

Feasibility study analysis for multi-function dual energy oven (case study: tapioca crackers small medium enterprise)

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Abstract. Conventional drying process is constrained by weather (cloudy / rainy), and requires wide drying area, and provides low-quality product. Multi-function dual energy oven is the appropriate technology to solve these problems. The oven uses solar thermal or gas heat for drying various type of products, including tapioca crackers. Investment analysis in technical, operational, and financial aspects show that the multi-function dual energy oven is feasible to be implemented for small medium enterprise (SME) processing tapioca crackers.

Keyword: Feasibility Study Analysis, Multi-Function Dual Energy Oven, Incremental Rate Of Return (Incremental ROR), Tapioca Crackers.

1. Introduction

Until today, most of industries is still implementing conventional process in produce their product. One of these are utilize sunlight as the only one source of heat energy for drying the product. The process is done by storing the product outdoor to be able to exposed the sun's heat directly. Then, there are several challenges to be faced by small medium enterprise (SME).

First challenge is the need for a wide area as a place of drying. Spacious of drying land owned by small medium enterprise (SME) can also affect the amount of product that can be produced. If small medium enterprise (SME) have a wide area as a place of drying, more products can be dried and produced, and vice versa. So, when the market demand for the product has increased, small medium enterprise (SME) need to consider wide area of drying, the amount of product to be dried, and the length of time for drying the product until it is completely dry. It would be very unfortunate if a large market opportunity cannot be fulfilled by the small medium enterprise (SME) because the limited area of drying.

Next challenge faced by small medium enterprise (SME) are still utilizing the sunlight as the only one source of heat energy for drying the product. When cloudy or rainy, then the product being dried outdoor must be secured by the workers. But it would be more worried if the wind blew hard and damaging the product. small medium enterprise (SME) would worry because the weather can change suddenly. When the product is secured, then the drying process can be continued for the next day. But, if the product is damaged by the wind, rain, or fungus (temperatures are too humid) then it can cause great harm for industries.

Other challenge that need to be considered by small medium enterprise (SME) when drying the product conventionally is the contamination of germs or dirt that comes from the wind. small medium enterprise (SME) needs to pay attention to the equipment used, clean environment, away from garbage



or pollution. Considering that the product will be directly contact with customers, especially food products that will enter into the human body.

Oven multi-function dual energy is one of the appropriate technology that designed based on the various challenges faced by small medium enterprise (SME) as described previously. As the name implies, the machine has two types of energy or heat source that can be used to dry the product. The heat energy can be derived from sunlight and also gas. One such energy can be selected for use by weather conditions or by the needs of the small medium enterprise (SME).

Sunlight or solar thermal can be used when the weather is bright. The roof of oven multi-function dual energy can be opened so that the sun's heat can get into the oven space. Whereas when the weather is cloudy, rainy, or when small medium enterprise (SME) want to do the production process in the evenings (overtime), then the drying process can use the heat energy generated from the gas fuel. Oven space must be covered by a roof when the drying process using heat energy generated from the gas fuel. This technology able to dried various type of products (multi-function), one of them is tapioca crackers.

2. Methods

2.1 Forecasting

A seasonal pattern is a repetitive increase and decrease in demand. There are several methods for reflecting seasonal patterns in a time series forecast. We will describe one of the simpler methods using a seasonal factor. A seasonal factor is a numerical value that is multiplied by the normal forecast to get a seasonally adjusted forecast. One method for developing a demand for seasonal factors is to divide the demand for each seasonal period by total annual demand, according to the following formula [1]:

$$Si = \frac{Di}{\sum D} \quad (1)$$

where

Di : Historical data

2.2 Depreciation

Straight line method assumes that the loss in value is directly proportional to the age of the asset [1].

$$dk = \frac{B-S}{N} \quad (2)$$

where

dk : annual depreciation deduction in the k-th year

B : unadjusted cost basis

S : salvege value at the end of the depreciable life of the asset

N : depreciable life of the asset in year

2.3 Feasibility Study

Feasibility study is to reduce the level of risk of loss and ensure that the investment to be made is profitable [2][3].

2.3.1. Technical and Operational Aspect Analysis

The material will be covered in the technical and operational aspects, such as product design, raw material and product specifications, production processes, the location of the company (factory), factory layout, equipment and machines used, the layout engine, as well as quality control [2].

