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A PRELIMINARY ASSESSMENT FOR THE PRESENCE OF A CRUSHING PLANT IN LAMPUNG TIMUR REGENCY

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ABSTRACT

This paper aims to preliminary assessment for the presence of a crushing plant in Lampung Timur regency. Evaluation of this project included technical aspect and financial aspect. Tehnically, Marga Tiga district selected as the project location, caused of a lot of raw material and lack of competitor in this district. Hypotec reserves of basalt rocks in Marga Tiga district reach 8 milion tons. Single togle jaw crusher chosen as due; simple in construction, low maintenance, high productivity and can be produced locally. The installed capacity of the crushing plant unit is 20 m^3/hour, with production size of 2-3 cm,1-2 cm, and finess than 0.5 mm. Calculation of financial aspect obtained 4 years for payback period; positive Net Present Value (NPV) 1,109,106,085; 1.46 of profitability index; and 24.08% of Internal rate of return (IRR). The presence of a crushing plant in Lampung Timur regency is feasible and competent to be run. The presence of this unit will create very beneficial multiplier effect for development in the region.

Keywords: basalt, crusher, IRR, NPV, lampung timur.

INTRODUCTION

Indonesian governments have decided infrastructure development as priorities for the next five years. This condition needs to be followed by the availability of adequate materials. Split stone is one of the basic materials needed in the construction of infrastructures (bridges, roads, buildings, dams, etc.). Split stone can also be used as aggregate in concrete manufactured. Split stone obtained by crushing andesite or basalt rocks. Lampung Timur regency has potential of basalt rocks that can be used as raw material split stone. Total reserves of basalt rocks in Lampung Timur reached 27,088,789m^3 (Statistic of Lampung Province, 2014), scattered in the area of district Sukadana, Mataram Baru, Bumi Agung, Jabung, Marga Tiga, and Way Jepara. The potential has not been used optimally. As an illustration, in the range of 2009-2013 split stone produced only 172,225 m^3 (Statistic of Lampung Province, 2014). The low production capacity, caused the processing are still using manpower to break the rocks into the desired size range.The experience of the contractors in Lampung Timur regency, to meet the needs of split stone in large quantities required long periods of time, or obtained by supplied from other areas. This condition leads to high costs for contractors.

Split stone consists of various sizes such as sizes of 5-7 cm, 2-3 cm, 1-2 cm, 0-0.5 cm and size like sand. To process into various sizes is needed a circuit size reduction processes or better known unit of crushing plant. In industries supporting mining and milling operations, crushing plays a massive role in reducing particle sizes of rocks and ores. To reach desirable end product size, the feed material endures a few crushing stages that form a circuit. A crushing plant system consists of a combination of unit operations for storing, feeding, crushing, screening, and conveying (Villo K, 2011). The crushing plants are often designed to be able to produce certain throughput on predefined specification and a size distribution while keeping the plant capacity and quality, resulting a reasonable cost and energy consumption (Beerkircher G. *et al.* 2003, Lindqvist M., 2008, Asbjornsson G. *et al.* 2012). The main challenging of running a crushing plant as competently as possible is to know how each production unit affects efficiency of the whole plant (Svedensten P. *et al.* 2004). Therefore, a preliminary study on the technological and economic assessment for the presence of a crushing plant in Lampung Timur regency needs to be done.

Crushing technologies

Various types of crushers are used in the stone crushing industry such as Jaw Crushers, Roller Crushers, Cone Crushers, Impactor, Rotopoctor etc. Generally, only Jaw crushers are used as Primary crushers. For secondary and tertiary crushing application either of Jaw, cone, roller, impactor or rotopoctor type crushers are used. Various types of crushers are briefly described below (Gautam S. P, 2009).

Jaw crushers

These are the oldest type of and most commonly used crushers in use and have changed little from the original design. In Jaw Crusher the feed is compressed between a stationary and a movable surface. A few of common types of Jaw crushers, in use, are described below.

1) Double Toggle Crusher: The Blake jaw crusher has a fixed jaw and a moving jaw pivoted at the top. The crushing faces themselves are formed either of manganese steel or of chilled cast iron. The maximum pressure is exerted on the large material, which is introduced at the top. These crushers are made with jaw widths varying from about 2” to 48” and the running speed varies from about 100 to 400 RPM.

2) Single toggle Jaw crusher: The single-toggle crusher is the simplest and the lightest of the jaw crushers

but is suitable only for producing low crushing forces and therefore used for soft rocks.

3) Impact Jaw Crushers: In this type of crusher the crusher cavity is inclined. As there is larger stroke and higher rotation speed (about 400 rpm) a stronger impact is achieved. As a result, hard, tough materials can be processed (Gautam S. P, 2009).

