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Research Article

Technical Feasibility Study and Economic Development of Limestone at Pelawi Hill by PT. Semen Baturaja (Tbk.) in OganKomeringUlu District of South Sumatra

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ABSTRACT

Mining of limestone for cement has been increasing in Indonesia. PT. Semen Baturaja (Persero) Tbk. is one of cement producer in Indonesia; the Company has a strategic plan with expanding the limestone mining in Bukit Pelawi, Ogan Komering Ulu Regency. From the mine, the Company targets 2,000,000 tons of limestone per year to support the plan to increase cement production from 1.5 to 3.4 million tons per year. This study makes a technical and economic assessment of the Company's action plan. Based on detailed exploration drilling conducted, it has been identified limestone resources of 80.3 million tons and mining reserves of 43.4 million tons. Compositely, the quality of limestone that has been mine by company is CaO> 43% and RCO3> 78%. The value of Cut of Grade (COG) which is still categorized by ore is CaO at 30% and RCO3 is 70%.The results of this study indicate the assumption of the selling value of limestone with composite quality of Rp 48,500 per ton with a maximum production rate of 2 million tons per year, still provides eligibility criteria for all investment parameters that is calculated showing IRR 13.72%, NPV (+) Rp 5,111,313,765.-, PBP for 6.42 years. The effect of increasing or decreasing cement price assumption and operational cost ± 1.5%, will give a significant effect on the rate of return on the calculation of this study.

Keywords: limestone, investment cost, operational cost, other costs.

1. INTRODUCTION

Lime or carbonate is a rock composed of minerals of carbonate salts formed chemically in the form of a solution, in which aquatic organisms participate in the formation of carbonate rocks. The carbonate rocks are either clastically formed (via mechanized precipitation) or the chemical concentration processes of carbonate salts derived from marine animals including plankton foraminifera or mollusks that will form reefs through the process of diagenesis (cementation, micritization (by organic)), compaction, neomorphism (the process of replacing similar minerals or polymorph).

The Government of Indonesia began to realize the Master Plan for the Acceleration and Expansion of Indonesian Economic Development (MP3EI). One of them seen in the allocation of APBN for infrastructure development has increased from year to year, for the year 2016 and its funds reached more than 300 trillion rupiah. The sharp increase seen between 2014 and 2015 caused by the reallocation of energy subsidy funds was diverted for infrastructure development as seen in Figure 1. This trend encourages national cement producers compete to expand by investing trillions of rupiah, including PT. Semen Baturaja (Persero) Tbk.

The Company has made a strategic plan in 2017 by increasing its cement production capacity from 1.85 million tons of cement per year to 3.85 million tons of cement per year. Limestone as primary raw material requirement for cement production, it is supplied from existing mine and Bukit Pelawi mine which is 2 to 2.5 kilometers from cement processing plant. Therefore, a feasibility study is technically and economically needed to support the lime mining operations.

Mining feasibility studies generally describe the data and information that is quite detailed and accurate. It is used as the basis for the Company's strategic decision, and the terms of obtaining the financing activities (bankable document) of financial institutions. The feasibility study document has planned detailed production targets each year over the life of the project, based on "indicated" or "measurable" resources that become "proven" and "probable" reserves [1].

2. EXPERIMENT SECTION

Administratively, the research location goes to the administration of Laya Village and Pusar Village, West Baturaja District, Ogan Komering Ulu Regency, South Sumatera Province. The location of the Mining Permit Area (WIUP) inquiry has an area of 507.5 hectares. Geographically the area of investigation has regional boundaries as shown in Figure 2 and 3.

