Feasibility Study of Organic Fertilizer Factory from Slaughterhouse Waste

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Abstract. The increasing of meat consumption led to increasing supply from slaughterhouse. However, the slaughter waste generated another problem if directly release in environment. To solve slaughterwaste problem, slaughterwaste is converted into organic fertilizer. The organic fertizer can be utilized by local farmer. There was little study related with feasibility study for establishing organic fertilizer factory from slaughter house waste. The feasibility study will speed up the development of organic fertilizer from slaughter house waste. In this study, we did the techno-economic study for organic fertilizer plant from the mixture of slaughterhouse and municipal waste. From techno-economic analysis study, we did analysis for return on investment (ROI), pay out time (POT) and break even point (BEP). ROI value was 39.82%; POT value was 2.01 year and BEP value was 21.67%. From the techno-economic analysis study, organic fertilizer plant from slaughterhouse waste is feasible to establish.

Keywords: Organic fertilizer, Slaughterhouse waste, Fermentation, Feasibility study, Techno-economic analysis

1 Introduction

The demand for the meat especially from cattle always increasing. In Asia, the meat production from slaughterhouse reach the total production around 140 million ton/year[1] . In Indonesia, the production of meat from slaughterhouse is around 3.5 million ton/year. The increasing demand for meat led to increasing number of slaughterhouse. However, there is negative effect from the increasing number of slaughterhouse such as waste from slaughter house. From the cattle slaughter

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house, slaughter waste that generated were rumen (from the stomach), leftover food in animal stomach, animal wastes and also water that used during slaughtering process. All of the wastes had the negative effect to environment such as increasing the BOD value if the waste is dumped into water flow[2].

The slaughterhouse waste could be mixed with another waste such as organic waste from local market to produce organic fertilizer. Fermentation process is applied to convert the slaughterhouse waste and organic waste into organic fertilizer[2-8]. There are several studies related with fermentation of waste from cattle slaughter house and the results were tested as organic ferilizer. Organic fertilizer can replace the chemical fertilizer since it has similar contents and also more environmental friendly. From several study, organicfertilizer has been proven for farming[9-14]. The quality of organic fertizer from slaughter house has been improved by mixed with another waste such as organic waste and its proven[15-17]. In this study, we did techno-economy analysis study of organic fertilizer factory from slaughter house waste and organic waste.

2 Materials and Methods

The unit cost for the apparatus is based on the dimension of the apparatus. All of the apparatus has been well designed. The cost estimation for apparatus is based on the reference from Aries et.al[18]. The cost estimation is based on the capacity of factory which is 1000 ton/day and the present price is corrected by using correction factor which is chemical engineering plant index.

For the economic feasibility, we are following reference from Aries et.al and Timmerhaus et.al[18-19]. The feasibility of this process is measured from capital expenditures (CAPEX) and operational expenditures (OPEX). CAPEX consists of total direct cost (factory apparatus cost, instrumentation, etc) , total indirect cost (engineering, construction fee, etc) and working capital (product inventory, process inventory, etc). OPEX consist of manufacturing cost and general expenses. APEX and OPEX measurement is used for calculating important parameter for economic feasibility such as return on investment (ROI), payout time (POT) and break even point (BEP).

3 Result and Discussion

Figure 1 shows the production process for organic fertilizer factory that represent by block flow diagram. The factory production capacity of organic fertilizer is 1000 ton/year. In this process, we used several feedstock as raw materials. The main feedstock is rumen from slaughter waste. Other feedstock were leftover food, organic waste and animal waste. In feedstock preparation process, leftover food and organic waste were treated at size reduction unit to get uniform size.

In starter production unit, starter solution for fermentation is produced. In starter production unit, rumen is mixed with molases and water. Then the mixed solution is fermented at anaerobic condition for 1 week. After fermentation, the mixed solution is separated between the liquid and solid component. The liquid component is used for the next fermentation process. Meanwhile the solid waste is collected and can be used as solid fertilizer.

In fermentation process, all of feed stock is mixed and fermented with starter solution. The fermentation process is anaerob for around 35 days. Detail of process production for organic fertilizer factory is shown in **Figure 2**. R-01 is the reactor for starter production process. R-02 until R-08 are the reactor for fermentation process of organic fertilizer.

