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Cost Analysis the Implementation of New Material: The Case Study of Cement Product

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Abstract.
This study will perform a cost analysis of using synthetic and natural gypsum by using the traditional costing method and to determine the investment analysis of the initiative strategy of gypsum synthetic. The research purpose is to compare the impact of gypsum synthetic implementation cost and gypsum natural consumption cost, and to find out whether the savings cost from gypsum synthetic consumption can cover the investment costs of implementing strategy. The existing calculation cost of material consumption products uses traditional costing methods, so this research is using this method that will compare the consumption costs between both Gypsum. Net present value and interest rate return methods are to determine the levels of investments needed to overcome problems in the consumption of synthetic gypsum. According to this research, the result of the net present value methods was IDR 1,543,004,654 and the interest rate return reaches 17.09%, for the planned case of 10 years, which means that this initiative is accepted and feasible to apply, it means that to produce cement, for the application of gypsum synthetic consumption as initiative strategy and application of 3 alternative strategies for these investment will result in positive impact for long-term decision.

Keywords: cement industry, gypsum synthetic, production, cost analysis, traditional costing, net present value, internal rate return

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1. Introduction

The Gypsum is one of the main materials in cement processing and it has an important function in the calcination process for making cement, if there is no gypsum, the cement will crumble and have low strength. The addition of gypsum to cement is to regulate the setting time of cement as a retarder. (Tebabal, 2020). If gypsum is added more than this amount, it has an acceleration effect on the setting time. Previously, company use Gypsum Natural to produce cement nevertheless it has higher price purchased and lower resources. Afterwards, the company substitute Gypsum to Gypsum Synthetic which has lower price than Gypsum natural approximately IDR 172,540/Ton. So the company uses Synthetic Gypsum for a strategy to save material costs and avoid stock outs due to difficult resources. But in practice, there are 3 issue while consume Gypsum

Synthetic such us in production process, impact to Finish mill breakdown due to material plug up so it impact to down time performance of finish mill, for 2021 there are 52 times down time of finish mill caused material plug up. This picture show that material plug up in weight bridge of finish mill, and it impact to finish mill stop.

Figure 1: Case Material plug up in Weight Bridge of finish mill.

Second, there are higher moisture contain of incoming gypsum synthetic, in 2021 the average moisture contain is more than 15% above target of moisture contain, more over in October 2021 the highest moisture is 15.91%. Third, higher P2O5 Contained in Gypsum Synthetic estimate 0.2% above target. From these three problems, in order to implement a cost-saving strategy by using Gypsum Synthetic, the company took several initiatives to support smooth production operations. The purpose of this research is to analyse cost of consumption Gypsum Synthetic in cement product and compare cost spending between Natural Gypsum consumption cost and Gypsum Synthetic cost and determine the investment feasibility of implementing the strategy carried out by the Net Present Value and Interest Rate Return Methods.

2. Alternative of Gypsum Consumption Strategy

There are 3 alternative strategy to resolve Gypsum Synthetic consumption issues which is result the investment cost. In this section, explain issues of Gypsum Synthetic and how to resolve it.

2.1. Additional of material handling

The pupose of mixing and smelting process of materials with the addition of material handling such as excavators or loaders is to avoid material plug ups due to high moisture and balance the P2O5 content in Synthetic Gypsum. Previously, the company also used a loader to clean up storage by 2 loaders, but it still needed one additional loader for mixing old and new incoming materials, the purpose is to make the moisture content more balance on the gypsum material and it can reduce the risk of plug up materials in Gypsum Synthetic. And this material handling can be used to arrange FIFO system of incoming gypsum in storage.

2.2. Indoor storage of Gypsum Synthetic inventory

While using Gypsum Natural, there is no special treatment to keep inventory so there is no problems for open yard storage for Gypsum Natural because the contain of Moisture and P2O5 was balance. But there is different characteristic of Gypsum Synthetic, it need to keep moisture balance and to avoid exposure of rain water. Therefore, the company utilizes the existing storage by adding a rooftop so that the stored Gypsum Synthetic is not exposed to rain. The area of the storage that will be added to the rooftop is 1,547 m2 which can accommodate 10,212 tons of Gypsum.

