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TECHNO-ECONOMIC ANALYSIS FOR THE PRODUCTION OF ROSTER FROM PLASTIC WASTE TO SUPPORT SUSTAINABLE DEVELOPMENT GOALS (SDGS)

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Abstract

This research aims to analyze the techno-economics of roster production made from plastic waste. The method used in this research is to analyze the feasibility of the business for 20 years by comparing several economic parameters that are analyzed to inform the potential for roster production made from waste, including gross profit margin, internal rate of return, payback period, net present value, and so on. The results of this research indicate that the techno-economic feasibility analysis of the project for making rosters from plastic waste materials can be said to be feasible. This production feasibility assessment is prospective from a technical point of view and is quite promising in economic evaluation. The Pay Back Period (PBP) analysis shows that the investment is profitable after more than 3 years. Thus, this economic evaluation analysis can be projected to be feasible. The value of novelty in this study is the use of techno-economic analysis in reviewing the production of the roster from plastic waste. This study also supports current issues in sustainable development goals (SDGs).

Keywords: Economic evaluation, Feasibility study, Plastic, Roster, Waste.

1. Introduction

The need for plastic in Indonesia to increase from year to year average of 200 tons per year. One of the biggest impacts of this increase in plastic use is in plastic waste exist [1]. Plastic waste has now become a serious environmental problem because of the increasing amount of plastic waste that exists and the level of danger that plastic waste can cause to other living creatures [2]. According to data from the Indonesian Ministry of Environment, every day the Indonesian population produces total of 189 thousand tons of waste/per day. 15% of this amount is in the form of plastic waste or 28.4 thousand tons of plastic waste/day [3, 4].

Plastic waste is not disappear even if it is burned but it change shape into smaller pieces called microplastics. This material can be dangerous if mixed with soil and water because it become toxic if mixed with water and enter the human body. Apart from that, the accumulation of plastic waste also damages soil mechanisms. Many reports have been well-documented for solving plastic issues [5-9]. As part of efforts to reduce plastic waste, it is necessary to recycle waste into other products that have benefits and economic value. Among the aims of utilizing waste and reusing it to improve the local economy [10]. The use of plastic waste is by using plastic waste as a mixture of materials for making rosters made from plastic waste. Several previous studies regarding techno-economic analysis have been carried out as listed in Table 1, based on literature [11-18].

Table 1. List of several previous related studies (state of the art).

No	Title	Ref.
1	Techno-economic assessment of coal to SNG power plant in Kalimantan	[11]
2	Techno-economic analysis on the production of zinc sulfide nanoparticles by microwave irradiation method.	[12]
3	Techno-economic evaluation of hyaluronic acid production through extraction method using yellowfin tuna eyeball	[13]
4	Computational bibliometric analysis on publication of techno-economic education	[14]
5	Techno-economic evaluation of gold nanoparticles using banana peel (Musa Paradisiaca)	[15]
6	Techno-economic analysis of the business potential of recycling lithium-ion batteries using hydrometallurgical methods.	[16]
7	Domestic waste (eggshells and banana peels particles) as sustainable and renewable resources for improving resin-based brakepad performance: Bibliometric literature review, techno-economic analysis, dual-sized reinforcing experiments, to comparison with commercial product	[17]
8	Techno-economic feasibility study of low-cost and portable home-made spectrophotometer for analyzing solution concentration	[18]

The novelty value stated in this research lies in the research object locus which takes plastic waste objects as material for making rosters, apart from that the use of techno-economic analysis as a basis for project assessment is also a breakthrough in the value of novelty in research. The aim and objective of this research based on our previous studies [19-21], is to provide information regarding project potential based on tech economic analysis. This study also supports current issues in sustainable development goals (SDGs), as reported elsewhere [22-26].

