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The Effect of Resistivity of Used Cooking Oil on The Quality of Palm Cooking Oil

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Abstract

Indonesia is a country with a large area of oil palm plantations, so there are many factories for the production of cooking oil. Indonesian people use a lot of cooking oil because processed food in Indonesia is mostly fried which causes a lot of used cooking oil to be wasted. The purpose of this study was to determine the resistivity of used cooking oil on the quality of palm cooking oil which can be useful in the field of renewable energy and reduce environmental pollution due to excessive waste of palm cooking oil which can cause damage to aquatic ecosystems, pollute the soil, and cause health problems. Used cooking oil can be processed properly so it is not harmful to the environment and health. One of the steps in processing used cooking oil is to know its resistivity value as the beginning of the refining process. Used cooking oil has a resistivity value that contrasts with soil so it is easy to interpret. Thus it is expected to know the resistivity value of used palm cooking oil. The results of this test obtained the resistivity value of used cooking oil after frying five times, namely 13.320 Ohm meter.

Keywords: ATMega328 microcontroller, used cooking oil, resistivity, two paraller plates method

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INTRODUCTION

Cooking oil is one of the basic needs of society in daily needs. The cooking oil used for cooking is closely relate to health. There are two types of cooking oil, namely, bulk cooking oil and packaged cooking oil (Ayustaningwarno et al., 2014). In this study, the cooking oil used was packaged cooking oil made from palm oil. The sample used are used cooking oil made from palm oil or palm cooking oil used for frying salted fish. The chemical composition of used cooking oil is carcinogenic. This carcinogenic used cooking oil can reduce brain function when consumed in excess (Aulia & Mokhtar, 2022).

Electrical Resistivity is a quantity that indicates the level of resistance to the electrical current of a material. The characteristic feature of a material is that is has a resistivity, which is a quantity that inidcatesthe level of resistance of the material to an electric current. Low resistivity indicates that a material does not impede the movement of electrons. Resistivity is the opposite of conductivity (Sugito & Mujasam, 2009).

In the purification process of used cooking oil, electrical resistivity can be used as a parameter to measure the salt and mineral content in the waste. Used cooking oil can cause environmental pollution and human health problems. At first, the electrical resistivity of palm cooking oil was high because there was no salt and mineral content. However, after frying, the electrical resistivity will decrease because the frying results cause cooking oil be contaminated with salt and minerals. In the process of purification used cooking oil, electrical

resistivity can be used as an indicator to determine the effectiveness of the process. The higher the electrical resistivity of used cooking oil, the better the purification process will be.

The purpose of this study was to determine the resistivity of used cooking oil on the quality of palm cooking oil which can be useful in the field of renewable energy and reduce environmental pollution due to excessive waste of palm cooking oil which can cause damage to aquatic ecosystems, pollute the soil, and cause health problems.

METHOD

The method used in this study is two parallel plates method to measure the electrical resistivity value of used cooking oil. The To design a resistivity meter using two parallel plates method for used cooking oil, the steps that need to be taken include:

Preparation of equipment and materials:

1. Two parallel plates
2. Current source : power supply
3. Beaker glass
4. Magnetic stirrer
5. Resistivity meter

Sample Preparation:

1. Take used cooking oil and filter it to remove dirt or particles that settle
2. Put the used cooking oil into the beaker glass

Two Parallel plates :

1. Insert two parallel plates into sample
2. Heat used cooking oil five times frying using a magnetic stirrer with a temperature of 40, 50, 60, 70 and 80 degrees celcius
3. Measure the sample for each temperature with an ohm meter to determine the electrical resistivity result

System block diagram of resistivity meter design two parallel plates method.

