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TECHNO-ECONOMIC ANALYSIS: PRODUCTION OF CHARCOAL BRIQUETTES FROM COCONUT SHELL WASTE TO IMPROVE THE COMMUNITY ECONOMY

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Abstract

This research aims to analyze the technoeconomics of making charcoal briquettes from coconut shell waste. Indonesia produces a lot of coconuts and this has an impact on the amount of coconut shell waste. Often, this waste is burned or dumped, polluting the environment. Charcoal briquettes made from coconut shells have a high calorific value and are environmentally friendly, making them an attractive alternative to fossil fuels. This can be an environmentally friendly and economical solution. The research method used is to analyze the next 5 years and compare the prices of charcoal briquettes. Several economic parameters are analyzed and evaluated to inform the production potential of materials from coconut shells, including gross profit margin, internal rate of return, payback period, net value, and so on. The results of the analysis using techno-economic analysis show that BEP can be obtained after the 3rd year and the payback period continues to increase until the 20th year. According to the research results, the production of charcoal briquettes from coconut shells is technically feasible. The quality of charcoal briquettes meets industry standards. Economic analysis shows that this project is profitable because it has an attractive Internal Rate of Return (IRR) and positive Net Present Value (NPV). Apart from that, the production of charcoal briquettes is more environmentally friendly than using fossil fuels. It has been proven that making charcoal briquettes from coconut shells is technically feasible, economical, and environmentally friendly. This study is useful for entrepreneurs and policymakers who are interested in developing the charcoal briquette industry in Indonesia. This study also supports current issues in sustainable development goals (SDGs)

Keywords: Charcoal briquettes, Coconut shells, Economic technology, Environmental friendliness, Feasibility analysis.

1. Introduction

Charcoal briquettes are currently in great demand and are used by people for their daily needs because they are considered practical and economical. Not only for household needs, charcoal briquettes are also in great demand by restaurants and eating places that provide barbecue and grilled food menus. Processing food using grilling and grilling methods will be more complicated if you have to prepare firewood and wait for it to become charcoal, not to mention that when the rainy season arrives it will be very difficult to find dry firewood to make charcoal. Apart from being a burning medium, charcoal is still used by traditional communities to this day for burning perfumes and so on. The use of charcoal that has been processed in the form of briquettes is considered very practical because it is easy to store and can be carried for outdoor activities. Many reports regarding briquettes (see Table 1). Coconut shell charcoal briquettes have better quality than briquettes made from other biomass. However, these briquettes also have a weakness, namely slow initial ignition [1]. Coconut shell briquettes have a longer burning time to ash than wood charcoal briquettes, however, based on these advantages, coconut shell charcoal briquettes take a long time to ignite. Meanwhile, things that many charcoal briquette users consider are the ignition time until the briquettes are ready to use and how long they burn. Research on techno-economics and utilization of Coconut Shell waste has been widely used as in Table 1.

Table 1. Previous studies on briquettes and technoeconomics.

No.	Title	Ref.
1	Bibliometric analysis of briquette research trends during the covid-19 pandemic	[2]
2	Effects of particle size and composition of sawdust/carbon from rice husk on the briquette performance	[3]
3	Effects of particle size and composition of cassava peels and rice husk on the briquette performance	[4]
4	Effect of particle size and tapioca starch content on performance of the rice husk and red bean skin briquettes	[5]
5	E-module in producing briquettes from melinjo (Gnetum gnemon) shell with various particle sizes and binder concentrations for vocational school students	[6]
6	Techno-economic assessment of coal to SNG power plant in Kalimantan	[7]
7	Techno-economic analysis on the production of zinc sulfide nanoparticles by microwave irradiation method	[8]
8	Computational bibliometric analysis on publication of techno-economic education	[9]
9	Techno-economic feasibility study of low-cost and portable home-made spectrophotometer for analyzing solution concentration	[10]

Based on our previous study [11-18], this research aims to be able to utilize coconut shells produced from coconut-based food and beverage processing producers which have been thrown away as waste. Coconut shell waste can be utilized and processed into many materials including fuel and charcoal. The demand for charcoal briquettes in many developed countries is quite high because of the people's need to use them as fuel for food processing such as barbeques, grilled foods, and perfumes. So far, briquette charcoal has been produced mostly from coconut shells and wood as the main ingredients. However, briquettes can be

produced from other flammable materials such as rice husks and dried cassava skin waste, but briquettes charcoal made from wood and coconut shells have been proven. more durable. So far, in developing countries, a lot of coconut shell waste is produced, some of which is used as charcoal, arts and crafts, and the rest is wasted. This research seeks to utilize coconut shell waste which is processed into charcoal briquettes that can be marketed internationally [19]. The production process for charcoal briquettes made from coconut shell waste can be explained in the following Fig 1

Fig. 1. Charcoal briquettes procces.