2. Literature Review

Based on Fig. 1, the process of making rosters made from plastic waste is divided into 5 stages, namely the first is sorting the waste where what are further processed is inorganic waste, then the second stage is carrying out the waste washing process or process. sterilization, then the plastic waste is shredded using a chopping machine, then the process of mixing the roster material consisting of water, cement, stone ash sand, and plastic waste is carried out, while the final stage is the process of molding the roster material into various shapes according to the pattern. Thus, the process of making a roster made from plastic waste is complete (see Fig.1).

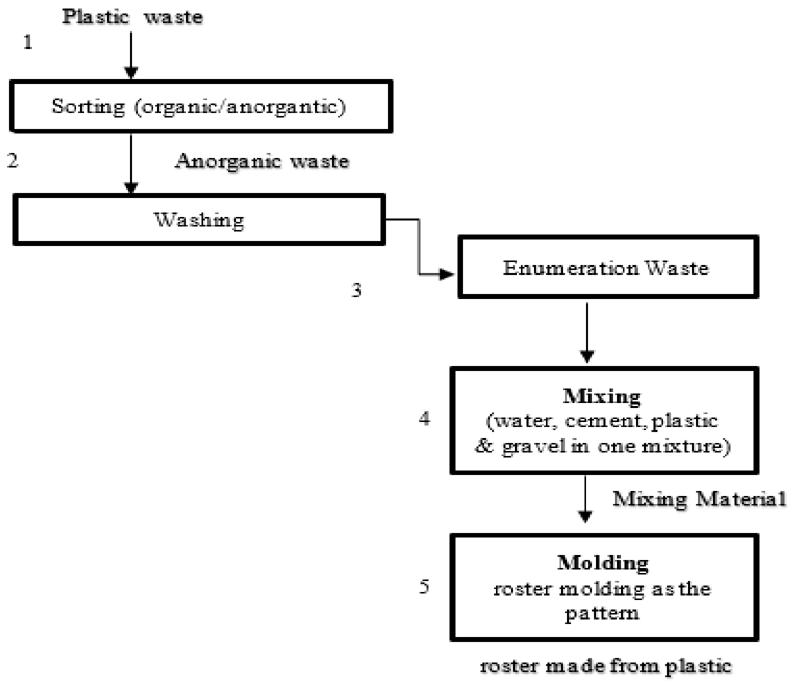

Fig. 1. Production roster from plastic waste.

3. Method

The method used in this research is the analysis required regarding the business feasibility of producing rosters made from plastic waste. This techno-economic feasibility analysis includes analysis of determining raw materials and their price components, determining production capacity, selecting technological tools, and the required workforce structure. and several other financial feasibility analyses including analysis of estimated production costs and others. Detailed information for the calculation is explained elsewhere [27, 28].

4. Results and Discussion

In the context of this research, to further ensure the economic analysis carried out, several assumptions are used. This assumption is needed to analyse and predict several possibilities that may occur during the project are as follows:

(i) Prices for equipment and raw materials along with their actual conditions are determined based on commercially listed values (See Table 2) and (Table 3). Other supporting costs (for example, start-up, instrumentation, and electrical-related components) are ignored.
(ii) Production costs can be changed and predicted from the start of the project. Estimated production costs are shown in Table 4.
(iii) One process cycle (the process from the plastic waste processing stage to obtaining 40 rosters) takes 1 hour.
(iv) The discount rate is 15% per year.
(v) The duration of the project operation is 20 years.

In Table 2, the calculation of the cost of raw materials required in one production cycle which consists of components of waste costs, cement, stone ash sand, and water to be able to produce 8 pcs in one production process cycle results.

Table 2. Calculation of raw material costs.

No	Raw material	Waste Requirements per Small Scale production (kg/h)	Unit	Requirements per Large Scale production (Scale Up 1000x)	Price (IDR)
1	Rubbish plastic	5	kg	1	3,000.00
2	Cement	125	kg	1	1,440.00
3	Sand stone	125	kg	1	1,900.00
4	Water	10	Liter	1	1,000.00
				Price/day	3,520,000
				Price/year	84,480,000

Table 3 shows that the calculation of equipment components needed in one production cycle consisting of plastic chopping machine components and roster molding tools can be used in several production process cycles resulting in a total cost of IDR 7,820,000 (see table 3).

