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Modification of Distillation Engines Using Used Oil into Diesel and Premium Fuel Using Circular Condensation

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ABSTRACT

In the era of the industrial revolution which is very developed today, the automotive world is also increasing, especially in vehicles that are fueled by premium diesel, due to the increasing vehicle demand in the wider community as more and more innovations are issued to create something latest and new, from data (Central Statistics Agency 2020) vehicles on Indonesian roads from passenger cars, goods, motorcycles, buses reached 14. Behind the positive effects due to the increasing development of the automotive world, there are also negative effects, one of which is pollution and waste generated from vehicle lubricants, oil, from periodic replacements resulting from engine maintenance that must be carried out. So the author is interested in designing a distillation machine with a condenser to convert used oil into base oil (base oil gar reduces the negative impact, the method used is by literature review, field study, preparation and testing, although the results of the test were obtained from 3 samples, namely A, B, and C with different cooking times and temperatures, it was found that the physical results obtained were too different from each other, However, not with the content in the sample, which was tested using (GC-MS) it was found that compounds with different amounts were found, namely sample A with 48 compounds, Sample B with 42 compounds and Sample C with 68 compounds, the most compounds were found in the sample with the highest cooking time and temperature with a time of 160 minutes and a temperature of 254 °C. It was found that only sample A had a premium characteristic, namely the compound octane. So that this research can be used in the community.

Introduction

The development of the automotive world, especially vehicles that use diesel and premium fuel, is very rapid and advanced along with the increase in the population of the community and the ease of buying vehicles, there are many easy ways to buy vehicles such as cash or direct payments and credit or gradual payments that have various kinds

of time that can start in 1 year, some up to 4 years or more, This youth is one of the drivers of many people who have more than one vehicle (Nupus, 2022). From data (Central Statistics Agency 2020) vehicles on Indonesian roads from passenger cars, goods, motorcycles, and buses reached 141. 992.573 (Pratama, 2019).

The development of vehicles is very promising in the economic system that is developing in Indonesia, it is found that not a few workers participate in the automotive-based industry, but behind the positive effects, there are also negative effects, one of which is pollution and waste generated from vehicle lubricants, oil from periodic replacements resulting from engine maintenance that must be carried out. (Ikhwanudin, 2024).

The author is interested in designing a distillation machine with a condenser to convert used oil into base oil. (Marjuni, Minarto, & Wahyono, 2021).

Distillation is a way to distinguish chemical compounds that are based precisely on the difference in the rate or ease of evaporation in the existing material. (Ikhwanudin, Narendro, & Widadi, 2022). The incorporation of substances that have been heated to boiling and evaporation occurs, after which it enters the boiling phase which is produced by sitting until it gets a phase in a liquid state. (Irawan, 2010).

In this activity, a cooler is required as a cooling medium or as a heat transfer temperature or what is called a condenser. The following is a brief explanation of the cooler it can also be called a condenser. (Maroghi, 2017).

The base oil from this refining tool will be used as 2 types of fuel equivalent to diesel and premium, after which the base oil will be tested as an alternative fuel, namely by Gas Chromatography Analysis (GC-MS) testing, to find out what compounds are contained in the refined oil so that it can be concluded as a vehicle fuel and can reduce waste oil that is wasted in the soil. (Fonna, 2019).

Tabel 3.1 Waktu kegiatan Pembuatan Rancang Bangun

No	Kegiatan	Waktu (Bulan)												
		Mei		Juni				Juli				Agustus		
		3	4	1	2	3	4	1	2	3	4	1	2	3
1.	Studi Literatur													
2.	Studi Lapangan													
3.	Perancangan Desain													
4.	Proses Produksi													
5.	Pengujian Mesin													
6.	Pengujian Sample													
7.	Analisis													
8.	Kesimpulan													

Tabel 3.1 Jadwal Kegiatan Pembuatan Rancang Bangun

Figure 1 Time of Design Making activity

Research Methods

Place and Time

The work process was carried out at a house located in Bandung Baru village, Adi Luwih District, Pringsewu Regency. With a work time of July 2, 2023, to July 25, 2023.