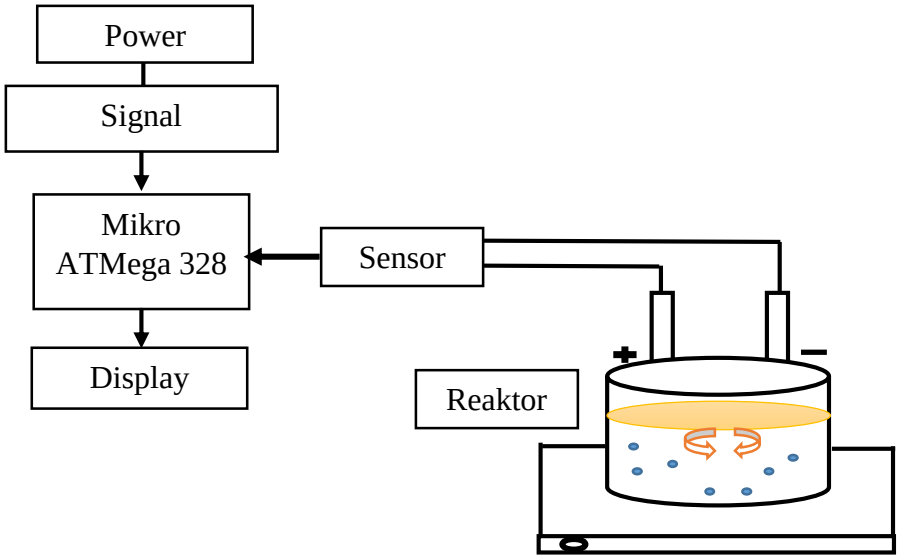

Figure 1. System Block Diagram

Power supply block to change the current voltage, signal conditioning as a signal amplifier, ATMega328 as a source of frequency control and PWM (Pulse Width Modulation), display as a viewer of data, such as characters, letters and numbers, sensor as a

converter of physical quantities into voltage, reactor as a place for the two paraller plates, magnetic stirrer as a stirrer and heating solution, used cooking oil as a test sample.

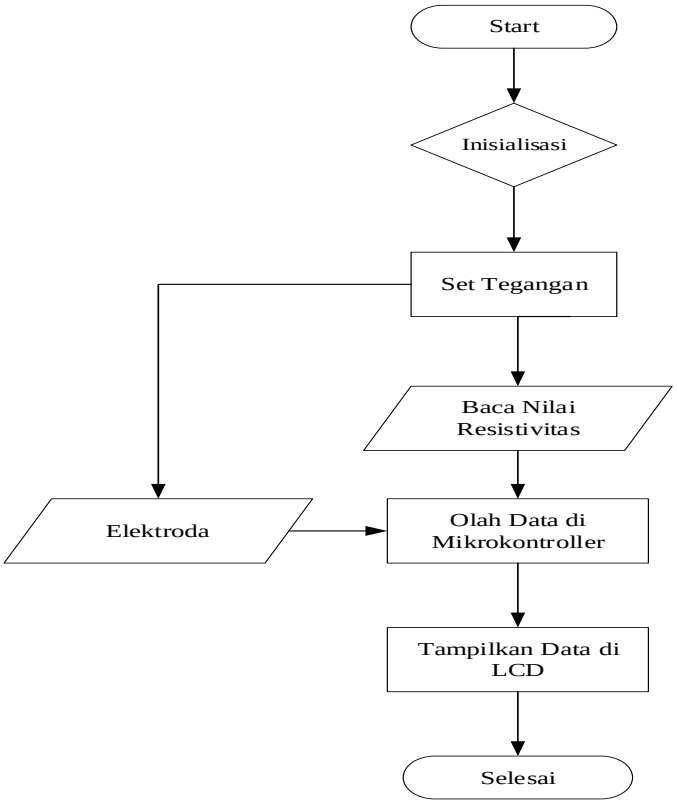

Figure 2. Flowchat

Figure 2 is a system flowchart. Starting from the voltage set to look for sensor characteristics that match what is expected. The electrode is placed into the sample (used cooking oil), then the measurement results will be read by the microcontroller and displayed on the LCD.

RESULTS AND DISCUSSION

In this study, two parallel plates made of cooper metal were used as electrodes or conductors of electric current. (Salamena et al., 2017) In this study, the current source used is the power supply. Power supply is a component that provides power electrical loads. Power supplies are made to convert several different forms of energy. The working principle of the power supply is that when a device is turned on, the power supply will send a signal to the mainboard as a sign that the device that is turned on is ready to operate. (Tarigan et al., 2019)

Electrical resistivity is the opposite of electrical conductivity (Suminten et al., 2021), can be seen from the following equation.
Electrical resistivity can be written as follows:

$$\rho = \frac{RA}{l} \qquad (1)$$

Conductivity can be written as follows:

$$\sigma = \frac{\mathbf{1}}{\rho} \qquad (2)$$

Information :
ρ : electrical resistivity (ohm meters)
R : resistance of material (ohm)
l : electrode length (meters)
A: cross-sectional area of the electrode (meters)
σ : electrical conductivity ($ohm^{-1}m^{-1}$)

The test results obtained from measuring the resistivity value in used cooking oil can be seen in Table 1.

Table 1. The results of the resistivity test for used cooking oil

Frying time	Resistance (Mega Ohm)	Resistivity (Ohm Meter)
1 time frying	5.050	15.150
2 time frying	4.855	14.565
3 time frying	4.702	14.106
4 time frying	4.612	13.836
5 time frying	4.440	13.320

From the test result in Table 1 can be concluded the more often the frying is done with the same oil the lower the electrical resistivity value. This is because the amount of salt and mineral content or impurities found in used cooking oil affects the electrical resistivity value of used cooking oil, that is, the more impurities in used cooking oil, the lower the electrical resistivity value and the higher the electrical conductivity value.