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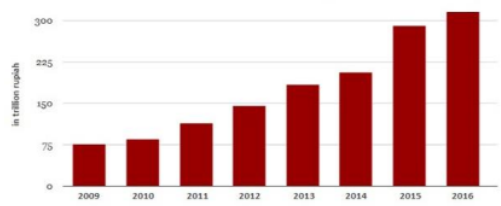

Figure 1. Allocation of APBN Funds for Infrastructure Development [2]

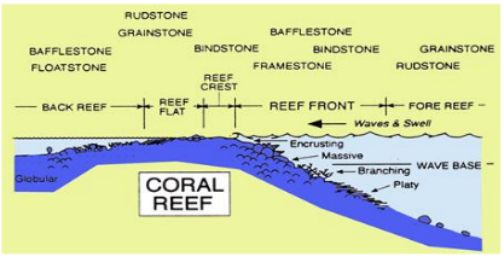

Figure 2. The Model Carbonate Facies [3]

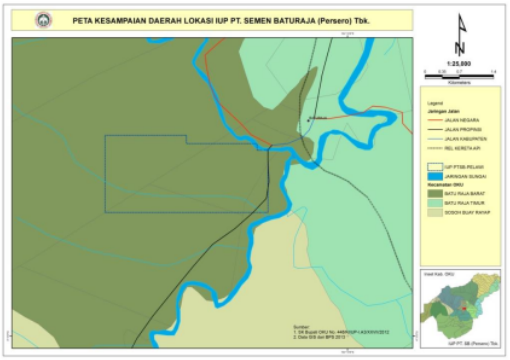

Figure 3. Location Research Map of PT. Semen Baturaja (Persero) Tbk.

This research in the early stages is to conduct a review of exploration report documents owned by PT. Semen Baturaja (Persero) Tbk. The review also looks at the Company's strategic plans in the future. From the data analysis, the feasibility of limestone mining business will be undertaken by the Company, from the technical and economic side. This research will then create simulation calculations with various mining scenarios and financial analysis. To go to the results of the study, in the following question will be described how the processes to be done. These processes include the motion of data retrieval, data processing method, data analysis, and process to get results and conclusions. To more facilitate the understanding of this research methodology, the following explanation will be shown in Figure 4

2.1 Data Analysis Method

2.1.1 Technical Feasibility

The development of the mine will focus on limestone resource production activities that have been modeled using validated exploration data. The mining process will refer to the planned sequence of mining, production plans, AMDAL, and government regulations. The mining process includes the process of extracting, transporting, and processing of limestone as raw material of cement products.

Before calculate the amount of reserves, the pit optimization and design of the mine clearance plan are made first. The pit optimization process is performed to determine the final boundary of the mine, where the amount of reserves obtained can be optimized by taking into account the technical aspects that include slope geometry, resource model, sediment geometry, IUP boundary. [4]

Table 1. Distribution of Limestone Quality Classification [5]

Grade		*Classification*
% CaO	% RCO3	
< 30	-	*Waste*
30 - 46	>70	*Low Grade*
46 - 50	>80	*Med Grade*
> 50	>80	*High Grade*

2.1.2 Economical Feasibility

The results of data processing from the parameters above are presented in various forms of table and graphic variations to make it easier in analysis and understanding. From the tables and graphs will be shown the results of the calculation, among others, as follows:

1. The technical and economic feasibility of the mining plan.
2. The result of calculation of investment cost, operating cost, and income projection.
3. Cash flow tables over the life of the mine PT. Semen Baturaja (Persero) Tbk and summary table (summary) for financial valuation covering NPV, IRR, and PP.

The final result of the processing is then displayed on a table that will show the results of the calculation of investment criteria. From the table then can be seen at what level and how the investment will yield the most optimal profit for PT. Semen Baturaja (Persero) Tbk., and the recommended limits for the company not to lose. So the Company has a choice based on its resources.

This study will also look at the sensitivity level of the main variables used. The level of sensitivity will be visible to the NPV obtained by the Company in the event of changes in the limestone price, operating costs, and interest rate factors used. Given this sensitivity analysis, the Company can make adjustments to the current actual conditions.

3. RESULT

3.1 Mine Planning

The calculation of limestone resources is done by mining software. Limestone deposit modeling generates an area of 262.5 hectares with limestone resources of 87 million tons. With the stipulation of limestone end product target from the Company in the range of CaO> = 43% and RCO3> = 78%, the optimum resource is 80.304 million tons. The lowest average rate of resource optimization results is that CaO is 30% (cut of grade). The results of this optimization are also classified into three classes based on their quality as the table below, while for detail the number of resources can be shown in Table 1.

