A PROCESS CONTROL TOOL DESIGN HEATING BIODIESEL PRODUCTION FROM OIL BASED ON ARDUINO MEGA

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ABSTRACT

Biodiesel energy is one of the alternative energies in the current era of global warming, which is needed by the community to meet renewable energy in electrical energy but is constrained by the unavailability of electricity which so far has only relied on PLN as a national electricity source. Especially the people who are in the interior who do not get electricity from PLN, while electricity has now become a primary need, which means that the community at this time must be served by electricity. Considering that Indonesia is the largest producer of palm oil in the world today, so the waste left behind is also getting bigger. This research was conducted to take advantage of this by utilizing waste, namely used cooking oil which is converted into biodiesel which will be used as fuel for Diesel Power Plants (PLTD). This research produces biodiesel B-100, which means the biodiesel is pure without a mixture of petroleum, by designing an automatic biodiesel processing device based on Arduino Mega. This study also analyzes how feasible B-100 biodiesel is for use in diesel-powered generators, by looking at the economic aspect, and of course also in the electronics aspect.

Keywords: Biodiesel B-100, Primary, Arduino Mega

INTRODUCTION

A diesel Power Plant (PLTD) is a power plant that uses a diesel engine as a prime mover. A Prime mover is an equipment that has the function of producing the mechanical energy needed to rotate the generator rotor(S. Aryza et al., 2018). PLTD is a power plant installation consisting of a generating unit and generating facilities. In a diesel engine, fuel energy is converted into mechanical energy by the combustion process in the engine itself. Indonesia is one of the oil-producing countries in the world, but until now it still imports fuel oil (BBM). Biodiesel from vegetable oil is an alternative fuel specially formulated for diesel engines. This research was conducted by analyzing to determine the effect of using pure diesel fuel with biodiesel B15 and B20 on the performance of the Komatsu SAA6D107E-1 engine. (Leevijit et al., 2017).

The test results obtained through a dyno test on the Komatsu SAA6D107E-1 engine that uses B15 biodiesel fuel has decreased maximum torque performance by 8.7%, maximum power loss is 2.7%, while for biodiesel B20 fuel has decreased maximum torque by 10, 3% and a maximum power loss of 6.1%. Biodiesel production in Indonesia is currently carried out by large industries. The raw materials used are generally derived from palm oil. The industry in addition to processing palm oil into cooking oil also processes it into biodiesel which is then distributed to government fuel oil distributors such as Pertamina and private distributors such as Shell, Total, and Petronas. Solar currently being sold is subsidized by the government(Santika et al., 2019).

The price of diesel also rises and falls along with the rise and fall of world fuel prices. However, biodiesel production will continue to be carried out by the biodiesel mandatory outlined in the Minister of Energy and Mineral Resources Regulation No. 20/2014 which requires 20% biodiesel content (B20) in 2016(Solly Aryaza, 2017).

To enjoy the electricity we use today, it all starts with a power plant. Generators are generators, these generators produce electricity and that electricity is delivered by

transmission and distribution lines to our homes. One of the most economical, easy, and safe ways to transmit energy is through the form of electrical energy. At the power plant, primary energy resources such as fossil fuels (oil, natural gas, and coal), hydro, geothermal, and nuclear are converted into electrical energy. Nur Sasongko(Misdawita & Sari, 2013)said also the depletion of oil reserves in the world as well as in Indonesia, is triggered by our dependence on energy consumption from petroleum. This situation is also driven by the increasing demand for oil energy in the transportation sector as well as the growth of the industrial sector in Indonesia(Deptt & Jabalpur, 2013).

This forces us to seek, utilize and develop new renewable energy sources as a substitute for petroleum fuel. One alternative renewable energy is Biodiesel. Indonesia has great potential as a producer of biodiesel because sources of biodiesel, namely sugarcane, cassava, sweet potatoes, jatropha, etc. are widely available and easy to develop in Indonesia. As an alternative to renewable energy, biodiesel can help in minimizing the world's dependence on fossil fuels. Then Magfirotunnisa, et al(Suryaputra P. et al., 2014)states that the content of biodiesel B15 and B20 still meets the standards or specifications of diesel fuel that have been set by the government. Judging from the parameter table, the cetane number of each fuel is increasing so that the combustion can be said to be complete and the flash point of the fuel is getting higher. In exhaust emissions, the SOx content in biodiesel fuel is lower than in diesel fuel, thereby reducing damage to the surrounding environment and helping the ozone layer in the atmosphere. Used cooking oil is used oil that has been used for household purposes and has undergone changes, both physically and chemically. One of the efforts that can be done to reduce the adverse effects of used cooking oil is to convert used cooking oil into biodiesel(Ilyas et al., 2018).