2.3.2. Financial Aspect Analysis

Financial aspects discuss about capital requirements and investment needed in the establishment / development effort is planned, then summarize it in the form of financial statements (balance sheet, income sheet, and cash flow), and analyze them to determine feasibility of the business [2].

A. Net Present Value (NPV)

Net Present Value (NPV) is the present value (present value) of the difference between the benefit (benefit) at cost (cost) at a certain discount rate. NPV is an excess benefit (benefit) compared to the cost / expense.

$$NPV = \sum_{t=0}^{t=n} \frac{B_t - C_t}{(1+i)^t} \quad (3)$$

where

B_t : Benefit / cash inflow in year t

C_t : Cost / cash outflow in year t

i : interest rate

B. Internal Rate of Return (IRR)

Internal Rate of Return (IRR), investor's method, discounted cash flow method, or profitability index solve for the interest rate that equivalent worth of an alternative's cash flow (receipts or savings) to the equivalent worth of cash out flows (expenditures, including investments).

$$\sum_{k=0}^N Rk\left(\frac{P}{F}, i\%, k\right) = \sum_{k=0}^N Ek\left(\frac{P}{F}, i\%, k\right) \quad (4)$$

*i is often used in place of i to mean the interest rate that is to be determined

where

R_k : net receipts or saving for the k-th year

E_k : net expenditure including investments for the k-th year

N : project life (or study period)

Once i' has been calculated, it is then compared with the MARR to assess whether the alternative in question is acceptable. If i' ≥ MARR the alternative is acceptable; otherwise, it is not.

C. Incremental Rate of Return (incremental ROR)

This policy can be reduced to three principles when applying rate of return methods:

- Each increment of capital must justify itself by producing a sufficient rate of return on that increment;
- Compare a higher investment alternative against a lower investment alternative only when the latter is acceptable;
- Select the feasible alternative that requires the largest investment of capital as long as the incremental investment is justified by saving that earn at least the MARR.

D. Sensitivity Analysis

Sensitivity analysis means the relative magnitude of change in the measure of merit (such as present worth) caused by one or more changes in estimated study parameters. Sometimes sensitivity is more specifically defined to mean the relative magnitude of the change in one or more factors that will reserve a decision among alternatives.

3. Research Methodology

3.1. Initial Research

3.1.1. Background of Problem

Background of problem is obtained from the field studies and literature review. Where, small medium enterprise (SME) still utilize the sunlight to drying their product, Small medium enterprise (SME) requires a wide area for drying, need a long duration for drying the products when the weather is cloudy / rainy, and the level of products cleanliness is low.

3.1.2. Statement of the Problem

Statement of the problem is a problem of analysis feasibility study for investment of oven multi-function dual energy based on the background described previously.

3.1.3. Goal Setting

The purpose of this feasibility study is to determine the appropriate solutions for small medium enterprises (SME) in improving the effectiveness and efficiency of the drying process of the product to make investments of the oven multi-function dual energy. This feasibility study will be reviewed by the technical, operational, and financial aspects.

3.2. Data Collection Stage

3.2.1. Data Collection of Technical and Operational Aspect

Technical and operational data collected in this feasibility study comes from interviews, observation, experiment, and also related institutions include the District Office, the Central Statistics Agency (BPS) and the Meteorology, Climatology, and Geophysics (BMKG).

3.2.2. Data Collection of Sales and Production Capacity

Sales and production capacity data will represent the amount of income earned for small medium enterprise (SME) that processing tapioca crackers.

3.2.3. Data Collection of Financial Aspect

The data collection of financial aspects includes the investment and operational costs by data collection in technical and operational aspects. In addition, there is also a data entry from the sales and production capacity as a revenue/income.

3.3. Data Processing

3.3.1. Data Processing of Technical and Operational Aspect

The data processed includes oven's capacity, location, the need for tools and materials, until building process of the multi-function oven dual energy. From technical and operational aspects will also be acquired investment costs, operating costs, up to the cost of treatment of oven multi-function dual energy which would be used on data processing of financial aspects.

3.3.2. Data Processing of Sales and Production Capacity

Sales and production capacity which useful as revenue or income which would be used on data processing of financial aspects.