Oil Distillation Machine Manufacturing Procedure

In the process of making an Oil Distillation Machine, the steps to make the engine are as follows:

1. Collecting information based on references related to the design of oil distillation engines.
2. The next step is to determine the concept of oil distillation machine design
3. After the concept has been determined, it is then continued to determine the design of the oil distillation machine. This step also creates a design drawing that will later become the initial reference for the oil distillation machine manufacturing process.
4. Then the next step is to collect and select the ingredients which are then made into a distillation machine.
5. After the selection of materials and the making of the design have been completed, the next step is the manufacture of the oil distillation machine.
6. The steps to make an oil distillation machine start from making oil combustion tubes
7. If so, the next step is to make both steam condensation tubes and also a stove that will be used to cook the oil.
8. After everything is done, then the components are assembled into one.
9. Check again if there are parts that are leaking or perforated due to imperfect welding or human negligence.
10. If there are no leaks from the connecting pipes or the tubes, then the coating work is done using paint.
11. The next step is to test the machine and take samples from the distillation.

Tools and Materials

1. Tool

The definition of a tool is something that is used continuously and never exhausted. Some can be carpentry tools, cutting machines, and others.

The tools used in the manufacture of used oil distillation machines include safety glasses, masks, hand protection, safety shoes, sitting grinders, measuring instruments, potog grinders, electric welds, blowers, water pumps and thermometers.

2. Material

The definition of the material is something that can be used continuously and will be exhausted, the materials that will be used in the design of oil distillation are as follows: pipes, oil drums, and elbow irons.

Results and Discussion

In the research design, the design and construction of a waste oil distillation machine into fuel uses a simple type of distillation that uses relatively cheap materials and can be used as fuel. (Purnomo, 2016).

In Figure 4.1, you can see the initial design of distillation of waste oil into fuel that can only dispense distillation results in one tube or can be called a type of diesel fuel. Then the creation of this thesis is intended to modify the distillation machine which produces one type of fuel into two different types of fuel.

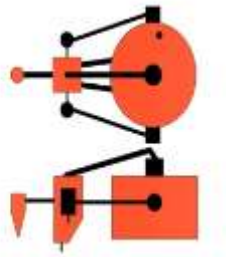

Figure 1 Initial distillation machine design

Then it can be seen in figure 1 is the design of the distillation machine that has been modified in such a way that it can produce two types of products in one cooking.

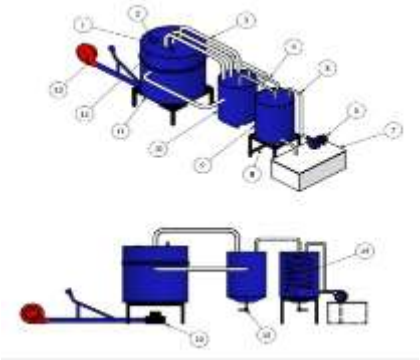

Figure 2 Distillation Machine Modifications

The specifications used in the design of the Used Oil Utilization Distillation Machine can be seen in Table 1 while the components can be seen in Table 2.

Table 1
Specification of Modification of Used Oil Utilization Distillation Machine

Tabel 4.1 Spesifikasi Modifikasi Mesin Destilasi Pemanfaatan Oli Bekas.

No	Spesifikasi	Parameter
1	Panjang alat keseluruhan	200 cm
2	Lebar alat keseluruhan	78 cm
3	Tinggi alat keseluruhan	145 cm
4	Diameter tabung pertama	59 cm
5	Tinggi tabung pertama	92 cm
6	Diameter tabung kedua	40 cm
7	Tinggi tabung kedua	60 cm
8	Tinggi tabung ketiga	60 cm
9	Jarak antar tabung	30 cm
10	Diameter pipa tabung pertama	4,5 cm
11	Diameter pipa tabung kedua	4,5 cm
12	Jumlah pipa	10 buah

In Table 1 are the components used in the manufacture of used oil utilization distillation machines, in this manufacture the materials used are used materials that are partly purchased from the plant to utilize materials that are no longer used and also save the budget.

Table 2
Components Used

Tabel 4.2 komponen- komponen yang digunakan

No	Komponen- komponen	parameter
1.	Tabung pertama	Drum oli bekas
2.	Tabung Kedua	Drum bekas epoxy
3.	Tabung Ketiga	Drum bekas epoxy
4.	Pipa uap	ERW

Distillation Machine Testing

The test carried out on the Oil to Fuel Utilization Distillation Machine, aims to find out the functionality of each part and the performance test aims to find out whether the system has functioned with or not by the expected purpose. (Batara, 2022).

Below is a table of the temperature of the first chamber chamber from the beginning of cooking to completion.

