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Micro-Scale Liquid Smoke Extraction as a By-Product from Coconut Shell Charcoal Production in Kotabatu Village

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Abstract

Liquid smoke is produced from the pyrolysis process and condensation from the coconut shell waste combustion process. This liquid smoke is known to have a high level of polyphenol content and is used as a rubber processing, deodorizing, and wood preservative to make it resistant to termites. In addition, it can also be used as an insecticide for plants. This community service is carried out to design and manufacture a micro-scale liquid smoke pyrolysis machine, which is expected to reduce the amount of smoke produced during the charcoal burning process, also to help partners create an additional type of product, namely liquid smoke. for plant insecticides so that it will increase partners' monthly income. The method that will be used in achieving this goal is to provide training and practice to partners on how to process cranium waste other than into charcoal, namely into liquid smoke as an insecticide in plants. The result of this community service is liquid smoke as a by-product of coconut shell charcoal production which is used as an insecticide, besides that there is also a good relationship between community service implementers and coconut shell charcoal farmer groups in Kotabatu Village.

Keywords: liquid smoke, pyrolysis, coconut shell.

1. Introduction

Coconut tree (Cocos nucifera L.) is an important tropical plant for Asian and Pacific countries, especially as a producer of copra (Suliyanto and Jati, 2013). Coconut is called the tree of life because coconut is a versatile plant whose almost all parts are beneficial to human life (Alouw and Wulandari, 2020). In the Asean Pacific Coconut Community (APCC) in 2000, in Indonesia there are coconut plantations covering an area of 3.7 million hectares. In Indonesia, people have used coconut shells for various purposes, ranging from handicrafts to their use as structural elements in buildings. Meanwhile, the processed products are burned and disposed of so that they become waste. Based on this background, the solution to this problem is to utilize coconut shell waste. Making charcoal from coconut shells that has been done by farmers in the village of Kotabatu still uses the traditional way, namely by burning it directly in a drum over a flame.

The farmers making charcoal from coconut shells in Kotabatu village still use traditional methods in the production process (See Figure 1). This has drawn protests from the community around the production site and has caused various environmental problems, one of which is the occurrence of air pollution from thick smoke produced from the burning process of coconut shells.

Figure 1. Conventional coconut shell charcoal making process

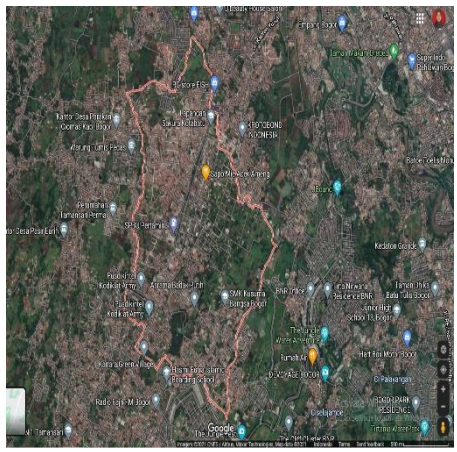

Figure 2. Kotabatu Village

The Kotabatu village is a fairly densely populated village, so residents who are close to the location of making charcoal from coconut shells have also complained about this situation, because every time the farmers start the production process, thick smoke from this burning process often enter the houses of local residents and greatly interfere with daily activities (See Figure 2). Based on the analysis of the situation above, the problems experienced by partners can be formulated as follows:

a. After conducting a field survey, it can be seen that the process of producing charcoal from coconut shells in Kotabatu village is still using the traditional method.
b. Based on data from the Village office, Kotabatu has a fairly densely populated location with a population of 22,615 people with 5766 families, so that the traditional coconut shell charcoal production process causes air pollution and disturbs the surrounding community, it must be changed into an environmentally friendly production process.
c. The less broad market reach and the lack of innovative products produced have caused the monthly income to remain relatively constant and even decrease when viewed from the increase in the Basic Electricity Tariff (TDL) and basic materials.
d. In 2019, based on reports on the Republika.co.id page, joint officers ordered the closure of the coconut shell charcoal burning business in Kampung Rawa Malang, Cilincing, North Jakarta. This control is carried out to follow up on a number of factories which are indicated to have polluted air due to charcoal burning in the area. This case is similar to the problem of partners, namely coconut shell charcoal farmers in Kotabatu village, of course the farmers also do not want to repeat the same mistakes as in this case. Therefore, efforts are needed to help resolve partner problems.

