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# Economic analysis of the making of red brick without burning made from Foundry Sand and Paper Sludge waste

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**Abstract.** This study aims to know the total profit gained as the third party's saving effort as waste processor from the utilization of foundry sand paper sludge as the raw material of red brick without burning. There are variations of the composition of the raw materials to get the red brick product with the quality of 50, that is A, B, and F. the calculations are obtained from the red brick production calculation data from 5% subtraction of the amount of paper sludge and foundry sand needed to meet production needs, production cost calculation data from consumables material which is being used in the making process of red brick without burning, calculation of waste fees data by the third party, third's party economic benefits and total profits calculation data as effort of saving by the third party. So, the total profit obtained by producing A variation is IDR841.803.600,00; B IDR471.602.500,00; and for F is IDRp556.641.900,00.

## 1. Introduction

B3 waste management according to the Government Regulations Number 101 Year of 2014 article 99 clause (1) that B3 waste management must be carried out by people who produce the B3 waste, clause (2) in this case is everybody just like what mentioned in clause (1) are not able to do it alone, processing B3 waste are handed over to B3 waste processor. Based on those regulation so as the party which produce the waste must do the processing themselves.

Foundry sand are made from silica sand which already being used in the production of making metal foundry and non-ferrous [5]. Paper sludge waste are from remaining solid waste from the process of deinking with the solidity composition of 90% and 10% of water [2]. Both kind of waste are categorized as B3 waste from general specific and are in 2 dangerous categories so it needs to be processed. Physical B3 waste treatment which is often being used is by stabilization-solidification. B3 waste management by stabilization-solidification based on organic and inorganic analysis. The analysis is carried out based on the quality standards of Toxicity *Characteristic Leaching Procedure* (TCLP) mentioned in PP number 101 year of 2014 [4].

In Brazil recycled the solid waste generated by the steel work for manufacturing clay-based structural products. Tests results for mechanical properties and leaching indicated that the solid generated by steel works can be used in construction materials, thereby reusing those waste in environmentally safe manner [1].



Based on the study about foundry sand waste and paper sludge as substitutes material of red brick without burning there are three (3) variations of ingredients to get the red brick with the quality of 50 which can be used as building material. Those variations of ingredients include: A and B with the ratio of foundry sands: paper sludge: each compactor is 75%: 15%: 10% and 65%:25%:10% and then F variation with ratio 90% of foundry sands and 10% of compactor.

That is the reason that underlies the economic analysis to know the comparison of expense incurred by the party which produced waste to ship and take care of the waste to the third party with the expense of doing the process to make it to be red brick as building material.

## 2. Research Methods

The method that is being used in this study is analysis method and comparative methods by data reference as follows:

1. Red brick production calculation data from 5% subtraction of the amount of the paper sludge waste.
2. The amount of foundry sands needed in the process of red brick production.
3. The calculation of red brick production expense
4. The calculation of waste fees by the third party
5. Third party's profit data
6. Total profit data of saving effort by the third party

## 3. Result and Discussion

The utilization of waste becoming red brick have the benefits includes: (i) Decrease the heap of waste used as raw materials and (ii) Economic values which produced from the production of red brick without burning.

### 3.1. Decreasing the heap of waste used as raw material

Paper sludge are produced around 170.00 kg/day [2]. The reduction of paper sludge with the assumption around 5% from the everyday total amount around 8.500 kg/day which can be done to be utilize as the raw material of red brick without burning of the variations of A, B, and F can be seen in the Table 1.

**Table 1** . The calculation of the production of red brick from the reduction of 5% paper sludge waste amount.

Variation	Type of Material	Each Variations Material Needed (%)	The Need of Material per Brick (Kg)	The Amount of Waste (Kg/Day)	5% Reduction of The Amount of Paper Sludge (Kg/Day)	The Production of Red Brick From The Reduction of 5% (Item)
<b>A</b>	<i>Paper Sludge</i>	15%	0,37	170.000	8.500	22.973
<b>B</b>	<i>Paper Sludge</i>	25%	0,60	170.000	8.500	14.167
<b>F</b>	<i>Paper Sludge</i>	0%	0	170.000	8.500	0

Based on the Table 1 5% of the amount of the paper sludge around 8.500 kg/ day. Those amounts can be used to produce A variation of red brick as much as 22.973 items; B variation around 14.167 items while for F variation are not using paper sludge. The calculation of the amount of foundry sands needed to produce red brick with the amount according to Table 1 can be seen in Table 2, with the assumption of the production of red brick for F variation is only use foundry sand waste around 20.000 of red bricks.

**Table 2.** The amount of foundry sands needed to produce red brick

Variation	Type of Material	Material Needed for each variation (%)	Material Needed per Brick (kg)	Needed Material in Total (kg)	Number of Red Brick Produced (Item)
A	<i>Foundry Sands</i>	75%	1,85	42.500	22.973
B	<i>Foundry Sands</i>	65%	1,56	22.100	14.167
F	<i>Foundry Sands</i>	90%	2,15	43.000	20.000

Based on Table 2 the amount of foundry sands which being used to produce red bricks for A variation is around 42.500 kg, B variations around 22.100 kg, and F variations which being assumed can be produced around 20.000 item of red brick by using foundry sands is around 43.000 kg.

### 3.2. The economic values which produced from the production of red brick without burning

The economic value of the waste counted based on the production expense of red brick. The example of the calculation of production expenses can be seen in Table 3.

