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Liquid Waste Utilization of Coconut Flour Industry at PT. Royal Coconut Airmadidi as an Alternative Fuel

HERDIANTO LANTEMONA, JELJION YOBONG, FESTUS EVLY R.I. LIOW,
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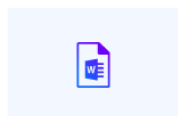
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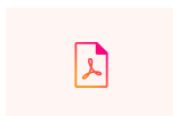
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Liquid Waste Utilization of Coconut Flour Industry at PT. Royal Coconut Airmadidi asan Alternative Fuel

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ABSTRACT: Coconut flour processing has a big impact on producers. However, in every processing of the coconut flour industry always produces liquid waste which makes the community around the site of processing industry get fretted. If this liquid waste, used cooking oil, is not handled properly, it will have a negative impact on the surrounding environment. Utilization of waste as stove fuel can be used as an alternative solution to overcome the scarcity of LPG, the soaring kerosene prices, and the fear of some people about LPG cylinder explosions. Therefore, stove fuel becomes an environmentally friendly alternative fuel. For this reason, an in-depth study is needed so that the liquid waste can be utilized by the community.

The purpose of this research is to make use of waste that is no longer useful as something that can be reused as an alternative fuel, especially for those whose economic level are still low. This research approach is experimentally to find out the outcome and whether there is a change or not after the treatment which is then carried out with 2 stages of experimental approach, namely the process of dilution and purification of the result of processing waste into fuel.

The processed liquid waste is visually black, turbid, and thick. Dark colors are caused by high temperature oxidation processes, as well as reactions with metals such as Fe, Cu, and Mn. After the testing process with 2 oil lamps using different fuels, namely kerosene and the results of processed waste that have been examined, it turned out that the second fuel did not cause smoke just like the oil lamp using kerosene does, and it is much economical. The lacking of this research is the aroma of oil that has not been completely removed even though it has been neutralized with wood charcoal. After being treated by adding different amounts of methanol (spiritus) and NaOH, then the level of dilution of the waste treatment result (used cooking oil) was indeed different, but also after being treated as above while stirring for five minutes there would be fat clumps which indicate the process of dilution of oil which makes it easy for absorption to the stove burner.

The result showed that wood charcoal can be used to purify the results of waste treatment, while Methanol and NaOH (caustic soda) are useful as neutralizers of the fat content in the liquid waste of processed coconut flour, so that it can be used for alternative fuel. Soaking time affects the expected oil purification results. From the result of the study proved that the optimal time is 1 hour.

KEYWORD: Used Cooking Oil, Industrial Waste, Wood Charcoal

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I. INTRODUCTION

Beside making a profit, coconut flour processing at PT. Royal Coconut Airmadidi is also facing a problem in handling the waste that is increasingly troubling the local community. If this waste is not handled properly it will have a negative impact on the environment. Based on a survey that the researchers have done in several residents around PT. Royal Coconut Airmadidi, among others, complained about the existence of factory waste. In this case the researchers wanted to make use of the waste that was no longer useful as something that could be used again as an alternative fuel. In addition, the general problem for the people with low economy is the government's decision to substitute kerosene for gas. They consider the price of gas is still expensive, even though it seems cheaper than the current price of kerosene. The decision has also left several problems, such as the low

level of safety of gas usage and the way to use it which is more difficult and have to be more careful compared to kerosene.

Meanwhile, the researchers also observed that PT. Royal Coconut Airmadidi produces a lot of waste every day, including the result of processing waste that has been formed into thick oil that is just accommodated, given to others, and sometimes thrown away. These habits will clearly be harmful to health, soil fertility and the environment. Therefore, the researchers wanted to process the processed waste into an alternative stove fuel.

Utilization of the waste as stove fuel can be used as an alternative or solution to overcome the scarcity of LPG that sometimes occurs, the soaring kerosene prices, and the fear of some people about LPG cylinder explosions. Therefore, the alternative stove fuel has the potential to become environmentally friendly fuels.

Formulation of Problem

Coconut flour processing is one of the industrial processes that can produce a lot of waste every day. For this reason, this research focuses on examining the potential of the waste to be used as fuel.

