



Ecotourism Development in Sampangan Muncar Beach Banyuwangi

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Aims: This study aims to provide counseling on waste management and preservation of the coastal environment to support the development of ecotourism around Sampangan Beach as well as education using the pyrolysis method in waste management.

Study Design: To address the trash and ecotourism issues at Sampangan Beach, a pyrolysis device and a 3D model of the ecotourism beach were created.

Place and Duration of Study: This research was conducted at Sampangan Beach which is located in Sampangan Village, Muncar District, Banyuwangi Regency in June 2022 until July 2022.

Methodology: This study uses a qualitative approach by taking data through surveys to obtain facts from existing symptoms. Field observations and surveys of locals and visitors were conducted in preparation to ascertain the field circumstances at Sampangan Beach before constructing ecotourism beach tools and designs. Additionally, observations are done to learn about the issues, difficulties, and opportunities existing at the site. In addition, researchers read up on pyrolysis machinery and beach design in the literature. Waste management is carried out using the pyrolysis method. The population of this study is the apparatus of villages, environmental management, and communities living directly adjacent to coastal areas.

Results: Based on the analysis using a qualitative approach and waste management using the pyrolysis method, the results of the process of burning plastic waste using a pyrolysis tool are influenced by the type of plastic and the temperature of the reactor combustion. Pyrolysis

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combustion using 3 kg of LPG gas can be used in 3-4 waste-burning cycles, so this method is very good for reducing plastic waste, especially in the coastal area of Muncar Banyuwangi. As well as coastal communities with livelihoods as fishermen can reduce the cost of purchasing diesel by replacing fuel pyrolysis fuel when to catch fish. This 3D model concept that has been compiled follows the style of arranging places such as the beaches in Banyuwangi to increase tourist attraction and increase public comfort when traveling on Sampangan Beach.

Keywords: Waste processing; ecotourism; pyrolysis; marine activities; plastic waste; environment.

1. INTRODUCTION

Ecotourism as a behavior can be interpreted as visits to areas that are still natural where marine tourism activities are carried out to appreciate the potential of local resources and culture. This understanding grows the term ecotourism that we often hear, namely natural tourism. Ecotourism as an industry can explain that tourism activities in unspoiled areas need to be carried out through collaborative development between all actors, such as the government, the private sector, and the community. The relationship between tourism and conservation is expanded and improved by ecotourism [1]. The benefits obtained are not only to the perpetrators but especially to efforts to preserve the area and prosper the people. On a micro-scale, ecotourism activities produce studies of tourist products, packaging, quality, quantity, actors, and prices. Meanwhile, on the macro side, the ecotourism sector discusses economic share, income, labor, and economic linkages.

In its development which has many positive values, the concept of ecotourism has several criticisms at the time of its implementation, including environmental damage, low community participation in ecotourism, and wrong management. When viewed from an environmental aspect, there are ecotourism problems, namely air pollution, water pollution, and a decrease in environmental quality due to waste around tourist areas, one of which is in coastal areas that have an impact on the ocean as well. Muncar's side area, Banyuwangi Regency is one of the sedition areas in Indonesia with marine debris problems. Banyuwangi Regency Regional Regulation No. 8 of 2012 concerning RT RW in 2012-2032 stipulates Muncar District as a minapolitan area. The designation of Muncar District as a minapolitan area makes Muncar District have a main focus on the fisheries sector. This directly supports the economy of Banyuwangi Regency but is not accompanied by good environmental management. One of the beaches in Muncar

District that is of concern to the community around the beach due to a large number of garbage piles is Sampangan beach.

There are challenges that are impeding the expansion of plastic waste recycling. Aside from the economic impossibility, there are numerous technical challenges. When dealing with more difficult plastic products such as multi-layer materials or plastics containing harmful substances as additives such as brominated flame retardants, phthalates, and so on, the complexity of plastic recycling increases [2]. Due to the additional costs associated with its recovery and the intensive labor required in the separation of its components, recycling plastic waste has been regarded as an unappealing option. The ever-increasing burden of plastic waste encourages the development of alternative waste-management technologies. This is also necessary due to the limitations of recycling methods. In a number of published papers, there has been increased interest in the conversion of plastic waste into value added chemicals and fuel products on conventional and microwave assisted pyrolysis [3]. Alston et al. [4] assessed the environmental impact of pyrolysis, incineration, and landfill of waste electrical and electronic equipment containing up to 25% plastics. They discovered that the main impact of landfill was the need for a large amount of land and the emission of pollutants.