In this study, the manufacture of biodiesel from used cooking oil was carried out using a transesterification reaction such as making biodiesel in general through pretreatment to reduce the acid value of used cooking oil. Too high an acid number will complicate the separation of glycerol from biodiesel so that biodiesel production will be low(Depeursinge et al., 2010). The use of biodiesel has its advantages and disadvantages. This can be seen from the gas emissions produced such as NOx, CO, CO2, hydrocarbons, and smoke from these emissions. The burning of biodiesel from castor oil, algae, palm oil, and used cooking oil results in higher NOx emissions compared to ordinary diesel oil. This is because the combustion temperature is too high so more oxygen is contained. CO and CO2 gas emissions from biodiesel combustion are lower than from diesel oil. Hydrocarbon emissions have their level of variation where hydrocarbon emissions from burning biodiesel are lower than diesel oil if the engine load is also low and will be higher if the engine load is high (Permana, 2020). Processing of used cooking oil converts unsaturated fatty acid molecules in the vegetable oil into saturated fatty acids using alcohol (methanol & ethanol) and technical NaOH catalyst in the transesterification process. The mixture of used cooking oil with technical NaOH will form glycerol which settles at the bottom and ethyl ester (biodiesel) floats on the surface. Based on this research, there is an opportunity to make biodiesel as a substitute for diesel fuel. By using used cooking oil or cooking oil (Prasetyo, 2018). Jauhari (2019) said that biodiesel can be made from vegetable oils, animal fats, and algae. The utilization of vegetable oil as raw material for biodiesel has several advantages,

Vegetable oils have different fatty acid compositions depending on the type of plant. 4 The main constituents of fats (both vegetable and animal) are triglycerides, namely trimester glycerol with fatty acids (C8 – C24). The fatty acid composition in vegetable oil determines the properties of the oil. Energy is a very important human need that is needed in large quantities but is expected at a low cost. The most important facility and infrastructure for Indonesia is the provision of electrical energy. Indonesia has provided this source of electrical energy in almost all of Indonesia, but there are still areas that have not been reached by the PLN network so they have not received electricity supply. Electrical energy

comes from two sources, namely renewable energy and non-renewable energy. Included in renewable energy are solar power, ocean wave energy, and wind energy but requires research for its development in Indonesia. The types of non-renewable energy are hydroelectric power plants, wind power plants, diesel power plants, gas power plants, and nuclear power plants. The use of non-renewable energy must be considered in quantity because it will greatly disrupt these energy forces in the future if used excessively. diesel power plants, gas power plants, and nuclear power plants. The use of non-renewable energy must be considered in quantity because it will greatly disrupt these energy forces in the future if used excessively. diesel power plants, gas power plants, and nuclear power plants. The use of non-renewable energy must be considered in quantity because it will greatly disrupt these energy forces in the future if used excessively.

LITERATURE REVIEW

Previous Research

In this chapter, we will discuss the theory. Various studies related to biodiesel fuel B-100 as a diesel power plant have been carried out. This is because its use is an alternative form to reduce PLN's energy demand and optimize natural potential so that it is very useful to reduce the use of fossil energy which is currently running low. Therefore, several previous studies that are used as references in this study include the following: The device that will be used in the design of this prototype.

The concept of using vegetable oil as engine fuel emerged when Rudolf Diesel (1858-1913) developed the first engine running on peanut oil which he demonstrated at the World's Fair in Paris in 1900. At that time, Rudolf Diesel believed that the use of biomass fuels was a future for his machine. His ambition is to allow farmers to produce their fuel. So in 1911, he said that diesel engines could be fed with vegetable oil and would be quite helpful in the agricultural development of the countries that used them.