The formulation of the problem is the extent of the process of liquid waste from the Coconut Flour Industry into an alternative fuel after mixing it with Methanol (spiritus), and NaOH (caustic soda) and compared to the absorption ability of kerosene.

II. REVIEW OF LITERATURE

2.1. Waste Classification Based on its Form

2.1.1. Liquid Waste

Liquid waste is any type of liquid waste, in the form of water and other waste materials that are mixed (suspended) or dissolved in water. Wastewater can be classified into 4 groups, namely:

1. Domestic wastewater, i.e. liquid waste that is discharged from housing (households), buildings, trade, offices, and types of facilities, for example detergent water of remaining laundry, soap water, and feces water.
2. Industrial wastewater, which is industrial waste water, for example the water from the meat, fruit or vegetable washing wastes from the food processing industry and from the remaining fabric coloring / materials from the textile industry.
3. Infiltration and inflow, i.e. liquid waste originating from various sources that enter the sewage disposal system through seepage into the ground or through overflow from the surface, for example the wastewater from the roof, air conditioning, the yard, the industrial trade building, and agriculture or plantations.
4. Rainwater (storm water), which is liquid waste originating from the flow of rainwater above ground level. The flow of rainwater on the ground surface can pass through and carry solid or liquid waste particles so that it can be called liquid waste. Apart from being a disease carrier in wastewater itself, there are many pathogenic bacteria that cause diseases such as (1) Viruses, which cause polio myelitis and hepatitis. The exact mode of transmission is still unknown and is abundant in effluent, (2) *Vibrio Cholera*, which causes Asiatic cholera spreading through wastewater that has been contaminated by human waste containing *vibrio cholera*, (3) *Salmonella Typhosa a* and *Salmonella Typhosa b*, are the cause of abdominal typhus and paratyphi which are found in wastewater when an outbreak occurs. The principle of transmission is through water and food that have been contaminated by human excrement that has many typhus diseases, (4) *Salmonella Spp*, can cause food poisoning and many types of bacteria found in treated water, (5) *Shigella Spp* is the cause of bacillary dysentery and there are many in polluted water. The way of transmission is through direct contact with human excrement as well as the mediation of food, flies and soil, (6) *Bacillus Anthracis* is a cause of anthrax disease, found in wastewater and spores are resistant to processing, (7) *Brucella Spp* is the cause of brucellosis, Malta fever and cause miscarriage (abortion) in sheep, (8) *Mycobacterium Tuberculosis* is a cause of tuberculosis and is mainly present in wastewater from sanatorium, (9) *Leptospira* is a cause of disease with main transmission from gutter mice, (10) *Entamoeba histolytica*, can cause amoebic disease with dysentery by spreading through mud containing cysts, and (11) *Schistosoma Spp*, the cause of schistosomiasis, but can be killed when passing through wastewater treatment.

Apart from being a carrier and containing germs, wastewater can also contain toxic materials, cause irritants, odors and even high temperatures and other combustible materials. This situation is greatly influenced by the origin of the waste water. The case that occurred in Minamata Bay in 1953 is a clear example where fishermen and their families experienced symptoms of narrowing of the field of vision, paralysis, their skins became thick and it could even cause death.

Such incidents happened after the fishermen ate fish that had contaminated with mercury as a result of consuming mercury content in the bay. This mercury came from wastewater of a factory that produced mercury in its waste dumps.

In addition to mercury, there are still many other poisons that can endanger human health, including: (1) Lead, if a person is exposed to lead, then he/she can develop anemia, damage to brain function, and damage to the kidneys, (2) Chromium with seven-valence compounds is more dangerous than chrome with three-valence. When exposed to this chromium can cause skin cancer and digestive tract, and (3) Cyanide, which is a compound that is very toxic to humans because in very small amounts it can cause poisoning and damage the liver. Sometimes the waste stream needs to be treated individually to reduce the concentration of some pollutants in liquid waste. Sulfide-containing streams can be oxidized to reduce sulfide levels. Chrome is almost always trivalent because there is no need to reduce its hexavalent form. Chromated streams can be precipitated using alum, iron salts or polymers at high pH.