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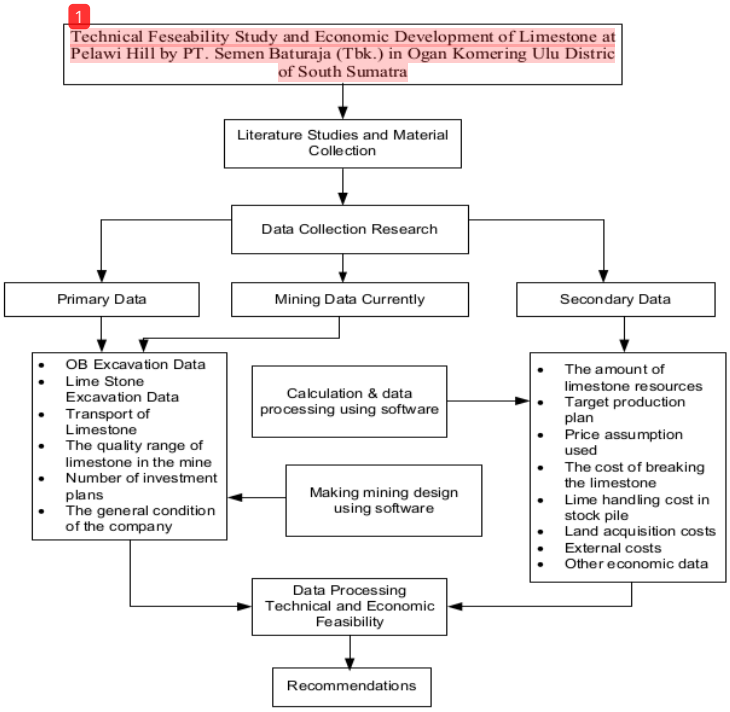

Figure 4. Flow Chart of Research

Table 2. Resume of Limestone Resources& Reserve Optimization Result

Limestone	Low Grade	Medium Grade	High Grade	Total Resources	Total Reserve
Volume	6,757,500	6,563,750	11,593,750	34,915,000	18,851,625
Tonnes	8,542,250	15,096,625	26,665,625	80,304,500	43,358,738
Al2O3	3.88	2.08	1.49	2.75	47.87
AM	3.19	10.71	32.45	14.32	86.95
CaO	39.58	48	51.79	45.22	2.17
Fe2O3	1.88	0.93	0.49	1.24	21.32
H2O	6.49	5.31	3.96	5.43	0.92
LOI	32.07	38.51	41.42	36.39	5.12
LSF	172.62	317.25	638.21	354.41	38.4
MgO	0.89	0.68	0.61	0.76	400.83
RCO3	72.61	87.11	93.71	82.34	0.7
SiO2	17.07	7.51	3.93	10.91	7.86
SM	2.78	2.36	1.77	2.37	2.22

Furthermore, the reserve amount is calculated based on the limit of the ultimate pit limit plan made. Total reserves of mined limestone deposits as a whole amounted to 43.4 million tonnes, which is the total value of deposit accounts after mining losses by 10%. A complete resume of the limestone resource and reserve, and then quality shown at Table 2. The cut of grade value of CaO used is 30%, and RCO3 is 70%. The cut of grade value is made to keep the final output target of CaO> 43% and RCO3> 78%.

The pit optimization process is carried out to determine the final boundary of the mine, in which the amount of reserves obtained can be optimal by taking into account the technical aspects that include slope geometry, resource model, sediment geometry, boundary IUP of Bukit Pelawi Mine and Ogan River line as far as 100 m. With these considerations, the design of the mine produces the ultimate pit with a total pit opening of 107.82 Ha and the drawings design of pit mine optimization openings can be seen in the Figure 5.

In accordance with the Company's strategic plan for limestone production target from Bukit Pelawi Mine is planned to be 2,000,000 tons / year. Based on the amount of previously mined reserves, the life of the mine under the production plan will take place within a period of 23 years (Life of Mine).

