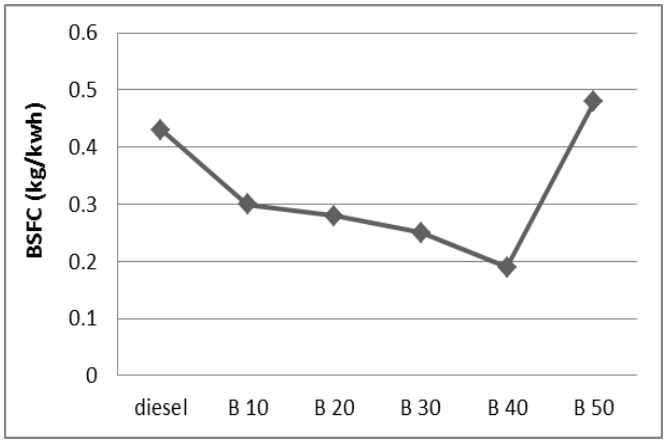

***Figure 4.** Effect of diesel-biofuel blends for Brake Specific Fuel Consumption (BSFC)*

Brake Specific Fuel Consumption (BSFC) shows how much fuel the engine consumed for each power generated. In this experiment, engine performance test to know the value of BSFC from diesel and diesel-biofuel blends with constant engine rotation rate of 1500 rpm. Brake Specific Fuel Consumption (BSFC) value of diesel-biofuel blends was compared with pure diesel BSFC value. For BSFC the lower the value of BSFC then the better the quality of the fuel [9]. Brake Specific Fuel Consumption (BSFC) values of diesel-biofuel blends show more better value than pure BSFC solar values except for B50 values, due to the high mass of B50 so it causes its BSFC value to be high. The best result was found in B40 blends with BSFC value of 0.19 (Kg / kwh).

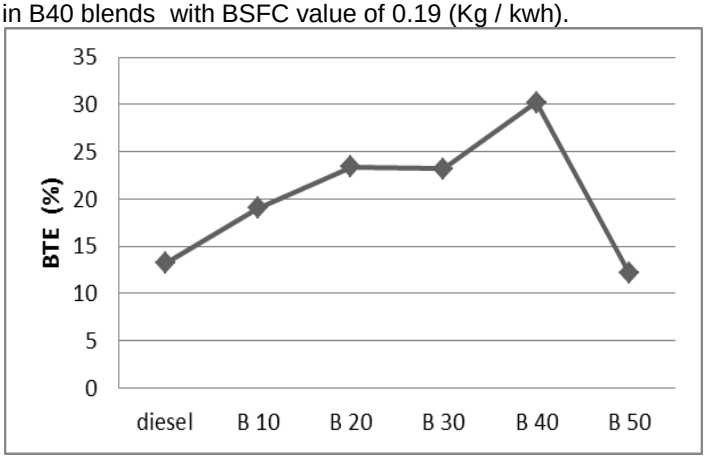

Figure 5. *Effect of diesel-biofuel blends for Brake Thermal Efficiency (BTE).*

Brake Thermal Efficiency (BTE) shows the extent to which the engine converts heat from fuel to mechanical energy. In this experiment, the engine performance test was conducted to determine the true diesel-BTE value and diesel-biofuel blends with a continuous engine speed of 1500 rpm. The BTE value of the diesel-biodiesel mixture would be compared with the pure diesel BTE value. The higher Brake Thermal Efficiency (BTE) using diesel was 13,23 % whereas it was 19 %, 23.41 %, 23.20 %, 30.22 % and 12.19 % in case of B10, B20, B30, B40 and B50 respectively. The higher Brake Thermal Efficiency (BTE) value, more better the quality of the fuel. The diesel-biofuel blends, BTE value shows more better value than the pure diesel. BTE value with the exception of the B50 value mix, because the B50 mix is low so that combustion heat is also low. The best results were found in the B40 mixture with a BTE value of 30. 22 %.

4 Conclusion

After conducting this work the following conclusion were drawn:

1. The effect of transesterification of jatropha oil via ultrasonic assisted was the highest yield of KOH as catalyst at 30 minutes with 89.53 %.
2. Results of the physical properties of the 5.71 cSt viscosity, the density of 860.17 % and the moisture content of 0.0136 % has met SNI 7182-2015 standard.
3. The pure biofuel have lesser caloric value as compared to pure petro diesel. Hence efficiency of biofuel is usually low.
4. Brake Specific Fuel Consumption (BSFC) reduce in load for the entire biofuel considered.

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