The problem of waste in Sampangan Beach needs to be solved so that environmental pollution is not sustainable and the beach area can be used to increase the community's economy by developing ecotourism. Therefore, the purpose of this study is to assist in waste management at Sampangan Beach and develop ecotourism in the area around Sampangan Beach. In addition, it is necessary to provide counseling related to waste management by utilizing the pyrolysis method and the design of tour packages that are of high value and can support the development of ecotourism in the Muncar Coastal area, especially Sampangan Beach and its surroundings.

2. METHODOLOGY

This study uses a qualitative approach by taking data through observations and surveys to obtain facts from existing symptoms. In this approach, the researcher creates a complex picture, examines words, reports detailed views of the respondents, and conducts studies in natural situations [5]. In qualitative research, the researcher is the key instrument. In qualitative research, researchers must have the provision of theory and broad insight so that they can ask, analyze, and construct the object under study to be clearer. Qualitative research is used if the problem is not yet clear, to find out the hidden meaning, to understand social interaction, to develop the theory, and to ensure the correctness of the data.

This research focuses on the six villages of ecotourism development in the coastal areas of Sampangan Beach which is located in Sampangan Village, Muncar District, Banyuwangi Regency. Before creating ecotourism beach tools and designs, observations were done to ascertain the circumstances at the research location, namely at Sampangan Beach. The outcomes of observations are expected to capture behavior and events as they actually take place under actual conditions and to convey truth based on firsthand experience. These findings should enable knowledge of the context, issues, challenges, and possibilities existing there, as well as provide a variety of other relevant data. After the observation stage, the survey approach is used to collect data from the observed symptoms and seek for factual information about the local social and economic institutions. Questionnaires were addressed to village officials, environmental management (Department of the Environment) and communities living next to coastal areas. A visual description of garbage management operations in six communities along the seaside is provided along with an explanation of waste management techniques. To support the information obtained from the survey results, literature reviews and other research were done in addition to using the survey data. A literature review was conducted with the intention of gathering written fundamentals and opinions by looking at various publications on waste management that served as a basis for comparing theory and practice in the area. Furthermore, a documentation study is conducted to gather and examine textual, visual, and electronic records.

Waste management in coastal areas is carried out using the pyrolysis method. Pyrolysis is a process of chemical decomposition of organic matter through a heating process without or a little oxygen or other material consumed during a chemical reaction, where the raw material will undergo the breakdown of chemical structures into a gas phase. The gas will later be flowed into the iron pipe to be cooled so that there is a change in form from gas to liquid which will become pyrolysis oil.

Research steps:

- 1) Conducting the observation process.
- 2) Conducting survey methods to obtain facts from existing symptoms and looking for factual information.
- 3) Conducting literature and documentation studies to support the facts that have been obtained from the survey results.
- 4) For waste management in coastal areas is carried out using the pyrolysis method.

2.1 Muncar Coastal

Muncar Subdistrict is the main fish landing place with the largest fish catch in Banyuwangi Regency. Perdana [6] mentioned that the problem found in Muncar was a decrease in lemuru fish stocks, which made the productivity of lemuru fishermen in the Muncar area decrease every year. One of the marine resources that have been overexploited is the fishery resources in Muncar. Exploitation in this case is lemuru fish. According to Setyaningrum [7], Muncar's fishery resource stocks have experienced over fishing conditions and the number is decreasing.

Muncar's side area, Banyuwangi Regency is one of the sidition areas in Indonesia with marine debris problems. Banyuwangi Regency Regional Regulation No. 8 of 2012 concerning RTRW in 2012-2032 stipulates Muncar District as a minapolitan area. The designation of Muncar District as a minapolitan area makes Muncar District have a main focus on the fisheries sector. This directly supports the economy of Banyuwangi Regency, but is not accompanied by good environmental management.