3.3.3. Data Processing of Financial Aspect

Financial aspects include the investment costs, operating costs, sources of funds, then the revenue will be calculated on the financial statements include an income statement, cash flow, and balance sheet. In addition, the processing of financial data also includes the calculation of investment feasibility criteria, incremental ROR, and sensitivity analysis.

3.4. Analysis Stage

3.4.1. Analysis of Investment Feasibility

The feasibility analysis of investment aims to answer questions about the feasibility of the investment of oven multi-function dual energy when it is implemented in small medium enterprise (SME) that processing tapioca crackers.

3.4.2. Sensitivity Analysis

A sensitivity analysis was conducted to determine the effect of variables. By looking at the changes in these variables that will be known how much sensitivity of the feasibility.

4. Analysis

4.1. Technical and Operational Aspect

Here are the specifications of the oven multi-function dual energy.

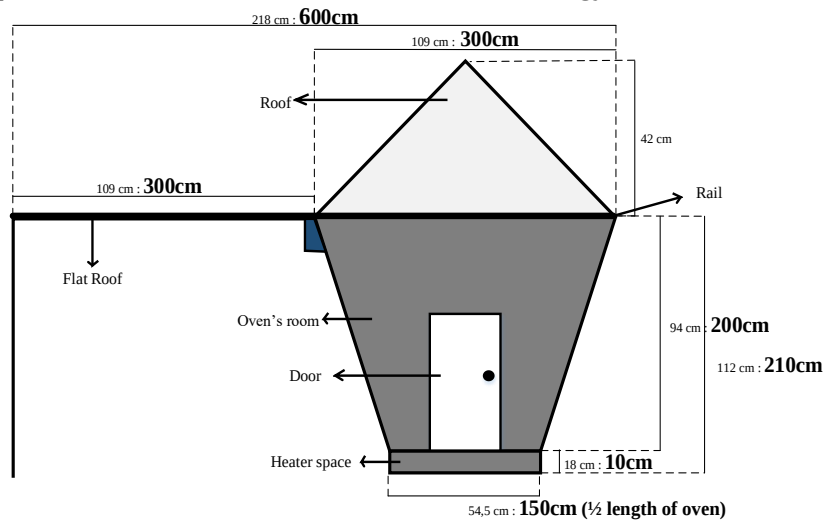


Figure 1. oven multi-function dual energy

When the small and medium enterprise (SME) is not using oven multi-function dual energy, they need to rent a land for drying tapioca crackers about 60 x 10 meters.

Oven multi-function dual energy has a capacity adjusted production capacity of tapioca cracker / day in small medium enterprise (SME). The details of prototype compare with the actual oven multi-function dual energy are:

- 1) Rack size is 60 x 20 cm (prototype) and 400 x 50 cm (oven);
- 2) Crackers size is about 3 x 5 cm;
- 3) Capacity per racks is 60 crackers (prototype) and 1000 crackers (oven);
- 4) Number of rack is 8 racks (prototype) and 32 racks (oven).

The production capacity of tapioca crackers is 31200 pieces / day on the small medium enterprise (SME). So, the oven's capacity to dry the tapioca crackers is enough.

4.1.1. Result Of The Experiment

Here is the result of experiment (drying tapioca crackers) using prototype oven multi-function dual energy with solar thermal energy

- 1) Location : Tapioca crackers small medium enterprise (SME) owned by H. Sumarno ST. Rt. 01 Rw. 02;
- 2) Date : Friday, Mei 27th 2016;
- 3) Capacity : 480 piece;
- 4) Result : Temperature 35 °C; duration 10 hours; and the result is normal.

Then the result of experiment (drying tapioca crackers) using prototype oven multi-function dual energy with gas fuel energy.

- 1) Location : Tapioca crackers small medium enterprise (SME) owned by H. Sumarno St. Rt. 01 Rw. 02
- 2) Date : Saturday, Mei 28th 2016 – Tuesday, Mei 31st 2016
- 3) Capacity : 480 piece;
- 4) Result:
 - Temperature 60 °C; duration 3 hours; gas used 0,8 kg; and the result is normal without roasted;
 - Temperature 70 °C; duration 2,5 hours; gas used 0,4 kg; and the result is normal without roasted;
 - Temperature 80 °C; duration 2 hours; gas used 0,6 kg; and the result is normal without roasted.