The solution to the partner's problem is to design and manufacture a micro-scale liquid smoke pyrolysis machine. Coconut shell liquid smoke is the result of condensation of coconut shell smoke through the pyrolysis process at a temperature of around 400 0C. Liquid smoke contains various chemical components such as phenols, aldehydes, ketones, organic acids, alcohols and esters (Guillen et al. 2002; Kailaku et al., 2007). These various chemical components can act as antioxidants and antimicrobials as well as give the effect of the color and distinctive taste of smoke in food products (Šimko, 2005; Soldera, 2008). By designing and manufacturing a micro-scale liquid smoke pyrolysis machine (Sipahutar et al., 2020), it is hoped that it can reduce the amount of smoke produced during the charcoal burning process and also help partners create a new type of product, namely liquid smoke for plant insecticides so that it will increase partners' income. per month.

2. Research Methods

Community service will be held in April – September 2021 in the village of Kotabatu GG. Guava Rt. 003/015, Kelurahan Kotabatu, Kecamatan Ciomas, Kabupaten Bogor 16610. In general, the method of implementing the activities refers to the following steps: The first activity is a survey of the coconut shell charcoal production process in Kotabatu village, the second is training for farmer groups on how to make liquid smoke. from the by-product of coconut shell charcoal production, the third is the practice of pyrolysis to obtain liquid smoke, the fourth is the practice of making various types of packaging and labeling liquid smoke as a plant insecticide in various sizes. The fifth activity is an evaluation of the success of each activity. If in the evaluation there are indications that the implementation of the activity has not achieved the results according to the minimum target set, then the target that has not been achieved will be repeated until the target is achieved.

2.1. Principle of Liquid Smoke Production

Making liquid smoke using the pyrolysis method, namely decomposition with the help of heat in the absence of oxygen or with a limited amount of oxygen. Usually there are three products in the pyrolysis process, namely: gas, pyrolysis oil, and charcoal, the proportion of which depends on the pyrolysis method, biomass characteristics and reaction parameters. There are several ways to utilize the energy stored in biomass through pyrolysis. Direct combustion is the oldest method used. Burned biomass can directly generate heat but this method only has an efficiency of about 10%. Another way is to convert the biomass into liquid. This method is used because of its advantages in the form of ease of storage, transportation, and combustion. The liquid produced from biomass processing can be in the form of crude bio-oil. The following is a schematic of the pyrolysis concept (Figure 3).

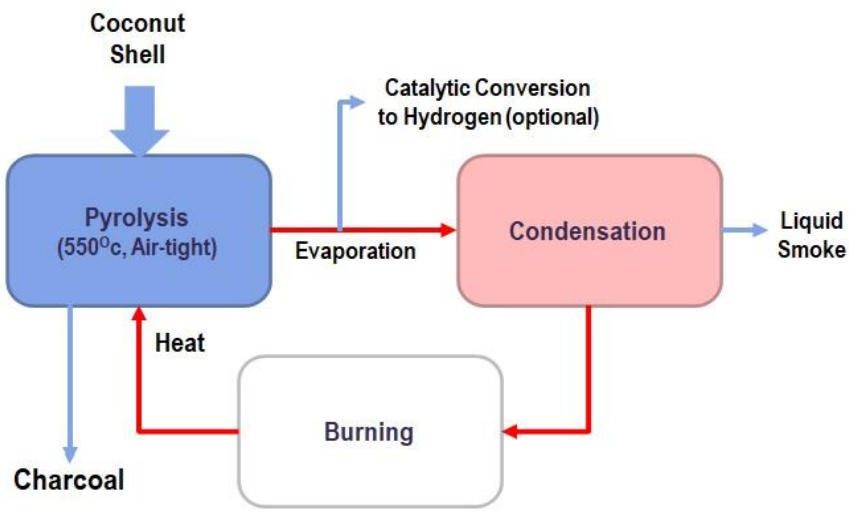

Figure 3. Pyrolysis Process

2.2. Tools and Materials

The equipment used to build an installation for making liquid smoke can be assembled yourself, of course with certain standards such as tightness, strength and safety in operation. Equipment and materials needed:

1. Combustion vessel, combustion chamber, tar/liquid smoke reservoir, distillator can be made of stainless steel or modified iron drum as shown above.