To get production according to the expected target, the design of the production plan is adjusted to the target quantity and

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Table 3. Annual Scenario Production of Limestone

Production Capacity of 100%					
Year	Vol Waste (m3)	Vol Ore (m3)	Tonase Ore (ton)	CaO	RCO3
1	1,249,633.89	229,646.74	528,187.50	45.44	82.72
2	707,359.59	411,104.35	945,540.00	46.23	84.1
3	233,974.33	586,173.91	1,348,200.00	46.59	84.79
4	1,105,576.53	800,060.87	1,840,140.00	45.53	82.96
5	244,869.58	887,947.83	2,042,280.00	45.94	83.75
6	460,622.70	885,521.74	2,036,700.00	46.47	84.44
7	584,330.62	885,521.74	2,036,700.00	47.53	86.33
8	303,657.66	885,521.74	2,036,700.00	49.02	88.91
9	298,714.73	887,947.83	2,042,280.00	50.17	90.88
10	394,433.90	885,521.74	2,036,700.00	50.46	91.38
11	1,901,942.87	885,521.74	2,036,700.00	45.9	83.56
12	856,524.09	885,521.74	2,036,700.00	45.02	82.09
13	271,208.63	887,947.83	2,042,280.00	48.65	88.18
14	2,183,484.20	885,521.74	2,036,700.00	46.89	85.21
15	4,248,391.22	885,521.74	2,036,700.00	45.8	83.37
16	1,290,753.11	885,521.74	2,036,700.00	45.07	82.19
17	333,660.85	887,947.83	2,042,280.00	47.54	86.32
18	641,993.67	885,521.74	2,036,700.00	46.26	84.23
19	168,539.89	885,521.74	2,036,700.00	49.88	90.37
20	391,347.86	885,521.74	2,036,700.00	47.46	86.25
21	149,339.83	887,947.83	2,042,280.00	51.5	93.23
22	149,755.88	885,521.74	2,036,700.00	48.21	87.46
23	118,263.10	873,117.92	2,008,171.22	47.49	86.14
Total	18,288,378.74	18,851,625.53	43,358,738.72	47.26	85.88

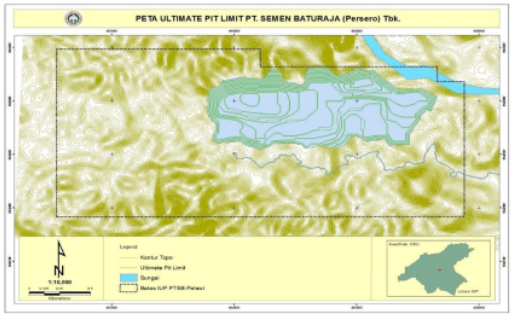

Figure 5. Map of Ultimate Pit Limit

quality target. Production optimization is done through a simulation process of mining block sequences. The ratio of quantity and quality during the production period continues to be maintained to achieve the target limit. The annual scenario production of limestone is shown on Table 3.

3.2 Investment

This analysis is based on the calculation of mine life for 23 years. Investment and economic analysis is based on the concept of discounted cash flow analysis. As a basis of analysis, the components of capital costs, production costs, limestone

Table 4. Resume of Estimated Investment Price

DESCRIPTION	COST	COST/TON
	(Rp)	(Rp)
Pre-development	56,500,000,000	1,888.09
Road Construction	30,510,900,000	1,019.60
Supporting Facilities	4,593,352,400	153.5
Equipments	14,581,350,000	487.27
Working Capital	7,730,888,330	258.35
TOTAL	113,916,490,730	3,806.80

production levels and estimated limestone selling prices.Based on the resume of the calculation done, then the total investment required is Rp 113,916,490,730 with details of resume cost as can be seen in Table 4.

Operational costs arise from the process of excavating soil cover to the transport of limestone to the processing facility, which consists of direct, indirect costs, as well as general and administrative costs. The detail of operational cost are listed in Table 5.