2.3. Additional Grinding Aid

Gypsum Synthetic has P2O5 material content which is higher than the normal limit estimate 0.2%. In 2021 the average of P2O5 content in Gypsum Synthetic is 0.238%. P2O5 is a phosphorus pentoxide in Gypsum material which has the potential to interfere with the quality of cement strength, high compressive strength in cement has a short setting time process, setting time is the speed of hardening in cement, if P2O5 content is higher, it can produce cement products with a longer setting time and it is impact to lower cement strength. From these problems, the company took the initiative to

Figure 2: Loader for additional Material Handling.

stabilize P2O5 during the production cement by adding grinding aid material. Grinding aid material is a material purchase category.

3. Literature Reviews

The cost calculation in this journal apply the traditional cost method, According to Hansen and Mowen (2005), the cost calculation system with the Traditional Costing method is carried out by calculating product costs with charging costs from direct cost in products and then overhead costs charged using unit activity drivers. In this journal, we calculate the cost of each strategy by breaking down the cost result in the implementation of the strategy.

Net Present Value is one of the discount models that explicitly considers the time value of money and combines the concept of discounting cash inflows and outflows

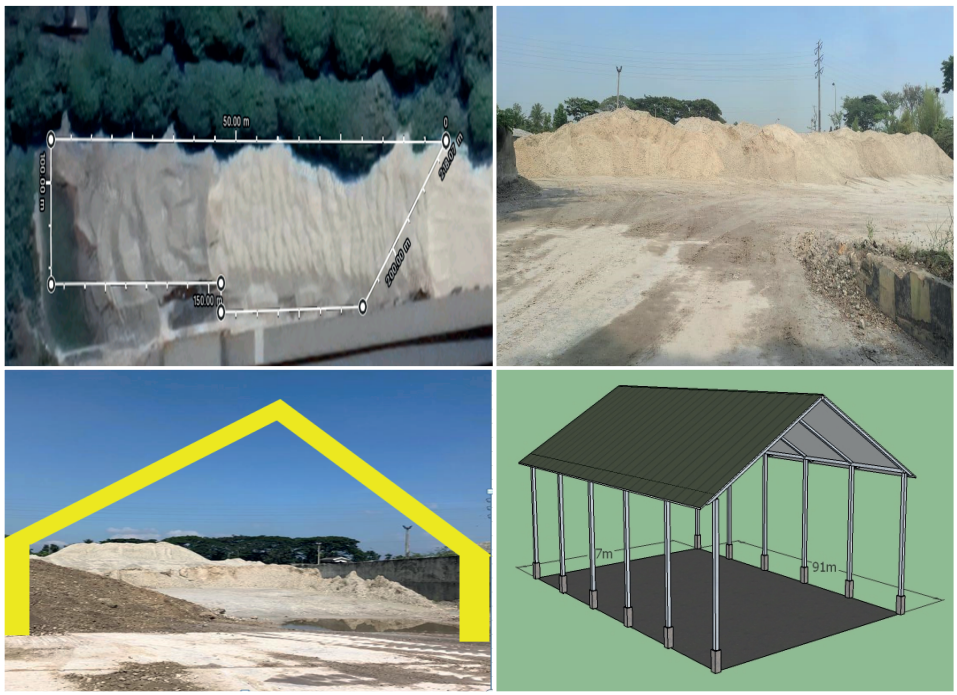

Figure 3: (a) Location Gypsum Synthetic Storage (b) Gypsum Synthetic Storage existing (c) Planning Indoor Storage of Gypsum Synthetic.

(Hansen, 2005). The Net Present Value method calculates the cash flows and time value of money. The decision-making rules for the Net Present Value method are while Net Present Value is more than 0, it means thet the Investment decision is accepted, otherwise while Net Present Value is lower than 0, it means that Investment decision is declined, then while Net Present Value is 0, it means that Investment decision is Break Even Point condition. According to Hansen (2005), the formula of Net Present Value is:

$$NPV = \sum \frac{CFt}{(1+i)^t} - I$$

$$(1) = P - I$$

Equation 1 -- The Formula of Net Present Value

Remarks:

I = The present value of the investment cost

CFt = The cash inflow received in period t, with t = 1, . . . , n

i = The interest rate of return

t = The time period

P = The present value of the project's future cash inflows

To get the decision of investment from the implementation strategy, it should calculate Interest Rate Return. The purposed is to decide whether the investment project from

the implementation of the Gypsum Synthetic strategy can be implemented or not. The formula used to analyse the data is below.

