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The Utilization of Waste Cooking Oil as A Raw Material of Soap

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Abstract

Cooking oil is a vegetable oil as a glyceride compound from various fatty acids. Cooking oil can be used up to 3-4 times for cooking. If cooking oil is used repeatedly, the fatty acids will be more saturated and can change color. The waste cooking oil is said to have been damaged and is not good for consumption and can pollute the environment. Appropriate technology is a technology designed for a particular society to be adapted to environmental, political, cultural, social, and economics aspects. The purpose of appropriate technology is to be able to save money, be easy to maintain, and minimize costs to the community. The appropriate technology in this study aims to facilitate the production process of making soap or can also achieve the desired goals effectively in a place or production. The results of this research are mixer and soap products, which are mixers made from used materials to be used as soap making tools. For the processing of soap products, cooking oil waste is used, which is known that the cost of production per soap bar is Rp578.00. Researchers sell it at a price of Rp1,000.00. The Break Event Point (BEP) value is 200 bars of soap per year or Rp200,000.00. Net Present Value (NPV) in 4 years is Rp9,498,061.00, and the Return of Investment (ROI) from the payback period is 0.9 months.

Keywords: Appropriate Technology, Break Event Point (BEP), Net Present Value (NPV), Payback Period (PP), Waste Cooking Oil.

INTRODUCTION

Cooking oil is a vegetable oil that contains glyceride compounds from various kinds of fatty acids. Waste cooking oil (Panadare, et al, 2015) come from various types of cooking oil, such as vegetable oil, coconut oil, and others. Waste cooking oil that is produced from industry or home contains high fatty acids (Chuah, et al, 2016). In addition, waste cooking oil contains carcinogenic compounds that are not suitable for consumption (Ganesan, et al, 2019). Therefore, the use of used cooking oil for a long time can damage health.

In the industry, waste cooking oil is usually discharged directly into the surrounding environment. This certainly has a negative impact on the environment and the survival of the ecosystems, such as soil and water pollution. To overcome this, an innovation in processing waste cooking oil is needed in order to increase economic value that can be utilized as a basis material for making soap.

MATERIALS AND METHODS

This research was conducted in three stages, namely (a) Making soaps from waste cooking oil, (b) Making a mixer as a tool for making soaps, and (c) Increasing the selling value of soaps. Then, we analyze the economic value using Break Event Point (BEP) (Kaviani, 2014), (Tui, et al, 2017) Net Present Value (NPV) (Jory, et al, 2016) and Payback Period

(PP) (Ardalan, et al, 2013).

a. Break Event Point (BEP). Break Event Point (BEP) is a sales volume where the amount of revenue and total expenses are thesame, and there s no net profit or loss. BEP is used to analyze how many units must be produced or how much income is received for return on investment.
b. Net Present Value (NPV). Net Present Value (NPV) is a combination of the present value of revenue and the present value of expenditure. NPV estimates the present value of the project. Investments based on incoming cash flows are expected in the future and outflows have been adjusted according to interest rates and initial purchase prices.
c. Payback Period (PP). Payback Period (PP) is a period of return from the investment, through the profits obtained from the planned project.
d. Method of collecting data. Preliminary data collection is carried out at the location (research object) directly, namely interview and observation.
e. Design Method. The method in data collection goes through several stages including: 1) Literature Studies; 2) Designing Mixer Products. 3) Making Soap Products. 4) Economic Analysis (BEP, NPV, PP)

RESULT AND DISCUSSION

The first step in this experiment is making mixer. In making mixer, first we measure the materials. Then we cut the materials. After the materials were being cut, we weld and drill the materials. Next, we refine the materials. Then, we check the components and instal the components. Lastly, we test the mixer.

a. Measure the materials. Materials consist of two u channel irons with 5 cm x 3.5 cm and length of 22 cm, two u channel irons with 6.5 cm x 4 cm and length of 25 cm and 20 cm, one u channel iron with 8 cm x 4.5 cm and length of 25 cm, angle iron 4 cm x 4 cm with a length of 25 cm, iron strip plate with a length of 25 cm, and a zinc plate with a diameter of 18 cm.
b. Cut the material. After measuring the materials, we cut all the materials that have been mentioned in subsection 3a. We cut the materials by using predetermined sizes. We cut the zinc plate to cover the iron ends of U channel and holo iron.
c. Weld the material. In the welding process, the electrode used is RB 3.2 or 2 m. Firstly, we weld the end of the holo iron and the end of the U channel iron. These welding processes are carried out to cover the front using zinc plate iron. The bolt welding in the U channel aims to lock it from moving when turning or opening the container. Finally, we weld the bolt at the end of the mixer blades with a bolt thread length of 4.5 cm.
d. Drill the material. After welding the material, we drill the U channel iron with 9 holes with size 12, consists of 5 holes of holo iron and U channel iron, and 4 holes size 16 in U channel iron and bearing.
e. Refine the material. Next is refining the material from the results of welding and drilling to clean the components.
f. Check the components. Checking the components is aimed to know if there is missing components needed to complete the research.
g. Instal the components. Next step is to instal the components, i.e. cable, switch, pulley, motor gear box, v-belt, and mixer blades.
h. Test the mixer. The last steps was testing the mixer to make sure that the mixer was capable to be used.