2.1.2. Solid Waste

Solid waste is one of the most abundant wastes in the environment. Solid waste is usually called garbage, and classified into 6 groups:

1. **Garbage.** It is easy to rot, semi-wet solid waste in the form of organic materials that easily decompose or break down microorganisms, e.g. kitchen scraps, food scraps, vegetable waste, and fruit peels.
2. **Rubbish.** It is inorganic or organic solid waste, dry enough and difficult to decompose by microorganisms which makes it difficult to rot, e.g. cellulose, paper, plastic, glass, and metal.
3. **Ash waste.** It is solid waste in the form of ash, and it is usually the result of combustion. This waste is easily carried by the wind because it is light and does not rot easily.
4. **Dead animal waste.** It is all waste in the form of dead animals, such as rats, fish and dead animals.
5. **Street sweeping.** The solid waste which is from street sweeps containing various rubbish scattered on the street, such as leaves, paper and plastic.
6. **Industrial waste.** All solid waste that comes from industrial waste. The composition of this waste depends on the type of industry.

2.1.3. Gas Waste

Gas waste is usually discharged into the air. The air contains chemical elements such as O₂, N₂, NO₂, CO₂, H₂, and others. The accumulation of gas in the air that exceeds the natural air content will reduce air quality. Waste gases discharged into the air usually contain particles of solid or liquid materials that are so small and lightweight that they are suspended with these gases.

4. Sound waste

It is the waste in the form of sound waves that propagate in the air. Sound waste can be generated from vehicle engines, factory machinery, electronic equipment and other sources.

2.2. Grouping by its Source

2.2.1. Domestic waste

The waste which is originating from residential (household) activities and business activities such as markets, restaurants and office buildings, for example food scraps, paper, cans, plastic, soapy water, detergents, feces.

2.2.2. Industrial waste

It is the type of waste produced depends on the type of industry. For example, liquid or solid organic waste will be produced by the food processing industry, while inorganic waste such as heavy metal is produced by the textile industry. Industries that carry out the combustion process produce gas waste.

2.2.3. Agricultural waste

The waste is originating from agricultural waste, and is usually in the form of inorganic compounds from chemicals used for agricultural activities, such as fertilizers, pesticides, and plant remnants.

2.2.4. Mining waste

It is originating from mining activities. This waste content mainly consists of mining material, e.g. metal or rock. The waste generated in some areas can be handled by recycling into raw materials for the production of paper, cardboard, plastic, metal, bottles, and so on. They also can be sold to flea markets or junk dealers who usually pass by in front of houses. This method can make waste or garbage that was originally uneconomical items to become economical ones and can make money from it. The items that can be sold include used paper, old newspapers, old magazines, old bottles, old tires, old radios, old TVs and worn bicycles.

Compost processing is usually for the type of organic waste that is piled in landfills (Troschinetz, 2008). Comprehensive waste management process must pay attention to some aspects of the source of waste, the location of the waste itself, the movement or circulation of waste, and the interaction of waste in an area. Well managed waste will be able to get out of the very complicated problems of the process of accumulation or disposal of waste,

as well as providing benefits or high economic value. Properly managed waste from sources can provide sufficient value to the financing through waste collection from the community. Polluter pays principle must be fulfilled to support the sustainability of waste management in economic terms. "However, if waste management is carried out simply or conventionally or too centralized, then of course it will require special subsidies from large local governments (Utami, et al. 2008)".

2.3. The Impact of Waste

2.3.1. Health

The waste can cause diseases. Potential health hazards that can be caused are as follows: 1) diarrheal disease, this disease occurs due to viruses originating from waste with improper management, and 2) Skin diseases such as scabies and ringworm.

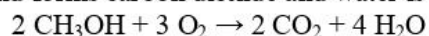
2.3.2. Environment

Liquid from waste that enters the river will pollute the water so that it contains disease viruses. Various fish can die so that they may eventually go extinct. Humans also consume or use water for daily activities, so that they will be affected directly or indirectly by the waste. In addition to polluting, environmental water also causes flooding because many people dump household waste into rivers, so the floodgates are clogged, and during the rainy season the water cannot flow and even rises and inundates people's homes which can disturb the residents.

2.4. Methanol

Methanol, also known as methyl alcohol, wood alcohol or spiritus, is a chemical compound with the chemical formula CH₃OH. It is the simplest form of alcohol. In "atmospheric conditions" it is liquid which is mild, volatile, flammable and toxic with characteristic odor (smelling lighter than ethanol). Methanol is used as an antifreeze coolant, solvent, fuel and as an additive for industrial ethanol.