(2) $0 = -IO + \sum \frac{CFt}{(1+IRR)^t}$

Equation 2 -- The Formula of Interest Rate Return

Remarks:

IO = Investment 0

CFt = Cash Flow in t period

IRR = discount rate (cost of capital)

t = Period

n = number of period

With this Interest Rate Return method, the decision to accept or reject an investment proposal is based on the following assessment criteria. While the Interest Rate Return is greater (>) than the interest rate applied, the decision of investment is accepted and otherwise while the Interest Rate Return is less (<) than the interest rate applied, the decision of the the investment is declined.

4. Cost Analysis

Cost analysis is carried out to calculate the difference costs between the strategy of using synthetic gypsum and Gypsum Natural by considering the cost of the resulting initiative. The calculation of costs carried out as follows:

Gypsum Natural Cost Yearly (IDR)				
Cost Items	**Unit**	**Quantity**	**Price**	**Cost**
Purchase Cost	Ton	5,578	593,002	**3,308,026,077**
Loss Production cost				
- Actual Stock Out Gypsum	Ton	28,659	258,000	**7,394,022,000**
Rental Material Handling to Clean up Warehouse	Unit WL	2	1,500,000,000	**3,000,000,000**
Direct Labor Cost				
- Month	Month	12	3,500,000	
- number of operator	Worker	2	42,000,000	**84,000,000**
Fuel cost	**Liter**	110,712	13,591	1,504,686,792
Total Cost Gypsum Natural				15,290,734,869

Figure 4: Cost Calculation of Gypsum Natural Consumption.

The highest of Gypsum Natural cost is lost production cost, impact from limited quota delivery minimal 10 KT. In 2021 there are twice stock out in March and October estimate 1.5 months for each. Therefor higher purchase cost due to higher price of Gypsum

Gypsum Synthetic Cost Yearly (IDR)				
Cost Items	**Unit**	**Quantity**	**Price**	**Cost**
Purchase Cost	**Ton**	**5,578**	**420,462**	**2,345,337,036**
Maintenance Cost Impact FM Plug up				**3,444,480,000**
- Clean up and maintenance service	times	52	65000000	3,380,000,000
- Direct Labor cost (@8 hours * IDR 23,750)	Workers	4	9880000	39,520,000
- Overtime Cost (@4 hours*IDR 30,000/hours)	Workers	4	6240000	24,960,000
Rental Material Handling to Clean up Warehouse	Unit WL	2	1,500,000,000	**3,000,000,000**
Direct Labor Cost				**84,000,000**
- Month	Month	12	3500000	
- number of operator	Worker	2	42000000	84,000,000
Fuel cost	**Liter**	**110,712**	**13,591**	**1,504,686,792**
Total Cost Gypsum Synthetic				**8,117,166,792**

Figure 5: Cost Calculation of Gypsum Synthetic Consumption.

Investment Cost for Gypsum Synthetic Initiatives (IDR)				
Cost Items	**Unit**	**Quantity**	**Price**	**Cost**
Additional Material handling cost for mixing				**1,203,507,900**
-Rental WL	Unit	1	55,000,000	660,000,000
-Direct Labor	Operator	1	3,500,000	42,000,000
-Fuel Cost	Liter	3,075	13,591	501,507,900
Project contract building cost (Material & Service cost)				**4,469,997,347**
-Wall Construction (Material & Service cost)			1,014,295,347	
-Rooftop and civil cost (Material & Service cost)			2,210,400,000	
-Base floor warehouse (Material & Service cost)			1,140,802,000	
-Clean up material (Material & Service cost)			104,500,000	
Additional Grinding Aid cost				**1,438,296,500**
Consumption cost	ton	93,059	13,500	1,256,296,500
Logistic cost				182,000,000
Total Investment Cost for Gypsum Synthetic Initiatives (IDR)				**7,111,801,747**

Figure 6: Cost Investment of Gypsum Synthetic Consumption Strategy.