The problem of marine debris in Muncar District will affect the sustainability of Muncar District as a minapolitan area. Marine debris is one of the causes of the decline in the quantity and quality of fish in various coastal areas. In addition, the coastal environment will also be polluted such as

at Sampangan Beach which is famous for the beauty of white sand and big waves but the beauty is covered by piles of plastic waste along the coast and large waves bringing garbage into the ocean.

2.2 Pyrolysis Method

Pyrolysis is a process of thermal decomposition of materials formed by polymer chains such as plastics or organic materials such as biomass by combustion without direct contact with oxygen. This pyrolysis process is carried out in several stages. First, the PPE sample will be put into a nitrogen-fed reactor. Next, such reactors are connected with the end of the condenser. Inside the condenser, the gas will be cooled with running water so that condensation occurs. Pyrolysis was performed using a temperature of 450°C for 30 minutes. Pyrolysis products might consist of two kinds of gas products, namely, gas that will be condensed into oil (settles at the bottom of the condenser) and gas that is not condensed (flows into the filter tube), so that it is cleaner and has minimal impurities. The pyrolysis scheme can be seen in Fig. 2.

The pyrolysis process produce in the form of solids, liquids, and gases. At this temperature polymeric materials such as plastics will undergo a phase change into a gas phase. In the process, there will be a shorter cut of the hydrocarbon chain. The gas that is still hot is continued with the cooling process so that the gas is condensed into a liquid. This liquid is the final product of pyrolysis that can be used as fuel ([8] in [9]). The plastic pyrolysis process has three stages of decomposition, including:

1. Randomly cut polymer chains becomes shorter.
2. The occurrence of cutting at the end of the molecular chain.
3. The occurrence of separation in polymer chains resulting in the formation of smaller molecules

These stages will be directly related to the dissociation of their bonds, the degree of aromatic, as well as the non-uniformity of the atomic chain in the polymer chain. In many cases this process takes place simultaneously [10] (in [8]).



Fig. 1. Sampangan beach conditions

Source: Researcher (2022)

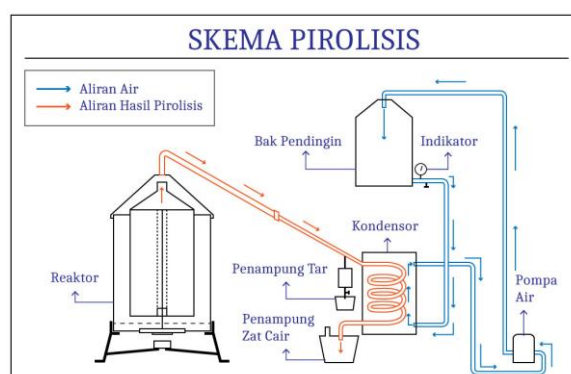


Fig. 2. Pyrolysis scheme

Source: Researcher (2022)

2.3 Ecotourism

Suprayitno [11] said that ecotourism is a model of responsible natural tourism in unspoiled areas or naturally managed areas that have the aim of enjoying the beauty of nature by involving elements of education and support for conservation efforts and increasing the economic income of local communities [7]. Based on this definition, ecotourism can be seen from three perspectives, namely:

- a. Ecotourism as a product. Ecotourism is all attractions based on natural resources.
- b. Ecotourism as a market, Ecotourism is a journey directed at environmental conservation efforts.
- c. Ecotourism as a development approach. Ecotourism is a method of utilizing and managing tourism resources environmentally.

Tourism activities that are responsible for the welfare of local communities and the preservation of the environment are highly emphasized and are characteristic of ecotourism. Parties who play an important role in ecotourism are not only tourists but also other tourist actors (tour operators) who facilitate tourists to show this responsibility [12].

The construction of ecotourism must pay attention to environmental preservation. With the attention to environmental sustainability, it can minimize damage to the environment caused by excessive development so that an ecotourism will be sustainable and the development is not to be used in the present but also to be used and felt by the future.