Methanol is produced naturally by anaerobic metabolism by bacteria. The result of this process is methanol vapor (in small amounts) in the air. After a few days, the methanol vapor will be oxidized by oxygen with the help of sunlight into carbon dioxide and water. The chemical reaction of methanol that burns in the air and forms carbon dioxide and water is as follows:



Fire from methanol is usually colorless. Therefore, we must be careful when in close proximity to burning methanol to prevent injury from invisible fire. Because of its toxic nature, methanol is often used as an additive material for the manufacture of alcohol for industrial use. The addition of this "poison" will prevent the industry from being taxed because ethanol is the main ingredient for alcoholic beverages. Methanol is sometimes also referred to as wood alcohol because it was a by-product of wood distillation. It is currently produced through a multi-stage process. Briefly, natural gas and water vapor are burned in a furnace to form hydrogen gas and carbon monoxide; then, hydrogen and carbon monoxide gas react at high pressure with the help of a catalyst to produce methanol. The formation stage is endothermic and the synthesis stage is exothermic.

2.5. NaOH (Caustic Soda)

Sodium hydroxide (NaOH), also known as caustic soda, is a type of caustic metal base. Sodium Hydroxide is formed from basic oxides. Sodium Oxide is dissolved in water. It forms a strong alkaline solution when dissolved in water. It is used in various industrial fields, mostly used as a base in the production process of wood pulp and paper, textiles, drinking water, soap and detergents. Sodium hydroxide is the most common base used in chemical laboratories.

Pure sodium hydroxide is solid, white and available in the form of pellets, flakes, granules or 50% saturated solutions, commonly called Sorensen solutions. It is damp liquid and spontaneously absorbs carbon dioxide from free air. It is very soluble in water and will release heat when it is dissolved because the dissolution process in water reacts exothermically. It also dissolves in ethanol and methanol although the solubility of NaOH in these two liquids is smaller than the solubility of KOH. It does not dissolve in diethyl ether and other non-polar solvents. Sodium hydroxide solution will leave yellow stains on cloth and paper.

2.6. Charcoal Quality

Physical/chemical properties are very important in terms of determining the quality of charcoal. Charcoal consists of elements C, H, O and non-organic components (minerals). The composition of these elements in charcoal depends on the carbonization process, temperature and carbonization method. The other properties of charcoal contain high CO levels, little P, S, N elements and large absorption.

III. THE PURPOSE AND BENEFIT OF RESEARCH

3.1. The Purposes of Research

1. To overcome the waste problem being faced by PT. Royal Coconut Airmadidi.
2. To utilize the waste of processed oil as an alternative fuel for cooking.
3. To make an effective and efficient stove fuel.
4. To promote appropriate technology, especially stoves with fuel from the result of waste treatment.
5. To add insight, knowledge and experience for the researchers.
6. To test the benefits of wood charcoal and NaOH (caustic soda) in the process of purifying and diluting Free Fatty Acid (FFA) levels in the processed liquid waste solution.

3.2. The Benefits of Research

1. The community can use this stove fuel so that it can improve their economy.
2. The stove fuel can reduce pollution due to the use of kerosene and also reduce the accumulation of processed waste products at PT. Royal Coconut Airmadidi.
3. Adding knowledge, experience and insights, as well as references in the application of the science of research methods, especially regarding how to reuse something that is not used becomes something useful for the community.

IV. METHODS

This research is focused on liquid waste generated from the coconut flour production process at PT. Royal Coconut Airmadidi which is taken at a certain time with a certain amount.

Based on the above research problem formulation, the research variable is the addition of a solution of Methanol (Spiritus), NaOH (caustic soda) and activated carbon in the process of purifying and diluting the results of processing waste that has become used cooking oil.

This type of research is an experiment. This is a study to find out the outcome, whether there is a change or not after the treatment in this condition which is called experimental research (Sugiono, 2010). This experiment was carried out into 2 stages, namely the process of dilution and purification of the results of processing waste into fuel.