purchase is IDR 593,002/Ton, more expensive price in IDR 172,540/Ton than Gypsum Synthetic price. While company was decide to consume Gypsum Synthetic, there are some problems and the highest cost problem is plug up material in Finish Mill, it impact to Finish mill breakdown 52 times in 2021 it cause additional maintenance cost activities estimate IDR 3.4 Billion per year. According to the calculation cost between Gypsum Synthetic and Gypsum Natural consumption, there are potential saving cost by using Gypsum Synthetic as follows

Saving Cost of Gypsum Yearly	
Cost Item	**Cost (IDR)**
Gypsum Natural Cost	15,290,734,869
Gypsum Synthetic Cost	8,117,166,792
Potential Savings	**7,173,568,077**

Figure 7: Saving Cost Gypsum Consumption.

Based on cost calculation between Gypsum Natural and Synthetic, we can analyze that company can save the cost of Gypsum for IDR 7.2 Billion. Therefore, to maintain the consumption of Gypsum Synthetic, with the investment costs incurred, the company

needs to conduct an investment analysis of 3 alternatives which is carried out by calculating the Net Present Value and Interest Rate Return.

5. Investment Analysis

In this section, using the costs in Table 3, Total cost investment of Gypsum Synthetic Consumption Strategy is IDR 7.1 Billion and potential savings in Table 4, the Net Present Value and Interest Rate Return were calculated in Table 5 by using the formula (1) and (2). Previously we calculate the cash flow in every period for 10 years on ward and from the cash flow diagram depicted in Figure 2, it can be estimated that it takes 4 years for cash flow to become positive.

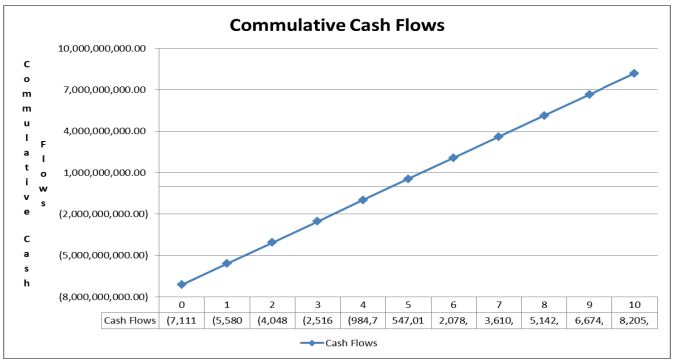

Figure 8: Commulative Cash flow investment of Gypsum Synthetic Consumption Strategy.

According to Table 4 The calculation of investment cost in initiative strategy of Gypsum Synthetic data, $\imath$t is the planned investment for initiative Gypsum Synthetic Strategy. The net present value, difference between costs and benefits, is evaluated to IDR 1.5 Billion, These indicators show that the initiative strategy will have a positive impact. According with the calculation, actual Interest Rate Return of Gypsum Synthetic investment is 17.09% or higher than interest rate. While the value of Interest Rate Return is greater (>) than the interest rate applied, the decision of investment project is accepted.

Investment Analysis	Value (IDR)
Net Present Value	1,543,004,654
Interest Rate Return	17.09%

Figure 9: Net Present Value and Interest Rate Return of Gypsum Synthetic investment.

6. Conclusion

This paper highlight cost and investment analysis for initiative Gypsum Synthetic Strategy considering while company apply 3 alternatives. Cost analysis was compare consumption Gypsum Natural and Synthetic. Therefor based on calculation cost, Gypsum synthetic consumption cost was lower than Natural, with variance saving cost estimate IDR 7.1 Billion, although it has negative impact for operational production. To resolve the negative impact by Gypsum Synthetic consumption, company do the initiative strategy and this study proposed to analyse based on investment analysis while 3 alternatives strategy applied. In this alternative we discussed, based on cash flow, the initiative cost has positive value in 4 years. The Net Present Value difference between costs and benefits, is evaluated to IDR 1.5 Billion, it conclude that this alternative result positive impact because Net Present Value is more than 0, it means that the investment decision is accepted, feasible. The return on investment reaches 17.09%, and that for the planned case of 10 years, it means that this initiative is accepted and feasible to apply. In summary to produce Cement, for the application was still consume Gypsum synthetic as initiative strategy and applied 3 alternatives strategic due to these investment will result positive impact for long term decision.

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