3. RESULTS AND DISCUSSION

3.1 Integrated Plastic Waste Pyrolysis System

This integrated plastic waste pyrolysis system is aimed at reducing plastic waste on the coastline of Muncar sampangan, Banyuwangi Regency. The full scheme of this system can be seen in Fig. 1. Plastic waste located in the coastal area of sampangan is taken and separated by type and color, the waste is then put into a pyrolysis reactor and carried out combustion. The energy source used for heating the pyrolysis reactor can be used several tools and materials, the first can be used semawar stove, the second can be utilized wood located on the coastline of the sampangan originating from the sea as a source of heat energy combustion of the pyrolysis

reactor, the third can be utilized tar residue as the energy source of combustion of the pyrolysis tool for the next cycle.

Oil from pyrolysis can be used on a small scale, namely by being used as an additional supply of fishermen's fuel for catching fish. In addition, tar residues in addition to being used as a source of thermal energy for the combustion of pyrolysis reactors can also be used as an auxiliary material for making pots with cement. With this integrated system, the problem of plastic waste is expected to be solved without the need for additional energy and at the same time getting oil from the pyrolysis process to be utilized by the community.

3.2 Pyrolysis

Pyrolysis tools are a waste burning technique as well as distillation of materials without O₂ with high temperatures and the gas produced is useful and safe for the environment, this is because the final product produced is in the form of CO₂ and H₂O. in addition to gases, liquid hydrocarbon compounds from C₁ to C₄ are also obtained and long-chain compounds such as paraffins and olefins. The final product result of this pyrolysis process depends on the type of plastic being burned. Furthermore, plastic waste management using the pyrolysis method also has the advantages of low energy consumption, can overcome plastic waste that cannot be recycled, operates without the need for air or hydrogen mixture and does not require high pressure. As well as solids residues from the pyrolysis process are also utilized in various ways.

The components in the pyrolysis tool correspond to the number in the figure below as follows:

- 1) Reactor
- 2) Connecting pipes
- 3) Temperature sensor
- 4) Condenser Tube
- 5) Spooling tubes

The manufacture of pyrolysis tools is carried out for 2 weeks from June 29, 2022 to July 14, 2022, the components of the pyrolysis tool are made according to the literature used, namely non-catalyzed pyrolysis tools. The implementation of this technology is focused on a small scale, namely to reduce the mitigation of plastic waste in the coastal areas of Sampangan. The tool is designed and modified according to the availability of existing materials, here is the design of the pyrolysis tool.

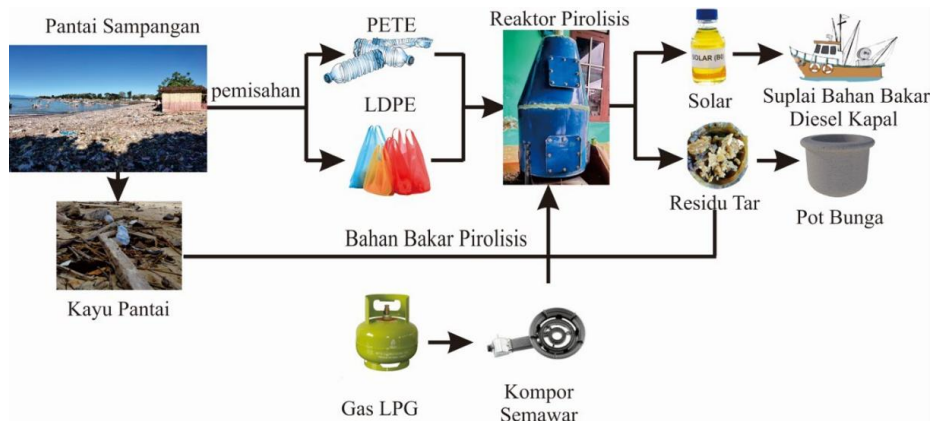


Fig. 3. The concept of integration of plastic waste pyrolysis system
Source: Researcher (2022)

