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Article

Preliminary Prediction of Biodiesel From Used Cooking Oil As Electricity Use DKI Jakarta

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Abstract

Biodiesel is a biodegradable fuel made from vegetable oils and animal fats processed by chemical reactions involving catalysts and alcohol. This study aims to determine the occurrence of cooking oil waste produced by residents of DKI Jakarta, to know the average electricity usage of residents in Jakarta, to find out whether the biodiesel produced can meet the electricity needs of every household in DKI Jakarta. The method used in this research is the quantitative method. Primary and secondary data are used to support the paper. Primary data was used from questionnaires distributed to residents of DKI Jakarta, and secondary data used for this paper are literature studies obtained from relevant books, journals, and research. The waste of used cooking oil generated by DKI Jakarta residents is 1,249 L/household/month.

Keywords: biodiesel; waste cooking oil; household; electricity

1. Introduction

As the time goes by, both the fuel demands and population are increasing. However, the current situation makes us driven to find a new energy source alternative due to the petroleum dwindling to fulfill the population energy demands. Utilizing a new energy source is considered an act to save the ancient energy source, which is petroleum oil. The recent alternative energy that could replace petroleum oil is biodiesel (Raksasat et al., 2021). Biodiesel is a biodegradable fuel that made from vegetable oil and animal fat processed in a chemical reaction involving catalyst and alcohol(Chozhavendhan et al., 2020) By implementing biodiesel as the alternative of ancient energy source, hence, biodiesel is not only a solution for environmental problems but also to economic problems. Because it is an eco-friendly energy source that give benefits to both environment and economic (Singh et al., 2020). The biodiesel feedstock that our group

chose is used cooking oil. The used cooking oil mostly came from households, hotels, and restaurants. Currently, used cooking oil is disposed to an open area or backyards without any further process to neutralize the waste. So, considering this situation will impact the environment and save the planet simultaneously, that's why we chose used cooking oil as our biodiesel feedstock (Rahman et al., 2020).

Biodiesel has several advantages over petroleum fuels, which can be produced locally by utilizing available natural oil/ fat sources. The production process and its use are more environmentally friendly with low CO, NO, and sulfur emissions and other combustion compounds and easier to decompose in nature. The use of biodiesel can also reduce soil pollution and protect the sustainability of water and drinking water sources. Another advantage of using biodiesel is that there is no need for engine modification. This is because biodiesel has a cleaning effect on fuel tanks, injectors, and slang, not adding to the greenhouse effect because the carbon produced is still in the carbon cycle.

Furthermore, biodiesel is safer, and its toxicity level is ten times lower than kitchen salt (Mohd Moiz Khan, Riyaj Uddin Khan, Fahad Zishan Khan, 2013). However, according to (Kelapa et al., 2009) in addition to these advantages, biodiesel also has drawbacks. This study aims to determine the occurrence of used cooking oil produced by citizens of DKI Jakarta, determine the average of electricity usage from DKI Jakarta citizens, and determine whether the biodiesel produced can meet the electricity needed to households DKI Jakarta.

2. Materials and Methods

The method that was applied for this research is the quantitative method. Primary and secondary data are used to support the paper. Primary data is a source of data received directly from data collectors. In contrast, secondary data is a source of data received indirectly from data collectors, such as from other people or available documents. Primary data used for this paper is the result from a questionnaire distributed to residents of DKI Jakarta as respondents from North Jakarta, East Jakarta, South Jakarta, West Jakarta, and Central Jakarta. The respondents can fill out the questionnaire from February 26 until March 6, 2021. Secondary data used for this paper are literature studies obtained from books, journals, and relevant research.

Used cooking oil can be used as a raw material in making biodiesel. The scheme of the method used for biodiesel production uses previous research carried out in the canteen of the Jakarta campus (Rahman et al., 2020). However, the content of used cooking oil is high in fatty

acids, which requires two times the process of making biodiesel. The first process is esterification using an acid catalyst and the second process is transesterification using an alkaline catalyst.

3. Results

Data from the spread of questionnaires about used cooking oil in DKI Jakarta obtained 39 respondents from West, East, North, Central, and South Jakarta. The data is sorted by the amount of electricity used in one family, the type of oil used, the volume of cooking oil produced, and the actions taken after the oil is produced. The questionnaire dissemination period runs from February 26, 2021 – March 6, 2021, using Google Form and disseminated using social media such as LINE, Instagram, and WhatsApp. From Table 1, a total of 39 Household respondents were obtained. From the 39 households obtained electricity usage data of 40,693 kWh / month.

Table 1. Survey data on electricity usage in DKI Jakarta

Name	Amount	Unit
Total Respondent	39	Households
Total Electricity Used	40.693	kWh/month

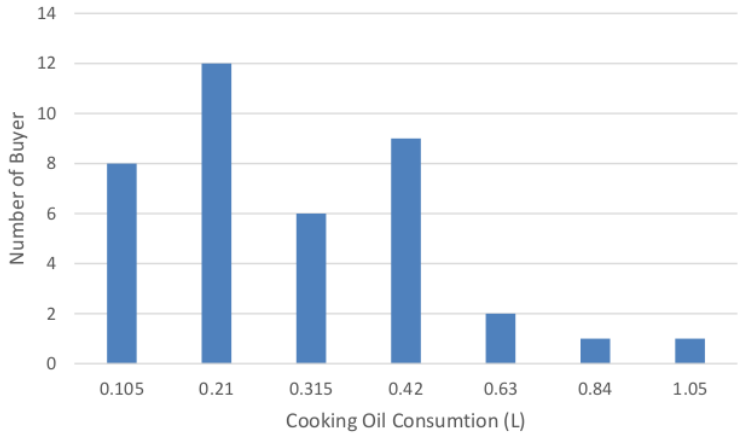

Figure 1. Total Use of Cooking Oil by Respondents (n=30)