Method of collecting data

The methods used in this study are as follows: 1) Literature Study, used to obtain information, the theoretical basis obtained from books, the internet, which support this final research, and analysis and calculation of data obtained, 2) Interviews and discussions, carried out to add input and additional knowledge from the supervisor and other parties who are experienced in this field to be more focused, as well as discussions with fellow students in order to obtain input, correction, and comparison, 3) Field Studies, to obtain information and data from observations that can support in making the final project, including surveys to the research site, and 4) Documentation, secondary data collection that is shared by the respondent, and related technical agencies in the form of instructions and data related to the general description of the research location and visual photographs.

V. RESULTS

The Experimental Method is used by using kerosene and waste oil which has been mixed with methanol (spiritus) and NaOH to determine the absorption ratio between the two lamps.



Figure 1. Without mixing Methanol (spiritus) and NaOH (caustic soda)

In this process, the flame is not normal (small) and the absorption of the burner is fairly slow due to the nature of the oil which is still thick



Figure 2. Mixing methanol (spiritus) and NaOH (caustic soda)

In this treatment, the flame is greater and the absorption of the burner is faster than the results of waste treatment without mixing methanol (spiritus) and NaOH solutions.

The testing in this experiment as follows: 1) Measurement of fuel consumption from the HOCK stove and the lamp to get the ratio of consumption of fuel oil (kerosene and processed oil waste); and 2) Testing the oil absorption after being mixed with Methanol and NaOH (caustic soda)

Tools and Materials

The materials used in this study are 1 Liter processed oil from coconut flour industry liquid waste, 65 ml of Methanol (Spiritus), 2 tablespoons NaOH (caustic soda) and kerosene. While the tools used are knives, holding containers, wood charcoal, funnels, cotton, HOCK stove, oil lamp, lighters, and clock.

Implementation of the experiment

Dilution process

1 Liter processed oil from liquid waste + 65 ml of Methanol (spiritus) + 2 tbs NaOH

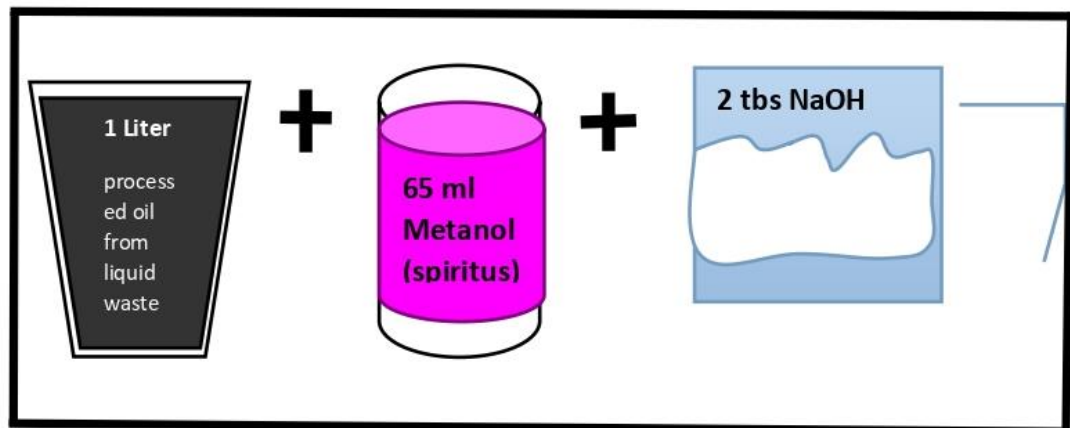


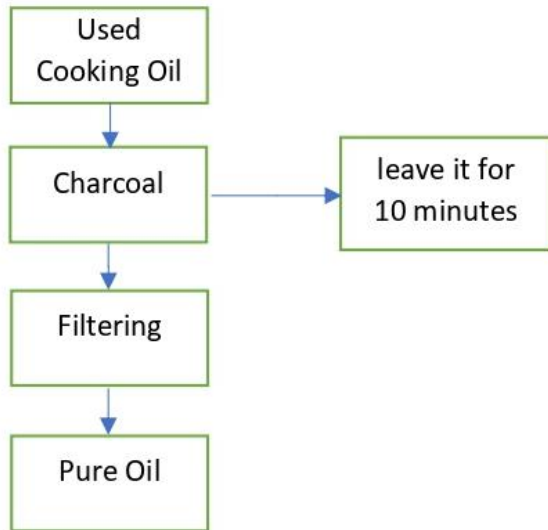
Figure 3. The process of dilution

In the dilution process, it is necessary to add solution of methanol (spiritus) and NaOH (caustic soda) so that the thickness of the oil from the processing of liquid waste can be eliminated.