After finishing assembling the mixer, the second step is making soap. The processes of making soap undergoes in several steps. The first step is sedimentation. Sedimentation takes place in 1-2 days and is aimed to purified the waste cooking oil. We add charcoal as an active carbon to bind all the dirt particles in the waste cooking oil. Further, charcoal is also beneficial in reducing rancid odor from the waste, so it does not cause any unpleasant odors in the soap. Then, filter it. Figure 1 shows the sedimentation process. The next step is mixing the materials, i.e. Sodium Hydroxide (NaOH) and water (see Figure 2). Then, mix it to the waste cooking oil that has been sedimented, as shown in Figure 3. Add deodorizers and dyes then mix it with the mixer until it thickens. Pour the mixture into containers and let it cool. This step can be seen in

Figure 4. Table 1 shows overall ingredients needed in making soap. The finished soap product is left in 1-2 days until it is solid and can be removed from the container. Figure 5 shows the results of soap products with various colors and shapes that are ready to be marketed.

Figure 1. The sedimentation process of waste cooking oil.

Table 1. The ingredients of soap

No.	Materials	Composition
1.	Waste cooking oil	250 ml
2.	Sodium Hydroxide (NaOH)	25 gram
3.	Water	50 ml
4.	Dyes	1 ml
5.	Deodorizers	1 ml

Figure 2. Mixing NaOH and water

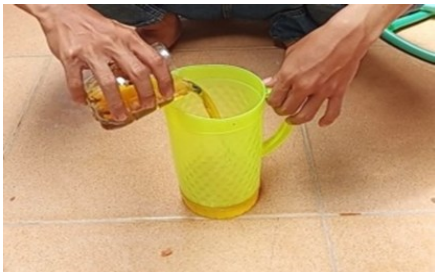

Figure 3. Mix NaOH and water with waste cooking oil

Figure 4. Pour the mixture to the containers

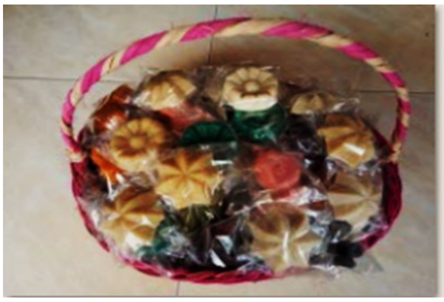

Figure 5. The finished soap

To ensure that the product is safe and can be used widely, several laboratory tests have been carried out. The scientific tests are:

a. Taste test. Soap products do not cause a pungent taste when licked and smell. It shows the acid levels is normal and tolerable. Soap has also been tested to be used for bathing. There is no itching or heat caused when the soap is used. The resulting foam is also pretty much similar to commercial soap.

b. Test the pH of the acidity. Soap products have also passed laboratory tests to measure the acidity (pH) of the product. The results indicated that the pH value varied with several variables showed the same pH measurement results. This means that the soap with the basic ingredients of waste cooking oil is suitable for use. Table 2 shows the results of pH measurement test with variations in several conditions.

The third steps is analysing the economic value using Break Event Point (BEP), Net

Table 2. The comparison results of pH measurement test from various types of soap

Various types of soap	**pH**
Soap with pure non-waste oil ingredients	9.4
Soap from waste cooking oil of meet floss products	9.4
Soap from waste cooking oil of fried onion	9.4
Commercial soap "X"	9.4
Calibrate the pH meter using pure water	7.0

Table 3. Cost of materials for soap production in a month

No.	Materials	Cost/unit (Rp)	Amount (Unit/ml/kg)	Cost (Rp)
1.	Waste cooking oil	0	15,000 ml	0
2.	Sodium Hydroxide	1,000	1,500 gram	60,000
3.	Water	0	3.000 ml	0
4.	Deodorizers	1,000	60 ml	60,000
5.	Dyes	1,000	60 ml	60,000
6.	Charcoal	500	3 packs	9,000
Total cost				189,000

Table 4. Tool cost

No.	Nama Alat	Jumlah	Cost (Rp)	Total	Lifetime (Year)	Depreciation per Year (Rp)
1.	Mixer	1	150,000	150,000	4	50,000
2.	Plastic Container	1	15,000	15,000	1	15,000
3.	Molds	4	15,000	15,000	1	15,000
4.	Balance	1	150,000	150,000	4	50,000
5.	Measuring cup	1	20,000	20,000	1	20,000
6.	Spoons	2	4,000	4,000	1	4,000
7.	Napkin	1	0	0	0	0
	Total		354,000	354,000		154,000

Present Value (NPV), and Payback Period (PP). The first analysis is determining the cost of production. Table 3 shows the materials and cost list to produce soap in one month.