The use of vegetable oils to fuel engines may seem insignificant today. Today's modern diesel engines are designed to operate using fuels that are more liquid (easy to flow) than fuels from vegetable oil. However, at a time when fuel became scarce, cars and trucks had been successfully run using preheated peanut oil and animal oil. Then, in 1990, there was increasing interest in developing biodiesel because of the major pollution reduction benefits that come from using biodiesel. Today's diesel engines require a clean burning, stable fuel that will operate under a wide range of conditions. The rise of biodiesel has been influenced by laws and regulations in all countries.
Raw materials that can produce biodiesel oil such as sampling oil, palm oil, coconut, or other vegetable oils. The largest use of crude palm oil is as a raw material for cooking oil. Cooking oil is one of the basic needs of the Indonesian population with consumption levels reaching more than 2.5 million tons per year, or more than 12 kg/person/year. The most widely used cooking oil in Indonesia is made from palm oil (more than 70%) (Joni Prasetyo, 2018).

The use of palm cooking oil as biodiesel is technically more profitable because it has gone through various processes of removing impurities, fatty acids, and solid fats. However, economically, the use of palm cooking oil as raw material for biodiesel production is technically unprofitable. This is due to the relatively low fuel price policy in Indonesia so when compared to the price of palm cooking oil there is a relatively large difference (Joni Prasetyo, 2018). One way that can be done is to convert vegetable oil into the form of fatty acid methyl esters (FAME = Fatty Acid Methyl Ester), which is better known as biodiesel through an esterification or transesterification process.

Along with population growth, of course, more and more waste is produced, including used cooking oil, and industrial and household waste. Cooking oil can ignite at a certain temperature, this means that cooking oil can be used as an alternative fuel, especially as a substitute for diesel. However, if you use cooking oil as raw material, of course, the selling price of biodiesel will be more expensive than the price of diesel. If cooking oil can be used as a raw material for biodiesel, the same goes for used cooking oil. Because used cooking oil is the closest derivative and has the same properties as cooking oil. Of course, the solution to using used cooking oil as a substitute for diesel oil will be able to overcome two problems at once, namely reducing environmental pollution waste and alternative fuels, especially diesel.

The manufacture of biodiesel from used cooking oil uses a transesterification reaction like the manufacture of biodiesel in general, with pretreatment to reduce the acid number in used cooking oil. An acid number that is too high will complicate the separation of glycerol from biodiesel so that biodiesel production will be low (Hadrah, 2018).
A generator is a source of electrical voltage obtained through the conversion of mechanical energy into electrical energy. The generator works on the principle of electromagnetic induction, namely by rotating a coil in a magnetic field so that an induced emf arises. Generators have two main components, namely a stationary part (stator) and a moving part (rotor).

The rotor is connected to the generator shaft which rotates at the center of the stator. The generator shaft is usually rotated using external work that can come from a magnetic field. As in direct current machines and asynchronous machines (asynchronous) then synchronous machines (synchronously) are divided into two types:
1. Synchronous generator (synchronous generator / alternating current generator/alternator which is widely used in power plants).
2. Synchronous motors (synchronous motors) can be used to drive production machines in industries that require constant rotation. As in direct current generators, the armature winding (coil) is placed on the rotor while the field winding is placed on the stator, as well as for synchronous generators for small capacities. However, in synchronous generators used for the large-capacity generation, the armature winding or coil is placed on the stator while the field winding is placed on the rotor for reasons
1. Anchor winding is more complex than field winding so it is more secure when placed in a stationary structure.
2. It is easier to isolate and protect the armature windings against high voltages.
3. Cooling of the armature windings is easy because the stator core made is large enough that it can be cooled by forced air.
4. Field winding has a low voltage so it is efficient when used at high speeds. Diesel Power Plants are suitable for locations where fuel expenditure is low, water supplies are limited, oil is very cheap compared to coal and all the heavy loads are such that a small capacity generating engine can handle. and can function in a short time The utility of a Diesel Power Plant (PTLD) is a provider of electrical power that can function as a backup unit that is run when the existing main generating unit cannot meet the electricity needs.
As a generating unit that supplies electricity for 24 hours or as a fixed load bearer. The nature of operation shall be at the base load of the highest capacity and not be affected by the frequency of the fixed load. This is also possible if the supply can be interrupted. As a unit of peak load or Peak Load. When PLTD is operated at peak load. usually in a short time. because it can serve to increase the voltage that drops at peak load.

Cooking Oil
Used cooking oil is waste oil that can come from various types of cooking oil such as corn oil, vegetable oil, ghee, and so on, this oil is used oil for household use. However, it should be noted, that cooking oil that has been used more than 3 times, can endanger the health of

the body, due to increased levels of peroxides and FFA due to use at high temperatures, can cause dangerous diseases, such as cholesterol, coronary heart disease and can even trigger cancer [25].].