Purification Process

1. Grind wood charcoal resembles fine powder with a knife into the provided container,
2. Pour the oil to be purified, leave it for 10 minutes,
3. Pour the oil into the filtering container that has been prepared. Repeat the steps 2-3 times until the oil is completely clear.

The flow diagram of the used cooking oil purification process is as follow:



In the picture above, (a) is the result of processing waste that has been heated many times so that there is a change in color which is jet black, and the property got thick, (b) is the result of the first purification by leaving it in a container containing wood charcoal powder for 10 minutes then filtered, and (c) is the result of purification using wood charcoal powder added with solution of methanol (spiritus) and NaOH (caustic soda) to make the thick oil became runny and the color became slightly purer (yellowish).

Discussion

1. Characteristics of Waste Management Results in PT. Royal Coconut. Waste used as raw material is obtained from the coconut flour industry of PT. Royal Coconut Airmadidi. Visually. This waste is black, turbid, and thick. The dark color is caused by the oxidation process to tocopherol (vitamin E), the extraction of dyes due to high temperature heating, and the reaction with metals such as Fe, Cu, and Mn (Ummy, 2008).



After the testing process with two oil lamps using different fuels namely kerosene and the results of processed waste that have been examined, it turned out that the use of the second one did not cause smoke just like the one produced by the lamp using kerosene. The drawback of this research is the aroma of oil that has not been completely eliminated even though it has been neutralized by wood charcoal. After being treated by adding different amounts of methanol (spiritus) and NaOH, the level of dilution of the waste treatment (used cooking oil) is indeed different.



In addition, after being treated as above while stirring for 5 minutes, the fat clot would occur which indicates the process of dilution of oil which makes it easy for absorption to the stove burner. As it is known, caustic soda has properties to dissolve fat tissue, therefore it needs to be careful in its use. Minimizing direct contact between skin and caustic soda is the first step of protecting yourself from its danger.

The function of caustic soda is quite diverse, especially in the manufacturing industry. Its benefit is as the mixture of the production of paper, textile, soap, detergent, drinking water, wood pulp and some chemical experiments in the laboratory.

2. Smoothing the Washing Pipeline. One of the functions of caustic soda in household life is as a tool or material to clean washing canals or even toilet channels that are stuck or clogged. The hard nature of caustic soda can dissolve the elements that block the drain in the sink or toilet.

3. For Cleaning. Another function of caustic soda is as a powerful cleanser to eradicate stubborn stains. It is usually mixed with water and washed on a dirty floor surface, moldy bathroom walls, and other surfaces covered with stains that are difficult to remove. But the level of use must be applied carefully because if it is too excessive, instead of cleaning the caustic soda will damage the surface. The hard nature of caustic soda is also widely used as an ingredient to fade motorcycle or car paint before the application of new paint.

4. Avoid Direct Touch. The benefits of caustic soda are indeed quite diverse. But behind these benefits, it has a negative effect on the body. It is indeed quite hard just like its use as an ingredient for peeling paint and repairing stuck sewerage. The mechanism of caustic soda in solving this problem by melting paint and dirt because of its hard nature. In medical world, caustic soda is indeed known as an element that dissolves fat tissue. Therefore, the skin will feel hot when having contact with caustic soda directly.

VI. CONCLUSION AND SUGGESTION

Conclusion

1. Wood charcoal can be used to purify the results of waste treatment while Methanol and NaOH (caustic soda) are useful as neutralizers of the fat content present in the processed coconut flour industry so that it can be used for alternative fuel.
2. Soaking time affects the expected oil purification results. The results of the study proves that the optimal of soaking time is 1 hour.
3. The results of this study can be followed up as an easy step to deal with the scarcity of oil fuel.

Suggestion

Based on the results obtained through this research, it is recommended to follow up the results of this study, and the commitment/encouragement of the government is needed so that the scarcity of fuel is easily overcome.

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