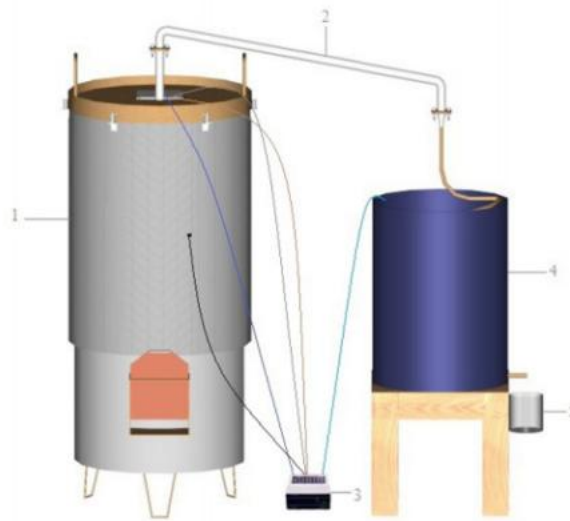


Fig. 4. Components of pyrolysis tool
Source: Researcher (2022)

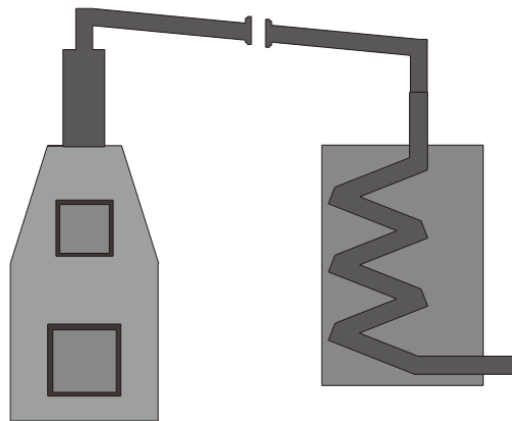


Fig. 5. Pyrolysis tool design
Source: Researcher (2022)

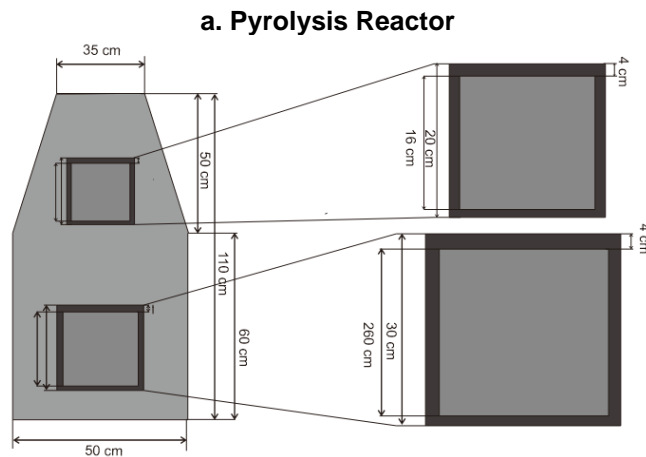


Fig. 6. Pyrolysis

Source: Researcher (2022)

The pyrolysis reactor functions as a decomposing device for plastic compounds which is carried out by heating process without being directly related to air or vacuum with temperatures reaching 300 to 600 degrees Celsius. Pyrolysis process It produces substances in three forms namely solid (Tar) liquid (BBM) and gas. The pyrolysis reactor is made pursing which aims for the resulting plastic vapor to easily enter the pipeline. The pyrolysis reactor is equipped with 2 doors, the upper door is used to feed in plastic waste and the lower door is used to pick up residues from the combustion of the pyrolysis reactor The door must be in a vacuum state, The vacuuming of the reactor is used solid silica resistant to heat formed according to the reactor cover. In addition, it can also be prepared by using used items such as tire rubber.

The connecting pipe functions as a link between the reactor and the conveyor where the evaporating gas will pass through the pipe. The shape of the pipe is made slightly tilted, this is so that the plastic vapor produced is forced to go down and into the condenser. In addition, the connecting pipe is divided into 2 parts aimed at facilitating the mobility of the pyrolysis tool when it is moved.