**Table 3.** The calculation of red bick production cost

Type of Material	The Total of Material Needed (kg)	Unit Price of Material (IDR)	Total Price per Material (IDR)
<b>A Variations with the Amount of 22.973 red bricks</b>			
<i>Foundry Sands</i>	42.500	0,00	0,00
<i>Paper Sludge</i>	22.973	0,00	0,00
Chalk	1.133,02	2.000,00	2.266.050,00
Cement	2.832,57	2.000,00	5.665.150,00
<i>Soil hardener powder</i>	1.699,54	5.000,00	8.497.700,00
<b>Total</b>	<b>71.138,13</b>	<b>9.000,00</b>	<b>16.428.900,00</b>
<b>B Variations with the Amount of 14.167 red bricks</b>			
<i>Foundry Sands</i>	22.100	0,00	0,00
<i>Paper Sludge</i>	14.167	0,00	0,00
Chalk	680,58	2.000,00	1.361.200,00
Cement	1.701,46	2.000,00	3.402.950,00
<i>Soil hardener powder</i>	1.020,87	5.000,00	5.104.350,00
<b>Total</b>	<b>39.669,91</b>	<b>9.000,00</b>	<b>9.868.500,00</b>
<b>F Variations with the Amount of 20.000 red bricks</b>			
<i>Foundry Sands</i>	43.000	0,00	0,00
<i>Paper Sludge</i>	0	0,00	0,00
Chalk	954,8	2.000,00	1.909.600,00
Cement	2.387	2.000,00	4.774.000,00
<i>Soil hardener powder</i>	1.432,2	5.000,00	7.161.000,00
<b>Total</b>	<b>47.774</b>	<b>9.000,00</b>	<b>13.844.600,00</b>

Based on the table it can be seen that the expense of red brick production for A variation is IDR16.428.900,00; B variation IDR9.868.500,00 and F variation is IDR13.844.600,00. Those red brick production expense are taken from the fees received by third party to process the waste. The example of the calculation gets by the third party to process the waste can be seen in Table 4. The amount of the waste that is processed based on the amount of the waste needed to produce red bricks from the previous calculations.

**Table 4.** The calculations of receiving expense by the third party

No.	Type of Material	Total Waste Needed (kg)	Processing Expense (IDR)	Fees get by the Third Party (IDR)
<b>A</b>				
1.	<i>Foundry Sands</i>	42.500	13.000,00	552.500.000,00
2.	<i>Paper Sludge</i>	22.973	13.000,00	298.649.000,00
<b>Total</b>		<b>65.473</b>	<b>26.000,00</b>	<b>851.149.000,00</b>
<b>B</b>				
1.	<i>Foundry Sands</i>	22.100	13.000,00	287.300.000,00
2.	<i>Paper Sludge</i>	14.167	13.000,00	184.171.000,00
<b>Total</b>		<b>36.267</b>	<b>26.000,00</b>	<b>471.471.000,00</b>
<b>F</b>				
1.	<i>Foundry Sands</i>	43.000	13.000,00	559.000.000,00
2.	<i>Paper Sludge</i>	0	13.000,00	0,00
<b>Total</b>		<b>43.000</b>	<b>26.000,00</b>	<b>559.000.000,00</b>

Based on the Table 4 the fees got by the third party to process B3 waste with A variation is IDR851.149.000,00; B variation is IDR471.471.000,00; and F around IDR559.000.000,00. The economic profit gain by the waste producer can be seen in Table 5.

**Table 5.** The Economic profit of waste producer

Variation	Total Amount of Brick Production (Item)	Total Red Brick Production Cost (IDR)	Total Cost Received to Process the Waste (IDR)	Economic Profit (IDR)
A	22.973	16.428.900,00	851.149.000,00	834.720.100,00
B	14.167	9.868.500,00	471.471.000,00	461.602.500,00
F	20.000	13.844.600,00	559.000.000,00	545.155.400,00

Based on the Table 5 it can be seen that the economic profit for A variation is Rp834.720.100,00; B variation Rp461.602.500,00; and F variation for IDR545.155.400,00. That means the expense to process the waste to be red brick without burning is much more profitable economically than hoard it in landfill.

Besides if the company needs red bricks to build building so the red brick without burning can be used internally. The building cost to buy red brick in the market which usually used for construction with the assumption of the amount based on the production of the red bricks A, B, and F variations each are 14.167; 20.000; and 22.973 bricks cost about IDR7.083.500,00; IDR10.000.000,00; and IDR11.486.500,00 each with the calculation of red brick class 50 which used in the calculation based on market price around IDR500,00 per item [4]. Those calculations then can be summed up with the economic profit as saving effort that can be used by the third party. The total profit as saving effort by the third party can be seen in the Table 6.

**Table 6.** Total profit as saving effort by the third part

Variation	Economic Profit (IDR)	Red Brick Buying Cost	Total Profit as Saving Effort by Third Party (IDR)
<b>A</b>	834.720.100,00	7.083.500,00	841.803.600,00
<b>B</b>	461.602.500,00	10.000.000,00	471.602.500,00
<b>F</b>	545.155.400,00	11.486.500,00	556.641.900,00

Based on Table 6 the total profit that can be used as saving effort by the third party for A variation is IDR841.803.600,00; and B variation is IDR471.602.500,00; and F variation for IDR556.641.900,00. Those results show that waste processing by the stabilization-solidification methods becoming red brick without burning can give profit to the waste processor party by use it as internal needs and can save money to buy red bricks building material.

#### 4. Conclusion

It can be concluded that in this study the total profit gets as effort to save by waste processor party of each Variation A, B, and F each are IDR3.313.706,00; IDR3.240.682,00; IDR3.223.567,00.

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