Fig. 1 Block flow diagram of organic fertilizer factory

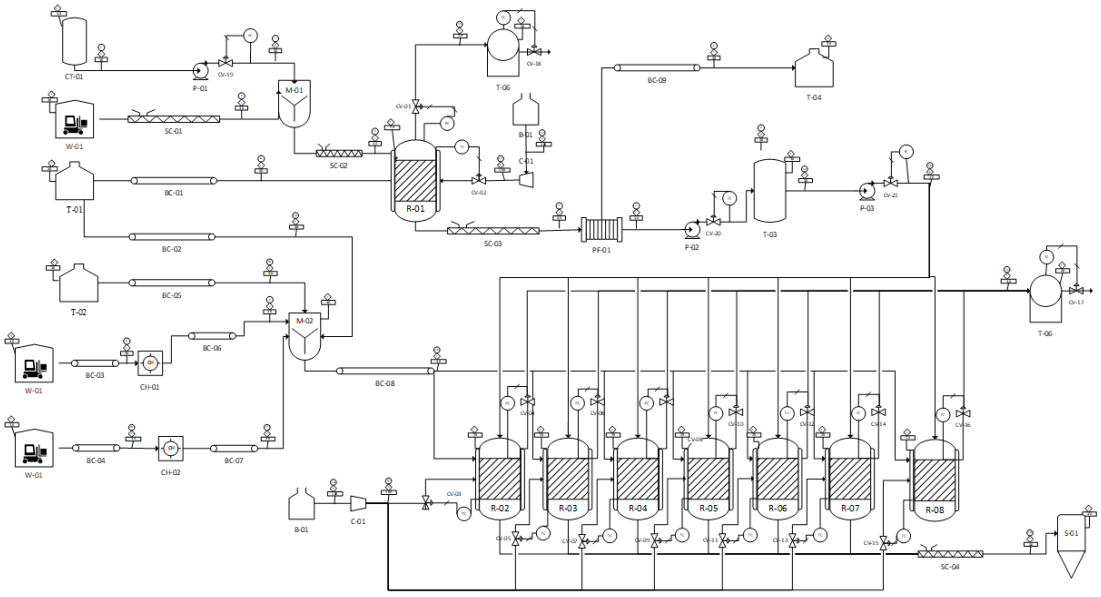

Fig. 2 Process Engineering Flow Diagram of Organic Fertilizer Factory

Table 1 shows capital expenditures (CAPEX) of organic fertilizer factory. Total CAPEX of this factory is Rp 95,417,641,734. Table 2 shows manufacturing cost for this factory and Table 3 shows general expenses of this factory. Operational expenditures (OPEX) is the total value of manufacturing cost and general expense. OPEX value for ths factory is Rp 24,620,543,203.

From the production capacity of this factory, we can arrange Table 4 for the total sales of the products. The total annual sales (Sa) is Rp 67,196,638,520. From Table 3, we calculated profit before tax.

Profit before tax = Total sales − OPEX
=Rp 67,196,638,520 − Rp 24,620,543,203
= Rp 42,576,095,316

According to Indonesia goverment regulation (UU nomor 36 pasal 17 ayat 1(b), 2018), the industrial tax is 28%. Then the profit after tax is;

Profit after tax = Profit before tax – (tax*profit before tax)
Profit after tax =Rp 34,060,876,253

Table 1. Capital expenditures (CAPEX) of factory

No	Components	Price (Rp)
1	Factory apparatus prices	27,570,019,251
2	Apparatus installation	6,892,504,812
3	Instrumentation	2,757,001,925
4	Pipe	2,205,601,540
5	Electrical system	2,205,601,540
6	Building	2,757,001,925i
7	Area development	2,757,001,925
8	Facility	9,538,650,000
9	Land price	5,843,301,737
.	TOTAL DIRECT COST	Rp62.526.684.657
1	Engineering and construction	12,505,336,931
2	Contractor fee	3,001,280,863
3	Contingency	7,503,202,158
	TOTAL INDIRECT COST	22,973,819,955
	FIXED CAPITAL COST	85,536,504,612
1	Raw materials inventory	119,383,740
2	Process inventory	158,568,023
3	Product inventory	1,651,750,248
4	Extended credit	6,299,684,861
5	Cash money availability	1,651,750,248
	WORKING CAPITAL	9,881,137,122
	CAPITAL EXPENDITURES COST	95,417,641,734