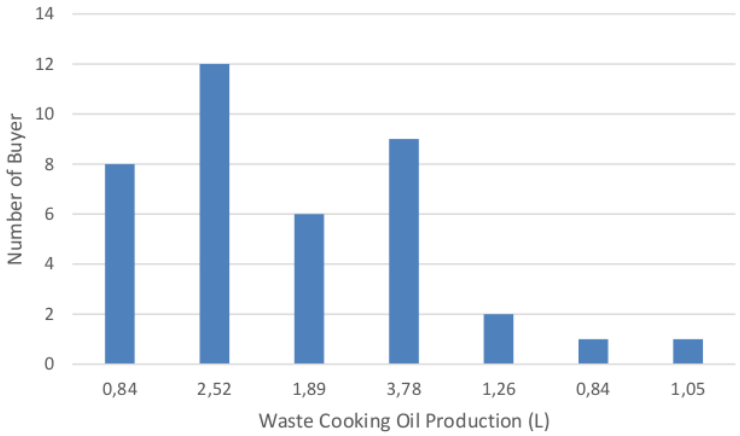

Figure 2. Total of Waste Cooking Oil by Respondents (n=30)

From Table 2, the average oil purchase used was 1.249 L/household/month. From table 3. obtained in the form of oil usage volume of 48.72 L. Percent of used cooking oil produced in a week from oil purchased is counted below:

Percent of used cooking oil produced = (Total of used cooking oil produced / Total of oil purchased) x 100% (1)

= (12.18 L/84.5 L) x 100% = 14.41%

From Figure 3. that 56% of respondence of DKI Jakarta use vegetable oil. Then, Figure 4. obtained the result that most of the respondence of DKI Jakarta have not done anything to the oil produced using cooking oil. However, some have done reuse of the oil produced

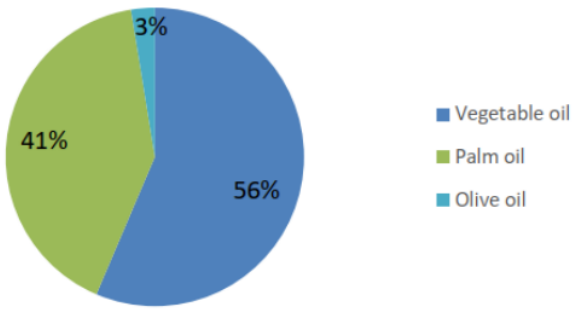

Figure 3. Types of Cooking Oil Used by Respondents

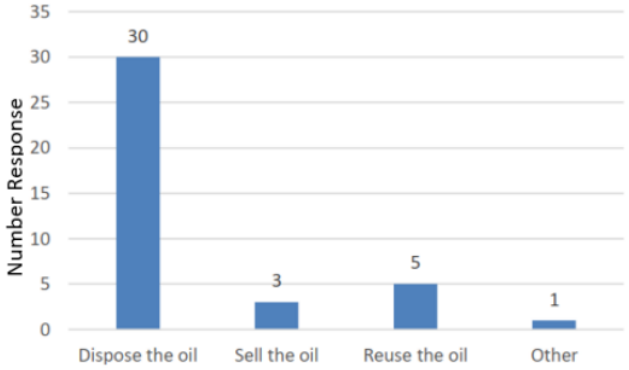

Figure 4. Management of Used Cooking Oil by Respondents

4. Discussion

Used cooking oil is waste from the use of cooking oil originating from households, the food industry, hotels, and others (Pemerintah Provinsi DKI Jakarta, 2016). Figures 1 and 2 show the large amount of cooking oil that becomes used cooking oil. This waste needs attention because it has the potential to affect health and the environment (Gkouskos et al., 2018). Used cooking oil is a pollutant whose effect is more visible in settlements urban areas. For example, if it is dumped in a drain, the oil can settle and clog waterways (Chhetri et al., 2008). As can be seen in Figure 4, most of the used cooking oil is thrown away.

In Indonesia, this process has been carried out in Bogor, Padang and Bali (Kharina et al., 2018; Kurnia & Hadiguna, 2016). The supply chain for the management of used cooking oil is described in Governor Regulation number 167 of 2016 (Pemerintah Provinsi DKI Jakarta, 2016), but its implementation has not been satisfactory. The poor supply chain's main factor is the lack of used cooking oil collected (Jachryandestama et al., 2021). However, with good management, at least it can support zero waste in Jakarta and can provide a circular economy from used cooking oil.

A circular economy is built from a community consumption and production system that maximizes the services produced, which are interrelated (Korhonen, Nuur, et al., 2018). For example, materials from nature, the surrounding community, and back to the environment form a linear relationship and the flow of output in the form of energy produced. This is done by using a material turnover scheme in the form of waste to produce renewable energy sources in an economic system oriented towards financial sustainability. A prosperous circular economy contributes to sustainable development's three dimensions (environment, energy, and sustainability) (Korhonen, Honkasalo, et al., 2018).

5. Conclusions

Based on the results and discussions, the value of waste oil produced by the citizens of DKI Jakarta amounted to 1.249 L/Household/month. For this research, we use two scenarios to treat used cooking oil produced. The first scenario is the manufacture of 20% biodiesel (B20 and the second scenario is the manufacture of 100% biodiesel (B100). With the B20 scenario, it turns out that the electricity needs for the citizens of DKI Jakarta can only meet by 21%.

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