Condenser Serves as a fluid coolant. Condensation occurs because the temperature of the material is below the saturation temperature of the gas, then in gas there is a phase change to liquid. Inside the condenser itself is only in the contents of water as a coolant. As in Fig. 6, the condenser pipe is made into a zigzag of 4 pieces which aims to prevent steam

from being blocked for a long time in the condenser pipe so that there can be a phase change from gas to liquid.

The pyrolysis tool uses several materials including three used drums, iron pipes, heat-resistant solid silica, probolte bolts and faucets. The capacity of the pyrolysis tool that has been made is able to reach 20–25 kg of plastic waste. The reactor burning media can use a stove or firewood with a combustion duration of up to 1 -4 hours depending on the amount of plastic waste burned. The combustion process of the reactor is in a vacuum state where there is no gap for steam from inside the reactor to come out, this is possible if the steam comes out, it will affect the amount of fuel produced from the pyrolysis process. Refractory vacuuming is used heat-resistant solid silica formed according to the reactor cover. In addition, it can also be prepared by using used items such as tire rubber.

The pyrolysis tool is expected to be able to reduce the amount of plastic waste in the coastal area of Muncar Banyuwangi sampangan, plastic waste used in the pyrolysis process comes from sampangan beach and household plastic from communities in the sampangan coastal area. The plastics used in the pyrolysis process are separated by type and color. The separation of plastic waste aims to make the color of the fuel produced, namely clear yellow. The separation carried out based on the first type is drinking bottle waste with pete or PET type (polyethylene Terephthalte and plastic waste such as plastic bags (crackles) and food marks with the type of LDPE (low density polyethylene). Here are the plastic images separated by color and type.

b. Connecting Pipes

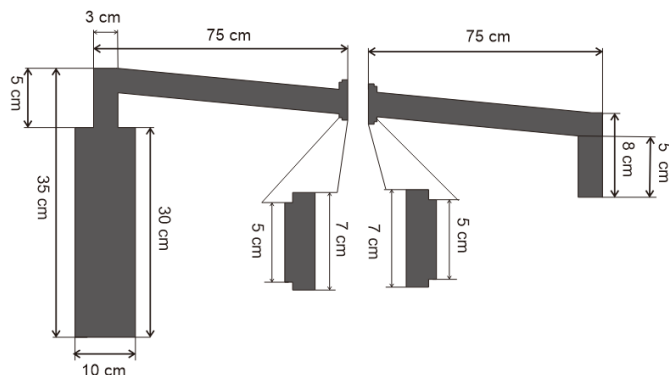


Fig. 7. Connecting pipes
Source: Researcher (2022)

c. Condenser

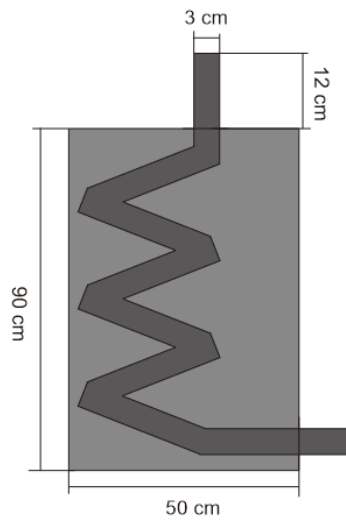


Fig. 8. Condenser
Source: Researcher (2022)



Fig. 9. Pyrolysis tool manufacturing results
Source: Researcher (2022)



Fig. 10. (a) PETE Plastic, (b) LDPE Plastic

Source: Researcher (2022)

The result of the process of incineration of plastic waste in the reactor is influenced by the type of plastic and the temperature of the reactor combustion. Burning plastic waste with homogeneous types and colors will produce fuel colors and better quality. On the other hand, the burning of plastic waste with heterogeneous types and colors will produce a murky fuel color. In addition, the influence of temperature in the expansion of plastic waste is that the higher the feeding temperature, the more fuel is produced and the less gas.