Table 3
Cooking temperature in the first tube

No	Time (minutes)	Temperature (℃)
1.	0	29,4
2.	10	67,5

3.	20	73,8
4.	30	80,5
5.	40	95,7
6.	50	124,8
7.	60	134,6
8.	70	148,5
9.	80	160,4
10.	90	182,8
11.	100	194,3
12	120	205,8
13.	130	205,3
14	160	205,8

In the table above, it can be seen that the test results show that when the temperature reaches 73.8°C, the output hole of the second tube begins to emit smoke, and at a temperature of 124.8°C, the third tube emits smoke but not as much smoke as the second tube emits smoke.

At this temperature, the oil and water content begins to separate and undergo evaporation, at a temperature of 148.5°C the second tube begins to drip deep black oil, while the third tube at a temperature of 194.3°C is dark yellow at the beginning of the discharge. The two oils that come out of the two tubes still have a characteristic oil and a slight odour (synthetic), then the fire is raised at a temperature of 205°C at a cooking time of 2 hours, and the two tubes release oil with a not-so-strong smell.

The fuel needed to cook oil for 2 hours is as much as 8 litres of used oil to burn while used oil is needed as much as 5 litres until 2 hours of cooking using an oil stove. The fuel produced by the Oil to Fuel Utilization Distillation Machine, the fuel produced in the third cylinder gets a brownish oil that smells like oil as seen in Figure 3.

Figure 3 Oil temperature 194 °C at 50 minutes of cooking

The result of the distillation of used oil into fuel produces three oils with different cooking times, namely oil with 50 minutes of cooking at a temperature of 194 °C producing a deep black colour with a very thick oil back, the second oil with a cooking time of 1 hour and 30 minutes producing a clearer brownish colour, and the last oil with a cooking time of 2 hours the oil is yellowish but the oil colour is still attached to the oil and the pungent smell from the oil. You can see it in the picture below.

Figure 4 Sample A 50 min cooking

Figure 5 Sample B 90 min cooking

Figure 6 Sample C cooking time 120 minutes

It can be concluded that the different cooking times and temperatures do not have much effect on the oil distilled using used oil, the colour and smell produced are not so different between cooking times of 50 minutes, 90 minutes, and 120 minutes.

Comparison of Physical Fuel Properties

By comparing the properties of samples A, B, and C with different cooking times with temperatures between 148°C and 205°C.

Table 4
Properties of the physical properties of the fuel

It	Properties of properties	Sample A	Sample B	Sample C
1.	Fire color	Blue, red	Blue, red	Blue, red
2.	colour	Blackish	Brownish black	Brownish black
3.	Combustion smoke color	Black	Black	Black
4.	Smell	Smells of used oil	Smells of used oil	Smells of used oil
5.	Flammable	Easy	Easy	Easy
6.	Yawning at room temperature	Not	Not	Not

Test Results (GC-MS)

Sample testing from the results of the distillation machine distillation of oil to fuel using tools (GC-MS) with the condition of the device:

1. Reference: Identification Of Heavy Residual Oil By GC & GC-M
2. Column: DB- 5 MS
3. Soluent: Hexane
4. Initial temp: 40℃ hold 4 min.
   300℃ at 5℃/min.

The value value means that a component that has a value above 90 is not easily lost or melted by heat treatment, on the contrary, a value below 90 will easily melt with certain heat treatment.

From 3 samples, namely A, B, and C with physically different cooking times and temperatures, not too different from each other, but not with the content in the sample, after testing with a tool (GC-MS) were obtained compounds with different amounts, namely sample A with 48 compounds, Sample B with 42 compounds and Sample C with 68 compounds, The most compounds were found in the sample with the highest cooking time and temperature of 160 minutes and a temperature of 254 °C, but those that indicated a fuel were found in sample A, namely the earliest cooking with a time of 50 minutes in the sample there was a compound octaneC_8 H_(18) contained.

Conclusion

In the results of the design of the distillation equipment, several important things were found. First, the designed distillation device was successfully used and tested successfully, producing oil. Secondly, the time and temperature during the distillation process do not affect the smell and colour of the oil produced. Third, a physical comparison of the fuels produced in different time spans shows that there are no significant physical differences. Fourth, sample C is known to contain the highest number of compounds, which is 68 compounds, while sample B has the least number of compounds between the two samples. Finally, from testing using Gas Chromatography-Mass Spectrometry (GC-MS), it was found that only sample A contained the compound octane, which is a premium characteristic.

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