Table 2. Manufacturing cost of factory

No	Components	Cost, Rp
1	Raw Material	119,383,740
2	Labor	816,000,000
3	Maintenance	1,710,730,092
4	Plant Supplies	171,073,009

5	Royalties and Patent	461,186,460
6	Utilities	3,895,534,491
DIRECT MANUFACTURING COST		7,255,507,793
7	Payroll Overhead	122,400,000
8	Laboratory	81,600,000
9	Plant Overhead	408,000,000
INDIRECT MANUFACTURING COST		612,000,000
10	Depresiasi	8,553,650,461
11	Property Taxes	855,365,046
12	Insurance	342,146,018
FIXED MANUFACTURING COST		9,751,161,525
MANUFACTURING COST		17,618,669,319

Table 3. General expenses of factory

No	Components	Cost, Rp
1	Administration	1,343,932,770
2	Sales Expenses	1,343,932,770
3	Research	3,359,831,926
4	Finance	954,176,417
GENERAL EXPENSES		7,001,873,884

Table 4. Profit of factory

Components	Rp
Sales	67,196,638,520
Manufacturing Cost (MC)	17,618,669,319
General Expenses (GE)	7,001,873,884
Total Cost (MC+GE)	24,620,543,203

Profit Before Taxes	42,576,095,316
Profit After Taxes	34,060,876,253

By using the data from Table 1 until Table 4, we calculated the discounted value (i) to prove the benefit for establishing this factory. We calculated discounted value by using equations below [19]:

$$WC + SV + \left(C\ x\ \frac{(1+i)^N - 1}{i}\right) = (FC + WC) + (1+i)^N \quad (1)$$

Notes:
WC : working capital = Rp9,881,137,122
SV : salvage value which consists of building and land price = Rp8,553,650,461
C : cash flow which consists of profit after tax, depreciation and loan interest = Rp43,568,703,132
FC : fixed capital cost = Rp85,536,504,612
i : discounted value
N : operational life of factory = 9 year

By using *trial and error method*, we got discounted cash (i) = 43.94%. The value of discounted cash (i) is bigger than average saving deposito interest rate in Indonesia (3%). The higher discounted cash value prove that inverstation for organic fertilizer factory in Indonesia is profitable.

Another key value to calculate the feasibility of factory are return on investment (ROI) and pay out time (POT). We calculated the value of ROI and POT after tax below, based on equation from reference [19]:

$$\text{Return on Investment (ROI) after tax} = \frac{\text{profit after tax}}{\text{total capital investment}} \text{ x } 100\% \quad (2)$$

$$= 39.82\%$$

$$\text{Pay Out Time (POT) after tax} = \frac{\text{total capital investment}}{\text{profit after tax} + (0.1 \text{ x total capital investment})} \quad (3)$$

$$= 2.01 \text{ year}$$

The value for ROI (39.82%) is higher than highest inflation rate in Indonesia at 2022 which is 6.95 % [20]. proving the investment for organic fertilizer factory is acceptable. Based on reference, low risk investment that has low risk of failure should be less than 5 year [18]. The POT for organic fertilizer factory is lower than 5 year, proving the feasibility of this factory. The POT result is also

comparable for several analysis study of organic fertilizer factory from different feedstock, that mentioned the POT value is less than 5 year [21-22].

Break even point (BEP) and shut down point (SDP) are another parameters for proving the feasibility of investment. BEP and SDP were calculated based on equation from reference[19]. The BEP value of 21.68 % related with the production capacity in the factory that the operational cost is similar with the profit. The SDP value of 4.50% related with the limit for the factory to shutdown the operation. If the capacity production of factory less than 4.50% then the production should be stopped, since the operational cost is higher than the profit.

4 Conclusion

From our study, the organic fertilizer factory from the slaughterhouse waste is feasible to be established in Indonesia. The discounted cash value (43.94%) is higher than saving deposito interest in Indonesia (3%), proving the investment for organic fertilizer factory from slaughter house waste is promising. Furthermore, the value for return on investment (ROI) is higher (39.82%) than highest inflation rate in Indonesia at 2022 (6.95%) also Pay out time (POT) value was 2.01 years, proving the investment for organic fertilizer factory is promising.

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