The incineration process is carried out for 3 hours with the use of plastic waste taken in the coastal area of Sampangan in the sampangan coastal area of 9 kg. The plastic used is plastic with the PETE type, first the plastic waste is dried by drying. This is done in order to obtain good quality oil. In addition, water can interfere with the combustion process inside the reactor. The plastic used covers the mineral water bottle with no lid and label, so that the reactor can hold a lot of plastic, the plastic is prepared by pressing and chopped. During the combustion process of the reactor, the condition of the fire in the vigil is kept constant. Produced 1 L of motor fuel (diesel) and tar. The following are the results of the pyrolysis process and the resulting residues.

A total of 9 kg of burnt plastic waste can produce 1 L of fuel with clear yellow criteria, compared to conventional fuel (Solar), fuel from the pyrolysis process is easier to ignite compared to diesel. In addition, the pyrolysis fuel has a more pungent odor compared to diesel. The pyrolysis fuel has a higher pour point compared to diesel, so in this

case the pyrolysis fuel cannot be stored or is in a place with a low temperature because there will be fuel freezing. Furthermore, from the combustion process also produced gas and solid, according to [4] the composition of the gas fraction of the pyrolysis process is dominated by propane and propene compounds which indicate the gas products produced are equivalent to LPG gas whose main component is propane, but in this case, the KKN team only focuses on the oil produced from the pyrolysis process, in addition, there have been no advanced stages in gas isolating from the pyrolysis process. The oil produced from this pyrolysis process can generally be used to replace diesel fuel in diesel engines both as a single fuel and a mixture with diesel. According to [4] the calorific value of pyrolysis oil does not have a significant difference compared to diesel so it is suitable for use as a substitute for diesel. Another product produced from the pyrolysis process is tar, as in Fig. 9 (b) tar has a solid form like wax, tar can also be used in various ways including being able to be used as a flame igniter and burner for non-food products. In addition, tar can also be used as a raw material for pot-making mixtures using cement.

Pyrolysis combustion using 3 kg OF LPG gas can be used in 3-4 waste burning cycles, so this method is very good for reducing plastic waste, especially in the coastal area of Muncar Banyuwangi. In addition, coastal communities with livelihoods as fishermen can reduce the cost of purchasing diesel by replacing fuel pyrolysis when to catch fish.

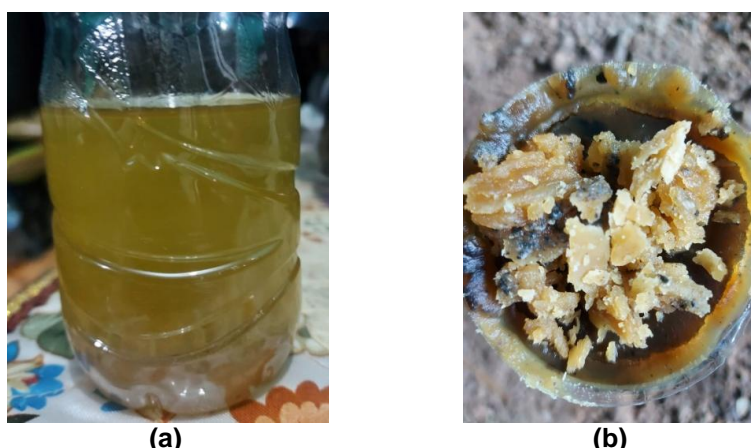


Fig. 11. (a) Diesel Fuel, (b) Tar Residue

Source: Researcher (2022)

4. CONCLUSION

Based on the results and discussion in the previous chapter, the following conclusions can be drawn.

1. The result of the process of incineration of plastic waste with a pyrolysis device is influenced by the type of plastic and the temperature of the reactor combustion. Pyrolysis combustion using 3 kg OF LPG gas can be used in 3-4 waste burning cycles, so this method is very good for reducing plastic waste, especially in the coastal area of Muncar Banyuwangi. In addition, coastal communities with livelihoods as fishermen can reduce the cost of purchasing diesel by replacing fuel pyrolysis when to catch fish.
2. This 3D Modelling concept that has been compiled follows the style of arranging places such as the beaches in Banyuwangi to increase tourist attraction and increase public comfort when traveling on Sampangan Beach.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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