Cost in a year
= (60.000+60.000+60.000+9.000)
= Rp189,000.00 x 12
= Rp2,268,000.00 per year

The second analysis is determining the tool costs. Table 4 shows the tools and costs list needed to produce soap. The third analysis is determining the other costs outside tools and materials that may be needed in producing soap.

Table 5 shows the costs for machine maintanance, electricity, and labor. The following is the calculation of the cost of soap production in one year divided by the amount of soap production in one year, so that the cost of soap production per bar is obtained, as shown in Table 6.

Production capacity in a month = 15 Liter
Production capacity in a year = 15 Liter x 12 = 180 Liter/year or 10.800 bars of soap

$$\text{Cost of production per bar} = \frac{\text{Total of Annual Cost}}{\text{Annual Prodution Capacity}}$$

Tabel 5. Machine maintenance, electricity and labor equipment costs

No.	Other costs	Costs per year
1.	Machine maintanance	50,000
2.	Electricity	180,000
3.	Labor	3,600,000

Table 6. The calculation of the cost of production

The costs of materials (1 year)	**Rp2,268,000.00**
Machine maintanance	Rp50,000.00
Electricity	Rp180,000.00
Labor	Rp3,600,000.00
Depreciation per Year	Rp154,000.00
Total	**Rp6,252,000.00**

$\frac{Rp\,6{,}252{,}000.00}{180\ liter/year}$ or, $\frac{Rp6{,}252{,}000.00}{10{,}800\ bars} = Rp578.9.00$

Calculation of determining the selling price by expecting a profit of 10% is

Price per bar (P)

= Rp578.9 + (578.9 x 70%)

= Rp984.13 or rounded up to Rp1,000.00

Break Event Point (BEP)

Break Event Point (BEP) is a point that shows the total revenue generated by the company or industry is equal to the total costs incurred, so the company does not make a profit and do not experience losses.

In this research, it is known that :

Depreciation per Year (BT)

= Rp154,000.00

Price per bar (P)

= Rp1,000.00

Variable costs per bar (V)

= Rp233

Calculation of BEP in Units per Year

BEP (Unit) $= \frac{BT}{P-V} = \frac{154{,}000}{1{,}000-233} = \frac{154{,}000}{767}$

BEP (Unit) = Rp200 bar per year

BEP calculation per year :

BEP (Rp) $= \frac{154{,}000}{1\frac{233}{1{,}000}}$

BEP (Rp) $= \frac{154{,}000}{1-0{,}233}$

BEP (Rp) = Rp200,782.00 per year or rounded to Rp200,000.00 per year.

Net Present Value (NPV)

We develop cash flow until the fourth period (each one year) with interest rate 30% per year.

$$NPV = \frac{C1}{(1+r)^1} + \frac{C2}{(1+r)^2} + \frac{C3}{(1+r)^3} + \frac{C4}{(1+r)^4} + \frac{Ct}{(1+r)t)} - C0$$

$$= \frac{Rp4{,}548{,}000.00}{(1+0.3)^1} + \frac{Rp4{,}548{,}000}{(1+0.3)^2} + \frac{Rp4{,}548{,}000.00}{(1+0.3)^3} + \frac{Rp4{,}548{,}000.00}{(1+0.3)^4} - 354{,}000$$

$$= \frac{Rp4{,}548{,}000}{1.3} + \frac{Rp4{,}548{,}000}{1.69} + \frac{Rp4{,}548{,}000}{2.197} + \frac{Rp4{,}548{,}000}{2.8561} - 354{,}000$$

= Rp3,498,461.00 + Rp2,691,124.00 + Rp2,070,095.00 + Rp1,592,381.00 – 354,000

= Rp9,498,061.00

Thus, the NPV is Rp9,498,061.00. From the calculation, $NPV > 0$, means that the income is greater than the expenses. Thus, we gain profits from this soap production.

Payback Period (PP)

We use Payback Period (PP) to show the payback of investment for soap production.

$$PP = \frac{investment\ value}{net\ income}\ x\ 1\ year$$

$$PP = \frac{Rp354{,}000.00}{Rp4{,}548{,}000.00}\ x\ 12\ months = 0.077\ x\ 12 = 0.9$$

From the calculation, we obtained 0.9 months for the payback period faster than the determined period, i.e 4 years. Thus, the proposed project of soap production is acceptable.

CONCLUSION

Waste cooking oil that can not be used can be reprocessed into valuable product, one of which is as a basic ingredient in making soap. The basic cost production is Rp578.00 and sold ar Rp1,000.00. So as not to lose, the value of

Break Event Point (BEP) is 200 bars of soap or Rp200,000 per year. The Net Present Value (NPV) in a 4 year period is Rp9,498,061.00 and the payback period is 0.9 months.

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