2. Modified iron pipe shaped like the picture above
3. The heating device can be in the form of a blower and or can use husk/charcoal
4. PVC pipe (customized quantity and size)
5. Water pump
6. Water tank and supports

2.3. Liquid Smoke Production Process

The raw material for the manufacture of liquid smoke is coconut shell which is described as follows:

a. Before being put into the pyrolysis reactor, first the pieces of coconut shell are cleaned of the remaining dirt. Then it is cut again into several parts so that the surface area of the combustion becomes wider so that the process can run faster.
b. Furthermore, drying is done by drying (in the air), to reduce the water content in the coconut shell.
c. Then proceed with the pyrolysis method, using the tool shown in Figure 4. Which is a reaction process for the decomposition of the compounds that make up hardwood into several organic compounds through dry combustion reactions without oxygen. This reaction takes place in the pyrolysis reactor which works at a temperature of 300-650oC for 8 hours of combustion.
d. The combustion smoke is condensed with a condenser in the form of a circular coil. The results of the pyrolysis distillate process obtained products namely grade 3 liquid smoke, tar, and charcoal. Condensation is carried out with a circular coil mounted in a cooling bath. Cooling water can come from rainwater that is stored in reservoirs, well water, river water or PDAM.

Figure 4. Tools needed to make a micro-installation

3. Results and Discussion

The manufacture of liquid smoke using the pyrolysis method begins with making installations from materials that have been prepared. The following in the picture is the initial process of designing a micro installation for the manufacture of liquid smoke. The next process after the micro installation is made is an experiment using the installation tool. So, the materials used are coconut shells as the main raw material for making charcoal. Figure 5 is a micro installation for making liquid smoke.

Coconut shell pyrolysis produces 30% liquid smoke. The liquid smoke obtained is dark brown in color as shown in Figure 6. The pyrolysis temperature is around 350 - 400oC. In the pyrolysis process, the pyrolysis tube is only filled with half the coconut shell, this is done so that all the materials in the pyrolysis tube get an even combustion heat. After 40-50 minutes of the heating process, the coconut shell smoke begins to flow into the condenser pipe which is continuously fed with water so that the smoke can be liquefied. During the pyrolysis process there is a small amount of smoke that cannot be liquefied and the gas is flammable. The pyrolysis process was stopped after no more liquid smoke distillate dripped into the container. Karseno (2002) explained that the composition of the yield obtained was also highly

dependent on the condensation system. Pyrolysis at temperatures that are too high and for too long will cause the formation of liquid smoke to decrease because the temperature in the cooling water is increasing so that the smoke produced is not condensed optimally (Adeleke, 2021; Demirbas and Arin, 2002; Haseli et al., 2011). The condensation process will take place optimally if the water in the cooling system is flowed continuously so that the temperature in the cooling system does not increase (Sari, 2021).

Figure 5. Micro installation for making liquid smoke

Figure 6. Grade 3 liquid smoke

Polycyclic Aromatic Hydrocarbons (PAH) include chemical components that can be formed in the manufacture of coconut shell liquid smoke. PAHs and their derivatives are mostly carcinogenic (Stolyhwo, 2005). One of the PAH compounds is Benzo[a]pyrene which is found in smoking products. Based on the results of research by Budijanto et al. (2018), it was stated that the results of the safety test of coconut shell liquid smoke had an LD50 value greater than 15,000 mg/kg body weight of mice, so it was categorized as a non-toxic material and safe to use for food products. These results are supported by the identification of components of coconut shell liquid smoke with the GC-MS instrument which shows that there are 7 dominant components, namely 2-Methoxyphenol (guaiacol), 3,4-Dimethoxyphenol, Phenol, 2-methoxy-4-methylphenol, 4- Ethyl-2-methoxyphenol, 3-Methylphenol, and 5-Methyl-1,2,3-trimethoxybenzene, and there were no carcinogenic Policyclyc Aromatic Hydrocarbons (PAHs) including benzo[a]pyrene in liquid smoke. In general, coconut shell liquid smoke can be used as an alternative preservative that is safe for consumption, and provides sensory characteristics in the form of aroma, color, and distinctive taste in food products. However, the results of this liquid smoke production are classified as grade 3 liquid smoke, which can only be utilized is the content of the carbonyl compound group which acts as a flavoring agent for insecticides on plants.

4. Conclusion

Coconut shell charcoal farmer groups in Kotabatu Village can do how to make liquid smoke as a by-product of coconut shell charcoal production, coconut shell charcoal farmer groups give a positive response to the utilization of coconut shell waste into liquid smoke to be used as plant insecticides, and there is a good relationship. both between the people of Kotabatu Village and community service implementers and the community of coconut shell charcoal farmer groups in Kotabatu Village.

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