So it is clear that the sustainable use of used cooking oil can damage human health, cause cancer, and can further reduce the intelligence of the next generation. For this reason, proper handling is needed so that used cooking oil waste can be useful and not cause harm from aspects of human health and the environment, another use of used cooking oil is biodiesel fuel [20]. Cooking oil that has been used repeatedly during subsequent frying becomes brown cooking oil. Actually, the used cooking oil can still be reused after the reprocessing process is carried out, so another alternative is to use it as raw material for non-food industries such as soft soap, candles and diesel engine fuel [26].

The use of vegetable oil repeatedly is very harmful to health. This is because in addition to the increasing number of impurities contained in the cooking oil due to the previous frying of food ingredients and the increasing number of free carboxylic acid compounds in the oil and the color of the cooking oil which is getting less clear when used repeatedly. Used cooking oil can be used as raw material for biodiesel because it is a vegetable oil derived from CPO (crude palm oil). The manufacture of biodiesel from used cooking oil uses a transesterification reaction such as making biodiesel in general by doing
Pretreatment is carried out to reduce the acid number in the oil
waste.

The treatment stages are, first, purification from frying residue and water content. Second, esterification of free fatty acids (free fatty acids) contained in used cooking oil. Third, transesterification of triglyceride molecules into the form of methyl esters and fourth, separation and purification.

New and Renewable Energy

Energy is a very important human need that is needed in large quantities but is expected at a low cost. The most important facilities and infrastructure for Indonesia is the provision of electrical energy. Indonesia has provided this source of electrical energy in almost all of Indonesia, but there are still areas that have not been reached by the PLN network so that they have not received electricity supply. Electrical energy comes from two sources, namely renewable energy and non-renewable energy. Included in renewable energy are solar power, ocean wave energy, wind energy but it requires research for its development in Indonesia. The types of non-renewable energy are hydroelectric power plants, wind power plants, diesel power plants,

The quantity of this non-renewable energy must be considered because it will greatly disrupt this energy force in the future if it is used excessively (Partaonan Harahap, 2019). Indonesia actually has the potential of renewable energy sources in large quantities. Some of them can be immediately applied in the country, such as: bioethanol as a substitute for gasoline, biodiesel as a substitute for diesel, geothermal power, micro-hydro, solar power, wind power, even garbage/waste can be used to generate electricity. Almost all of these energy sources have been tried to be applied on a small scale in the country. The surge in oil prices (BBM) of up to US$ 70/barrel affected economic activity in various parts of the world. In Indonesia, the current fuel crisis momentum (early 2006) is the right time to seriously organize and implement these potentials. Although it is currently very difficult to make a total substitution of fossil fuels, the implementation of renewable energy sources is very important to start immediately. Below are briefly discussed the various sources of renewable energy.

Renewable energy is energy that comes from nature around us. Some examples of renewable energy are wind, water, geothermal, biomass, and solar. It is called renewable energy because it can renew energy itself in a short period of time, unlike fossil energy which takes years to form energy again. For Indonesia, the potential for renewable energy is very large because the Indonesian state has a good climate for renewable energy, for example, the sun in Indonesia is quite frequent because in Indonesia it is only divided into 2 climates in a year, for water, Indonesia is mostly water so it can be used for generate energy. Renewable energy is also very environmentally friendly because it does not produce waste that can pollute the environment.

METHODS

The eco-energy research method is based on designing and designing a conversion device that is similar to biodiesel. Then perform an analysis of the performance of the generator through experiments and measurements made. The materials used in this study include:

1. Baking soda (NaOh)
2. Methanol-ethanol
3. Cooking oil
4. Biosolar (B-20)
5. Shark . Diesel Engine
6. Generator 1 Phase

The research was conducted with the following work procedures or stages:

1. Preparation stage

In the preparation stage, the research team made preparations in the form of theoretical studies related to the research carried out, discussions, sharing knowledge and searching for literature were activities at this stage.

2. Implementation Stage

The implementation of the research begins by making a portable generator design and calculating the components needed in the study, then assembling the components according to the drawings that have been made, then carrying out tests and experiments on the tools that have been assembled, then taking data from the results of the experiments carried out. carried out, and analyze the data obtained and discuss it.

3. Reporting Stage

At this stage the researcher and the team make a report on the results of the research conducted to the LPPS, by making a written report of the results according to applicable standards, then attending a seminar to disseminate the research results, and writing it in a National Journal as a scientific publication. Furthermore, developing research results into teaching materials, in the form of textbooks, and implementing the research in a community service in Tomuan Holbung Village, which is one of the assisted villages of the Panca Budi Development University.