This study aims to analyze the technoeconomics of charcoal briquette production from coconut shell waste. This study not only describes the existence of renewable technology in processing coconut shell waste into products that have added value, but can also provide an overview of the potential economic impact of the process, and that is what is novelty in this study. Using different types of coconut shells can also provide different results. for example, coconut shells that are young, old, or certain types can provide different results.This study also supports current issues in sustainable development goals (SDGs), as reported elsewhere [20-25].

2. Theoretical Production of Charcoal Briquettes

Figure 2 illustrates the production of Charcoal Briquettes From Coconut Shell Waste.

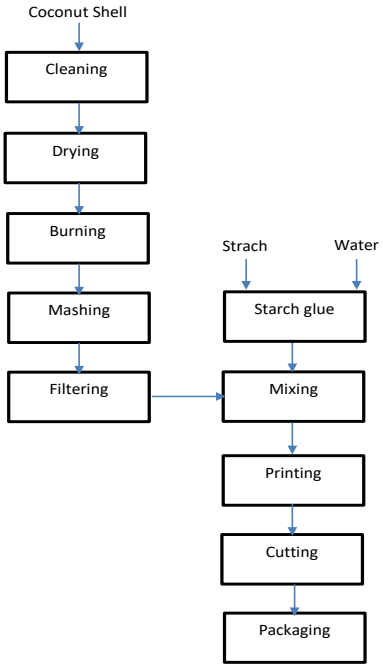

Fig. 2. Charcoal briquettes production.

The process of making charcoal briquettes begins by cleaning the shells obtained from waste to avoid mixed waste. Then the next process is to dry the coconut baroque until it dries and is easy to burn. Drying can be done for 2 to 7 days depending on the weather. After drying, coconut shells can be used as fuel to turn them into charcoal until they burn evenly. After that, it can be blended to produce charcoal that is soft and easy to print. The charcoal produced from the pounding process will be filtered so that you can get charcoal with a soft and smooth quality. Then the charcoal will be mixed with starch glue which is produced by mixing starch with water and can stick to the charcoal.The sticky charcoal will be put into a briquette printing machine to get the same printed results or you can use a press machine to compact the dense briquette charcoal. The sticks that come out of the mixing machine can be cut with a cutting knife to produce the same size and then dried in the sun to produce dry charcoal.

3. Research Method

The method used in this research is to analyze costs and capital to produce a picture of the business activities that will be carried out using the techno-economic analysis method. The method is for analyzing the economic performance of an industrial process, product, or service. This analysis uses software modeling to estimate capital costs, operational costs, and revenues using financial and technical parameters. In the economic evaluation study, an analysis of the prices of equipment, utilities, and raw materials available for making charcoal briquettes on the online shopping sites was carried out. Then the data is calculated using Microsoft Excel with several parameters such as GPM, IRR, PBP, CNPV, BEP, and PI from various cost variables. Calculations were carried out based on literature. Detailed information for the calculation is explained elsewhere [26-28].

4. Results and Discussion

To further ensure the economic feasibility analysis of coconut shell waste charcoal briquette production, several assumptions are used to analyze and estimate several possibilities that will occur in the implementation of production. Some of these assumptions are: (i) All financing analysis uses USD with a value of 1 USD = Rp. 15,949, (ii) The composition of the main raw material for production is coconut shell waste which is based on commercial prices on the dan-commerce website, which is USD 0.06/Kg; Strach which is USD 0.44/Kg and water. The total cost required is USD 510.50/day or USD 153,151.46/year.

The calculation of the cost of the equipment components needed to process coconut shell waste into charcoal briquettes, consisting of the following components: (i) 20-L bucket, (ii) charcoal briquette molding machine, (iii) charcoal blender machine, (iv) small briquette molding press machine, and (v) briquette cutting knife set. The total cost required is USD 1,338.35.

