

# Design and Development of Coconut Shell Charcoal Machine using Pyrolysis method

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**Abstract.** Coconut shell, a solid waste product from the processing of coconut meat for milk, is the focus of this study. Coconut shells are generally used for fuel, household purposes, or souvenirs. The design of this coconut shell charcoal-making machine is made from a used steel drum with a tube inside that comes from a used steel can. The pyrolysis method used in this study involves processing coconut shell charcoal in a way that does not come into direct contact with oxygen. This treatment is expected that the coconut shell charcoal produced has low water and ash content. The pyrolysis process lasts 2 hours with the average temperature in the combustion furnace at 417 °C. In this study, 7 kg of raw material was tested, and after a 2-hour pyrolysis process, 5 kg of coconut shell charcoal was produced by using 26.000 kcal.

**Keywords:** coconut shell charcoal, design, pyrolysis

## 1 Introduction

Coconut shell is the solid waste from processed coconut that has been taken from coconut meat to get coconut milk. Coconut shells are generally used for fuel, household purposes, or souvenirs. Indonesia is one of the world's largest producers of coconuts. Indonesia's head production according to the statistics agency was 2,839.90 thousand tons in 2019 and 2,811.90 tons in 2020. Jambi Province is one of the coconut producers in Sumatra with an average production of 108.90 thousand tons in 2019 and 109.60 tons in 2020 [1].

Coconut shells can also be processed into coconut shell charcoal. The chemical content of activated charcoal is a carbon compound, very useful for the purification process of liquid materials, both organic and inorganic materials which have been researched by Suhartana in 2006 [2].

In 2013, Gilar S. Pambayun conducted research on coconut shell charcoal by making activated carbon from coconut shell charcoal by SII No.0258 – 79. This research showed that activated carbon can be prepared from coconut shell charcoal with chemical activation of ZnCl<sub>2</sub> and

Na<sub>2</sub>CO<sub>3</sub> accompanied by pyrolysis at 700 °C for 4 hours. The characteristics of activated carbon produced are by SII No.0258-79, moisture content of 0.382-1.619%, ash content 2.28-7.79%, iodine number 448.02-1599.72 mg/g, surface area 189.630-1900.69 m<sup>2</sup>/g. The higher the concentration of the activator, the higher the percent removal of phenol that has been adsorbed by activated carbon. The highest percent removal was obtained in activated carbon with 5% Na<sub>2</sub>CO<sub>3</sub> activator with a removal percent of 99.745%. The optimum capacity of phenol absorption with activated carbon from coconut shell charcoal is best obtained on activated carbon with a 5% Na<sub>2</sub>CO<sub>3</sub> activator with an absorption capacity of 220,751 mg phenol/gram of activated carbon [3].

Siti Jamilatun and friends researched making activated charcoal from coconut shells in 2015. The result of this study is to obtain activated charcoal by utilizing Potassium Hydroxide 2N [4]. Coconut shell charcoal can also be used as the main raw material to make a briquette. The manufacture of briquettes was carried out by Edy Wibowo Kurniawan et al. in 2019 with a research study of the Characteristics of Coconut Shell Briquettes with Various Types of Briquette Adhesives [5].

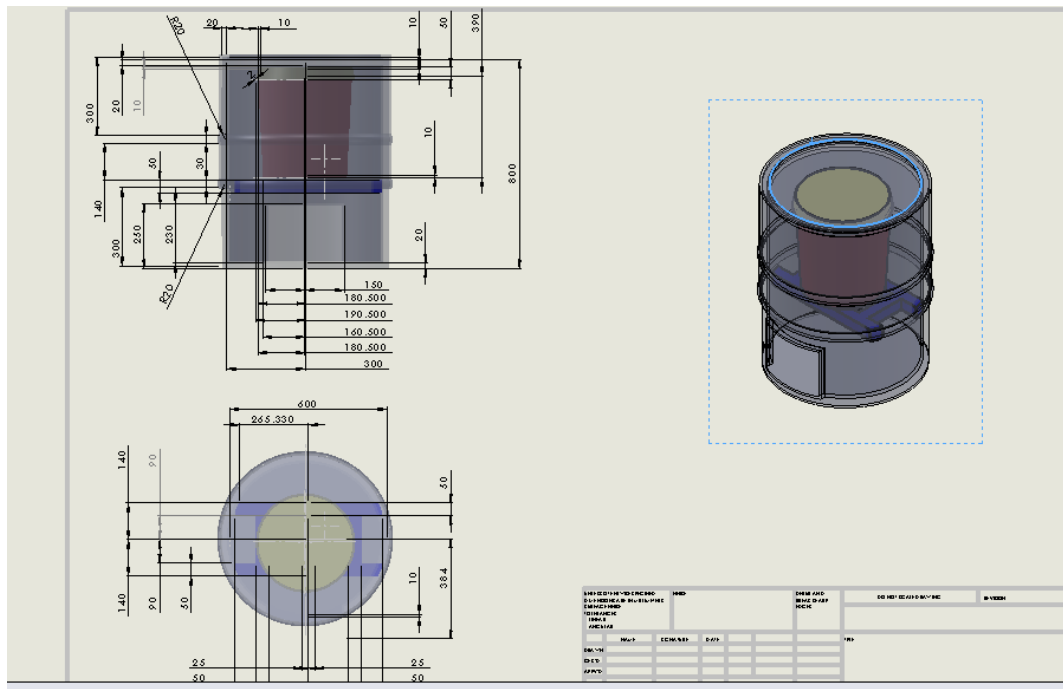
In 2014, research on Making Activated Charcoal from Coconut Shell and Its Application for Liquid Smoke Purification was conducted by Siti Jamilatun et al. The result obtained is that pyrolyzed coconut shell charcoal is carried out by a chemical process and then used as a tool to produce clear, odorless water and has a standard pH (7.0 - 7.5) [6].