RESULTS AND DISCUSSION

Results of Heater and LCD Design in the Process of Making Biodiesel With Arduino Mega

In the design of the Heater and LCD in the Biodiesel Making Process using Arduino Mege, it consists of several parts of the circuit which are then combined into a whole series of tools. The components of the Heater and LCD in the Biodiesel Making Process are as follows:

1. Heating element

The heating element functions as a used cooking oil heater which will later be mixed with other ingredients at a temperature of 50-60°C.

Figure 1. Heater and Stirrer

2. Thermostar / Temperature sensor XH-W3001
Thermostar/temperature sensor XH-W3001 functions as a temperature regulator for used cooking oil to maintain or ensure the heater works at the temperature that has been set automatically in the circuit. The heating element passes through the WHW3001 temperature sensor so that it can be ignited safely.

Figure 2. Thermostar / Temperature sensor XH-W3001 for some time

Table 1. Test Table

No	Suhu (°C)	Lama Proses Pemanasan (Menit)
1	30.3	1 Menit
2	34.9	2 Menit
3	38.6	3 Menit
4	45.9	4 Menit
5	51.9	5 Menit
6	58.3	6 Menit
7	60.9	7 Menit
8	59.8	8 Menit
9	59.0	9 Menit
10	58.7	10 Menit

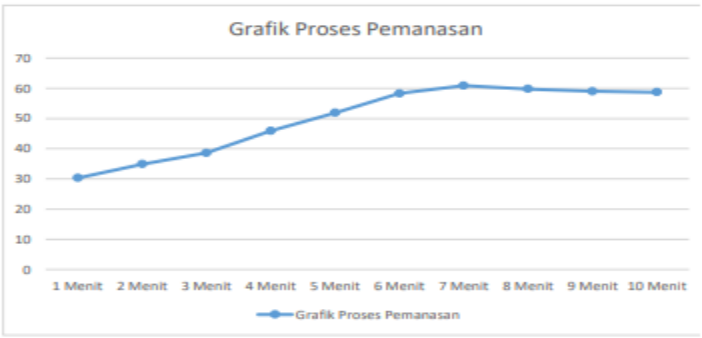

Figure 3. Warm Up Poses

Table 2. Heating Element Resistance Testing Table

No	Kondisi Elemen Pemanas	Tahanan Elemen Pemanas R
1	Saat kondisi dingin	150 Ω
2	Saat kondisi panas	150 Ω

How the Tool Works The Heating Process

After the design of the tool is complete, then you know how the tool works, then how it works, namely: Used cooking oil is heated to a temperature of 50-60°C which has been programmed using Arduino Mega for 30 minutes. After that it is mixed with the chemicals that have been made, then mixed with used cooking oil that has been heated and stirred at a constant speed.

After stirring at a constant speed the used cooking oil was transferred to a precipitation process for 1 day so that the oil and geliserol contained therein were separated. After being obtained for 1 day the used cooking oil was moved again to the washing process. In order to reduce the ethanol contained in the oil, this washing process uses water. Where the LCD on this tool is to display the working process of the tool from the first to the end, for example, a display will appear (pump on and heater on.).

How to Input Arduino Mega Program Settings for Cooking Oil Heater and LCD on Biodiesel Processing Equipment It is better to know how to input the Arduino program, the stages of the process are:

1. Prepare the Arduino connecting cable so that it can be connected to the laptop.
2. Prepare the laptop as a place to code the Arduino program.
3. Prepare the Arduino program application on the laptop, which can be downloaded on the internet.
4. Open the Arduino application that has been downloaded.
5. Connect the arduino to the laptop with the connecting cable.
6. Setting the program for the tool.
7. After the program settings are complete, click confirm then click upload, wait a few moments.
8. System working

Figure 4. Arduino Program Display For Processing Tool Control Biodiesel

CONCLUSION

Based on the results of the design, manufacture, testing, and analysis that have been carried out, it can be concluded that: 1. The biodiesel processing equipment using Arduino can work according to the design. 2. The time required for the heating element in the transesterification tank to reach a temperature of 60oC is 7 minutes. 3. XH-W3001 temperature sensor as a response to provide information on the temperature difference in the heating element and the temperature in the transesterification tank as a working reference of the relay.

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