Table 2 provides a summary of production assumptions and costs associated with a project or venture business. The total fixed costs after considering depreciation are USD 9,742.02. Total Variable Costs Variable costs USD 189,144.68 which includes costs such as Raw Materials, Utilities, Operational Labor, Labor Related Costs, and Sales Related Costs. Estimated Sales USD 329,256.82. The profit margin is 91%, and the Profit to Sales ratio is 16.84 %.

Table 2. Price of equipment for making charcoal briquettes from coconut shell waste.

Component	Parameter	Cost (USD)
Fixed Cost	Capital Related Cost	9,015.70
	Depreciation	726.32
	Total Fixed Cost	9,742.02
Variable Cost	Raw material	153,151.46
	Operating Labor (OL)	7,751.65
	Labor Related Cost	5,193.60
	Sales Related Cost	23,047.98
	Total Variable Cost	189,144.68
% Profit Estimated	Sales	329,256.82
	Manufacturing Cost	198,160.38
	Investment	7,785.19
	Profit	0.40
	Profit to Sales	16.84
BEP	Unit	210000
	Fixed Cost	9,742.02
	Variable cost	189,144.68
	Sales	329,256.82
	BEP	14601.33427
	Percent Profit on Sales	0.398158612
	Return on Investment	18.04933397
	Pay Out Time	0.055098441

In economic evaluation, ideal conditions are needed, so that they can be used as a benchmark for a project. Figure 3 shows ideal conditions by analyzing the relationship between CNPV/TIC and age (years). The curve shows that the CNPV/TIC value stagnated until the 2nd year. However, after the 3rd year to the 20th year, it can be said to be profitable because it has increased. In the 3rd year, the payback period (PBP). PBP can only be achieved in a short time, namely in the 3rd year and the income earned tends to increase until the 20th year. This shows that the briquette production project made from coconut shell waste has great potential and hope. The results of the PBP analysis reveal that the point where the return on capital is less than the planned project life is said to be profitable [29].

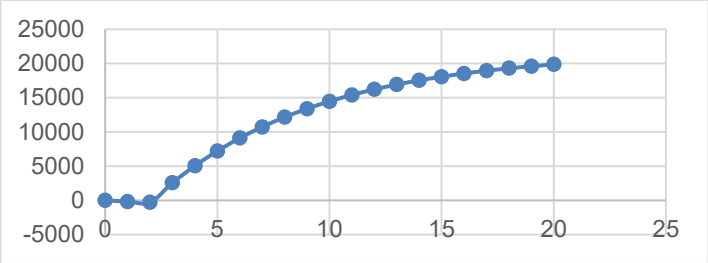

Fig. 3 Curva of ideal conditions for CNPV/TIC to a lifetime (year).

5. Conclusion

Based on the analysis above, the project for making charcoal briquettes using coconut shells as the basic material shows that from a technical and economic point

of view, it is very prospective. Cost analysis of several economic parameters was also carried out, which showed positive values for them. In addition, an analysis of several sensitivity parameters was also carried out, which showed several limiting conditions for obtaining benefits. The economic perspective suggests that results generate profits. In short, making charcoal briquettes using coconut shells as a base material can attract industrial investors because it is one possible approach to improve waste management. Therefore, the construction of this project cannot be avoided or it is very good to continue and improve. Agrarian countries should be project locations. Therefore, additional funds are needed to maintain this project. These funds can come from government social responsibility.

(i) Technical Feasibility: Charcoal briquettes made from coconut shells have high calorific value and low ash, comply with industry standards, and the production process is simple and easy to learn. Coconut shell is a raw material that is easily accessible in Indonesia.

(ii) Economic Feasibility: Economic analysis shows that the project of producing charcoal briquettes from coconut shells is profitable. The project has an attractive Internal Rate of Return (IRR) and positive Net Present Value (NPV). Production costs are relatively low compared to charcoal briquettes made from other raw materials. In addition, market demand for charcoal briquettes is increasing, especially in households and small and medium industries.

(iii) Environmental Feasibility: Charcoal briquettes from coconut shells are more environmentally friendly than the use of fossil fuels. Charcoal briquettes produce lower greenhouse gas emissions compared to coal and petroleum. Charcoal briquette production also does not produce hazardous waste.

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