Table 3. Calculation of equipment components.

	Name of Tool	Unit Price (IDR)	Total	Price (IDR)
1	Machine enumerator	5,070,000.00	1	5,070,000.00
2	Roster printing	550,000.00	5	2,750,000.00

Table 4 shows that the components which related to the estimated production cost calculation consist of several items to make profit estimated and show break event point (BEP) directed at demonstrating value of return on investment (ROI) and pay out time.

Table 4. Factors for estimating production costs.

Components	Parameter	Cost (IDR)
Fixed cost	Capital related cost	66,041,435.28
	Depreciation	4,382,845.20
	Total fixed cost	70,424,280.48
Variable cost	Raw material	2,202,000.00
	Utilities	256,000.00
	Operating labor (OL)	216,000,000.00
	Labor related cost	144,720,000.00
	Sales related cost	53,760,000.00
	Total variable cost	416,938,000.00
% Profit estimated	Sales	768,000,000.00
	Manufacturing cost	482,979,435.28
	Investment	46,978,092.00
	Profit	0.37
	Profit to sales	6.07
BEP	Unit	76800
	Fixed cost	70,424,280.48
	Variable cost	416,938,000.00
	Variable cost	0.00
	Sales	768,000,000.00
	Sales	0.00
	BEP	1,540,635,199
Percent profit on sales		
Return on investment		**6.50309449**
Pay out time		**0.151444145**

Figure 2 shows the cumulative net present value (CNPV) shows the graph of the relationship between CNPV/TIC against time. Where the y-axis is CNPV/TIC and the x-axis is a lifetime (years). The data in the graph shows a decrease in income in years 1 to 2, this is due to initial capital costs such as tools needed during the roster production process from plastic waste and purchased land. In the 3rd year, the graph shows an increase in income, this condition is the payback period (PBP). Profits can cover the initial capital spent and profits continue to increase thereafter until the 20th year. Thus, roster production can be considered a profitable project because this project requires a short time to recover investment costs since the PBP is only about 3 years.

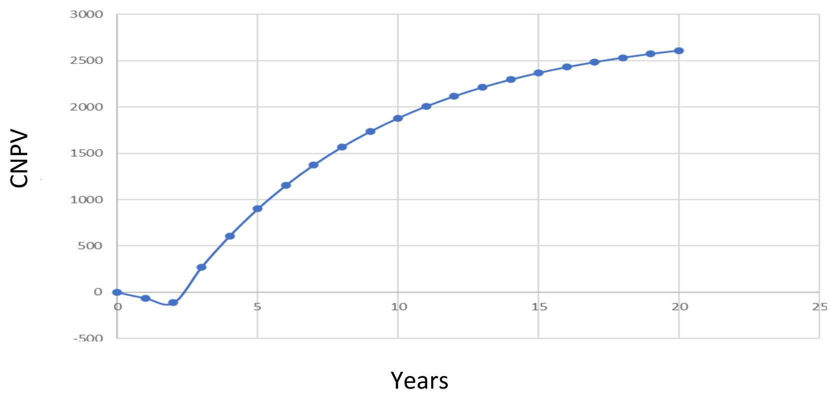

Fig. 2. Ideal conditions for CNPV/TIC regarding lifetime (years).

This project has potential and prospective in terms of several indicators of tech economic analysis. These results are in line with several previous results related to the application of tech economic analysis and also relate and relevan with the result of [29, 30].

5. Conclusion

This project for making rosters from plastic waste materials can be said to be feasible. This production is prospective from a technical point and promising in economic evaluation. Several things that influence these results include determining a very easy and simple processing method thus this economic evaluation analysis can be projected as feasible to carry out. The suggestion for further research is to use more technical economic analysis to get more information.

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