The value of the electrical resistivity is not only affected by the salt and mineral content but also by temperature. Where the greated the temperature, the lower the value of the electrical resistivity. This can be seen from the following equation.

The resistivity of a material depends on temperature, can be seen from the following equation:

$$\rho t = \rho_0 \ [1 + (T - T_0) \qquad (3)$$

Information :
ρ_0 : resistivity at standard temperature
ρt : resistivity at a certain temperature
T_0 : certain temperature
α : certain temperature coefficient

The results obtained from measuring the electrical resistivity value for the same sample, namely used cooking oil five times frying at different temperatures, namely the electrical resistivity value decreases. As found in research Irwan and Afdal (2016), the value of electrical conductivity is linear with temperature, that is, the greater the temperature value, the greater the electrical conductivity value. If the temperature is higher, then the ions moving faster and the value of the electrical conductivity will also be higher. Where, electrical conductivity is the opposite of electrical resistivity. From this can be concluded that, the greater the temperature value given, the smaller the electrical resistivity value.

Test results of the electrical resistivity value of used cooking oil five times frying by reheating used cooking oil at different temperature, namely, 40, 50, 60, 70 and 80 degrees Celcius, that is, different electrical resistivity values were obtained. The electrical resistivity value of used cooking oil obtained decreased at a temperature 80 degrees celcius.

The test results obtained from measuring the electrical resistivity value of used cooking oil five times frying at different can be see in the Table 2.

Table 2. The Effect of Temperature on the Value of Electrical Resistivity

Frying time	Temperature (^{0}C)	Resistivity (Ohm Meter)
5 time frying	40	13.120
5 time frying	50	12.970
5 time frying	60	12.702
5 time frying	70	12.497
5 time frying	80	12.207

Table 2. From the test results above it can be concluded, the more often frying is done with the same oil, the lower the electrical resistivity value even though each sample is heated to the same temperature. The electrical resistivity value of used cooking oil after heating to a temperature of 80 degrees celcius is 12.270 ohm meter.

CONCLUSION

From the results of the research conducted, it can be concluded that the resistivity value of used cooking oil is decreasing due to repeated frying with the same oil. With a decrease in the resistivity value of used cooking oil, the quality of palm cooking oil decreases. In addition, temperature also affects the electrical resistivity value of used cooking oil.

RECOMMENDATION

In this study, only two parameters were used, namely the first, salt and mineral content due to repeated frying of used cooking oil five times and the second is the effect of temperature on the value of the electrical resistivity. The For further research, it is better to add a liquid viscosity parameter.

REFERENCES

Aulia, H. N., & Mokhtar, A. (2022). Pengaruh Tegangan Listrik dan Rasio Solven pada Sintesis Biodiesel dari Minyak Jelantah Metode Elektrokatalitik. *Seminar Keinsinyuran Program Studi Program Profesi Insinyur*, *3*(1), 41–47. http://research-report.umm.ac.id/index.php/SKPSPPI/article/view/4968

Ayustaningwarno, F., Retnaningrum, G., Safitri, I., Anggraheni, N., Suhardinata, F., Umami, C., & Rejeki, M. S. W. (2014). *Aplikasi Pengolahan Pangan*. *5*(4).

Irwan, F., & Afdal. (2016). Analisis Hubungan Konduktivitas Listrik Dengan Total Dissolved Solid (TDS) dan Temperatur Pada Beberapa Jenis Air. *Jurnal Fisika Unand*, *5*(1), 85–93. http://jfu.fmipa.unand.ac.id/index.php/jfu/article/download/192/172

Salamena, G. A., Abdurrouf, A., & Santoso, D. R. (2017). Analysis of Experimental Results Measurement of Electric Impedance Value on Liquid with Injection Flow on Parallel Plate. *Natural-B*, *4*(1), 31–36. https://doi.org/10.21776/ub.natural-b.2017.004.01.4

Sugito, H., & Mujasam, dan. (2009). *Konduktivitas Listrik Pulp Kakao dengan Fermentasi dan Pengenceran* (Vol. 12, Issue 3).

Suminten, N., Arjo, S., Roza, L., & Fitriana, A. (2021). Perbandingan Konsentrasi Larutan Garam Dan Air Kelapa Terhadap Nilai Konduktivitas Listrik. *Jurnal Pendidikan Fisika*, *9*(2), 164. https://doi.org/10.24127/jpf.v9i2.4067

Tarigan, K., Perangin-Angin, B., Brahmana, K., Manalu, A., & Sinambela, M. (2019). Simple Designed of High Voltage Pulsed Electric Field Generator Based on Fly-back Transformer. *Journal of Physics: Conference Series*, *1230*(1). https://doi.org/10.1088/1742-6596/1230/1/012027