3.3 Selling Assumption

Based on internal data owned by PT. Semen Baturaja (Persero) Tbk., Limestone with quality in accordance with factory input

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Table 5. Details of Operational Costs

No	Cost Component	Value	Unit	Additional
A	Direct Cost			
1	Cost of Loading	9,736.90	ton	Estimate contractor price
2	Cost of Hauling	5,143.00	ton	Estimate contractor price
3	Cost of Blasting	5,186.00	ton	Estimate contractor price
B	Indirect Cost			
1	Transporting to Factory From Stockpile	930	ton	
2	Indirect Wage	330.8	ton	
3	Equipt. Maintenance	279.5	ton	
C	General and Administrative Cost			
1	Administration	2,370.60	ton	
2	Consumables	1,620.00	ton	
3	Insurance & Social Security	118.53	ton	
4	Environmental	945	ton	
5	Community Development	1,350.00	ton	
6	Tax And License	270	ton	
	TOTAL	28,280.33	ton	

Table 6.Assumptionof Limestone Mining Revenue

Year	Production (Tons)	Revenue (Rp.)
1	528,187.50	25,873,264,687.50
2	945,540.00	46,780,449,669.00
3	1,348,200.00	67,369,012,697.70
4	1,840,140.00	92,870,567,553.63
5	2,042,280.00	104,103,155,048.23
6	2,036,700.00	104,856,907,400.36
7	2,036,700.00	105,905,476,474.36
8	2,036,700.00	106,964,531,239.11
9	2,042,280.00	108,330,160,596.84
10	2,036,700.00	109,114,518,317.01
11	2,036,700.00	110,205,663,500.18
12	2,036,700.00	111,307,720,135.18
13	2,042,280.00	112,728,799,521.02
14	2,036,700.00	113,545,005,309.90
15	2,036,700.00	114,680,455,363.00
16	2,036,700.00	115,827,259,916.63
17	2,042,280.00	117,306,040,824.06
18	2,036,700.00	118,155,387,840.96
19	2,036,700.00	119,336,941,719.37
20	2,036,700.00	120,530,311,136.56
21	2,042,280.00	122,069,136,478.74
22	2,036,700.00	122,952,970,390.40
23	2,008,171.22	122,443,031,726.34

has a selling price of Rp 48.500/ton. In this case the escalation factor assuming revenue from the selling price is estimated at 1% per annum. Based on the production plan, it can be projected a large assumption of revenue from limestone mining can be seen in Table 6.

3.4 Economic Feasibility Calculation

From the results of the breakdown of costs and assumptions of income, then a cash flow projection is further developed to determine the economic feasibility assessment. Details of cash flow projections can be seen in the bellow. From the value can be seen the projection of cash flow based on revenue from the sale of limestone and production costs incurred [6]. Based on the cash flow projection, the following criteria are obtained:
IRR (Internal Rate of Return) : 13.72%
NPV (Net Present Value) : Rp 5, 111,313,765.70
PBP (Pay Back Period) : 6.42 Year

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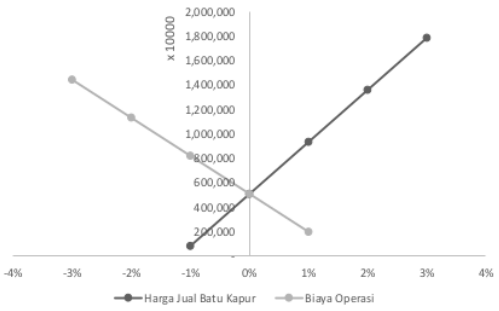

Figure 6. Sensitivity Analysis

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3.5 Sensitivity Analysis

Sensitivity analysis was conducted to see the effect of changes in selling price and mining operation cost at that time based on the decrease and increase of both factors. The sensitivity test results give results as shown in Figure 6.

4. CONCLUSION

From this research can be concluded about the expansion activity of limestone mining PT. Semen Baturaja (Persero) Tbk. in Bukit Pelawi is as follows; a technical and economic review provides eligibility criteria for mining plans at Bukit Pelawi. Through sensitivity analysis it can be concluded that the change of ± 1.5% to the assumption of selling price of Rp. 48,500 per ton and operational cost for production target of 2,000,000 ton per year can make the Company's investment value in BukitPelawi become negative.

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