The result of experiment (drying tapioca crackers) using prototype oven multi-function dual energy with gas fuel shows that the optimum temperature is 70°C with a time of 2.5 hours and spend 0.4 kg (give the lowest cost).

4.2. Sales and Production Capacity

Here's a sales and production capacity of tapioca crackers in 2017, 2018, and 2019 before - after using the oven based on the result of forecasting (seasonal method).

- 1) In 2017 the sales and production capacity of tapioca crackers is about 317 kg before using the oven and 472 kg after using the oven;
- 2) In 2018 the sales and production capacity of tapioca crackers is about 330 kg before using the oven and 472 kg after using the oven;
- 3) In 2019 the sales and production capacity of tapioca crackers is about 340 kg before using the oven and 472 kg after using the oven.

4.3. Financial Aspects

4.3.1. Income Statement

Income statement is calculated based on the estimated profits and losses derived from the production process tapioca crackers in small medium enterprise (SME) processing tapioca crackers.

- 1) Sales revenue before and after using the oven has a same number;
- 2) Direct material cost before and after using the oven has a same number;

- 3) Direct labor cost before using the oven is bigger than after using the oven. It's because the number of roasting labor before using the oven is more than after using the oven;
- 4) Overhead cost before using the oven is bigger than after using the oven. It's because before using the oven, small medium enterprise needs to pay the rent cost of field/drying area;
- 5) Depreciation cost before using the oven is cheaper than after using the oven. It's because after using the oven, small medium enterprise has more investment (oven multi-function dual energy);
- 6) There is no interest because the capital of investment only comes from the owner of small medium enterprise;
- 7) Based on the government regulation, small medium enterprise needs to pay 1% of tax from their revenue / year;

4.3.2. Feasibility Criteria

Feasibility criterias of investment oven multi-function dual energy include NPV, IRR, and incremental ROR with MARR (Minimum Attractive Rate of Return) is 17%.

Table 1 Feasibility Criteria

	BEFORE USING THE OVEN	AFTER USING THE OVEN
NPV	Rp84,089,575	Rp231,741,027
IRR	45.04%	29.29%
INCREMENTAL ROR	46.01%	

The result of calculation above said about investment of oven multi-function dual energy is the best alternative to be implemented in the small medium enterprise (SME) that produce tapioca crackers.

4.3.3. Sensitivity Analysis

Sensitivity analysis was conducted to determine the changes that occur in the variable investment oven multi-function dual energy.

Table 2 Sensitivity Analysis

Increasing the Investment Cost		
Condition	Incremental ROR	MARR
Initial	51.06%	
10%	41.95%	
20%	34.26%	
30%	27.65%	17%
40%	21.89%	
49%	17.31%	
50%	16.83%	

When the cost of investment oven multi-function dual energy is increase until 50%, the number of incremental ROR is 16,83%. So, the best alternative is using conventional drying process again.

5. Conclusion

- a. Sales and production capacity in produce tapioca crackers in small medium enterprise (SME) can continue production capacity 1,3 kw tapioca flour/days however the weather is rainy or cloudy using the oven multi-function dual energy (gas heat). The oven multi-function dual energy can dry 32000 pieces of tapioca crackers in one time with temperature 70°C, spend 2,5 hours, and only using 0,8 kg (based on the experiment using prototype of oven multi-function dual energy). It means the investment of oven multi-function dual energy in technical and operational aspects is feasible;
- b. The results of the feasibility analysis in financial aspect shows the value of NPV is Rp165,788,070 before using the oven and Rp231,741,027 after using the oven; value of IRR is 22.34% before using the oven and 29.29% after using the oven; as well as the value of incremental ROR is 50.06%. This indicate that the investment of oven multi-function dual energy is the best alternative to be implemented on a small industrial processing tapioca cracker;
- c. The limit of investment costs oven multi-function dual energy on small medium enterprise processing tapoka cracker is 49% with an incremental ROR of 17.31% > MARR (17%). Therefore, when the investment cost of the oven multi-function dual energy increase is higher than 49%, the alternative can use conventional drying process again.

6. References:

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