One way to utilize this coconut shell waste is to process the waste into coconut shell charcoal by burning it. The general public usually extinguishes fires by pouring water on the coconut shell charcoal condensation process. After the charcoal is obtained, the drying process is carried out by drying in the sun until it dries. This series of processes obtained charcoal quality with high moisture content. In addition, the results of the combustion produce a lot of ash. Therefore, this research focuses on making tools used to produce coconut shell charcoal by using the principle of pyrolysis.

## **2 Research Method**

The pyrolysis method used in this study involves processing coconut shell charcoal in a way that does not come into direct contact with oxygen [4]. This treatment is expected that the coconut shell charcoal produced has low water and ash content.

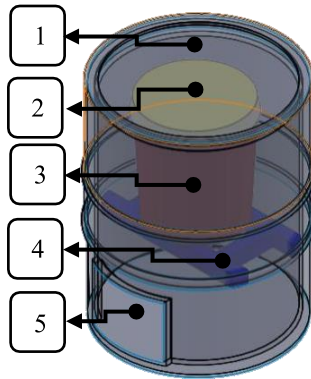
The design of this coconut shell charcoal-making machine is made from a used drum with a tube inside that comes from a used can. the material used is common steel. This design can be seen in Figure 1 and Figure 2 below.



**Figure 1.** Coconut Shell Charcoal Making Tool Design

**Table 1.** Structure of Coconut Shell Charcoal Making Equipment

No.	Component Name
1.	Charcoal Making Tool Furnace Cap
2	Charcoal Furnace Cap (Steel Can)
3	Coconut Shell Place Furnace (Steel can)
4	Charcoal Furnace Support Frame
5	A place to put firewood



**Figure 2.** Tool Structure

Making coconut shell charcoal is done by putting firewood in the bottom of the drum and placing a steel can on top of the firewood. Then the firewood (specific heat of 4.000kcal/kg [7]) is burned until the temperature in the drum reaches 417 °C.2

### **3 Result And Discussion**

The process of making charcoal is carried out by inserting coconut shells into the furnace, then the furnace is inserted into the combustion furnace that has been given a stand as a buffer from waiting for charcoal so that the charcoal furnace does not come into direct contact with fuel. After that, put fuel in the form of firewood into the combustion furnace.



**Figure 4.** Charcoal making process

The pyrolysis process lasts 2 hours with the average temperature in the combustion furnace at 417 °C. In this study, 7 kg of raw material was tested, and after a 2-hour pyrolysis process, 5 kg of coconut shell charcoal was produced.

The amount of energy used to convert 7 kg of coconut shell into 5 kg of coconut shell charcoal is about 26,000 kcal.



(a) (b)  
**Figure 5.** Coconut Shell before the charcoal-making process (a) and after the charcoal-making process (b)

#### **4 Conclusion**

The making of Coconut shell charcoal using the pyrolysis method using this tool can produce coconut shell charcoal weighing 71% of the initial weight before the process is carried out. The tool used in this study can process 7 kg of material every 2 hours, or 3.5 kg per hour. So, in a day with an average operation of the machine for 8 hours, it can produce 28 kg of coconut shell charcoal. by using this pyrolysis method, it is expected that the quality of coconut shell charcoal produced is better, due to the minimum water content and ash content of the combustion results. so that community productivity in producing coconut shell charcoal can increase.

#### **Acknowledgement**

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