Gyratory (Cone) crushers

In Gyratory Crushers the stress to the feed is applied between a stationary and a movable surface. The crushing head is employed in the form of a truncated cone, mounted on a shaft, the upper end of which is held in a flexible bearing, whilst the lower end is driven eccentrically so as to describe a circle. The crushing action takes place around the cone (Gautam S. P, 2009).

1) Primary gyratory crusher: In the primary gyratory crusher the stress is applied to the feed by pressure as the conical head periodically approaches the bowl. The primary Gyratory Crusher is a large, heavy and expensive machine. It is used only for special materials and high through put. As the crusher is continuously in action, the fluctuation in the stresses are smaller compared to the jaw crusher but the power consumption is lower. It gives a finer and more uniform product compared to the jaw crusher.

2) Cone crusher: Cone crusher have shallower cavity than that of the primary gyratory crusher. This crusher produces higher reduction ratios of up to 18. A uniform product size and good shape is ensured because of the long parallel gap before aperture. The stroke is large and the speed of rotation is 200 - 300 rpm, which ensures a cubical shape to the product. The shallow cone crushers are mainly used for the fine crushing of hard and moderately hard materials (Gautam S. P, 2009).

Hammer crusher

In hammer crushers the hammers are attached to the rotor via pivots so that they are deflected when they hit strong and particularly large stones. In most cases the crushing zone is surrounded by grate bars so that fragments which are larger than the openings of the grating are retained in the crushing zone. Huge hammer crushers with rotor diameters up to 3 m are available which have throughput of even 1500T/hr. Although hammer crushers wear more quickly than impact crushers, they can process moist materials more efficiently. Only soft to moderately hard materials can be processed because of wear considerations. These crushers are simpler than jaw and cone crushers and units with equivalent throughput are much smaller in size (Gautam S. P, 2009).

Financial analysis

Financial feasibility analysis carried out with the following parameters:

1. Payback period is the measure of capital investment desirability which was developed before discounted cash flow techniques were widely understood. This measure is still used as primary decision criteria for some firms. The payback period is the number of years until the cumulative cash benefit equals the money invested. Payback was the principle capital budgeting criterion for a number of years. The reason for its popularity is the ease to explain the rule to employees with no background in finance. The payback period is also used as a risk measure. The longer time it takes to cover the original investment, the more risk and the chance there is something to go wrong. Payback period is used primarily as supplementary information. Managers relied on payback in earlier years (Champathed K *et al.* 2015).

2. Net present value is the method which improves the effectiveness of project evaluations. This method which relies on discounted cash flow (DCF) techniques that proceed as follows: 1) Find the present value of each cash flow, including both inflows and outflows, discounted at the project's cost of capital 2) Sum these discounted cash flows: this sum is defined as the project's NPV 3) If the NPV is positive, the project should be accepted, while if the NPV is negative, it should be rejected. If the projects with positive NPVs are mutually exclusive, the one with the higher NPV should be chosen (Champathed K *et al.* 2015).

3. Internal rate of return is a yield, on average, per year. The IRR is defined as the discounted cash rate that equates the present value of a project's expected cash inflows to the present value of the project's costs: PV (inflows) =PV (investment costs) or the rate that forces the NPV to equal zero. The decision rule for the Internal Rate of Return is to invest in a project if it provides a return greater than the cost of capital. The cost of capital, in the context of the IRR, is a hurdle rate, the minimum acceptable rate of return (Champathed K *et al.* 2015).

4. Profitability index is the ratio of the present value of change in operating cash inflows to the present value of investment cash outflows. PI is the ratio of the tow present values. The PI is often referred to as the benefit-cost ratio, since it is the ratio of the benefit from an investment to its cost. PI tells how much value we get for investment. The rule is PI is greater than one, we accept it. Capital investment projects are classified by project life within short- term or long- term. The long-term projects, in case of long term, the time value of money plays an important role. Long-term asset are based on projections of cash flows far into the future and consider the time value of money. Investment provides benefits over a limited period of time, referred to as its economic life asset by physical deterioration, obsolescence or the degree of competition in the market for a product (Champathed K *et al.* 2015).

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RESULTS AND DISCUSSION

a) Analysis of technical aspects

Location determination is based on the following considerations; marketing factors; regulations and policies of local governments and land use rights; labor factor, regarding the availability, level of wages, the cost of living; factor driving force regarding electrical energy, fuel problem; the availability of raw materials; environmental factors such as transportation, roads and telecommunications (Djamin Z, 1993). Marga Tiga district was chosen as the location for the establishment of the unit crushing plant. Factors of raw materials and relatively small level of competition are main reason why Marga Tiga districts selected for the project location. Marga Tiga have a hipotic resource of 6 million tons bassalt rock.The aavailability of labor and electricity resources, as well as other supporting facilities adequate. Marga Tiga bordered with Sukadana district, which has reserves of 18 milion m^3 of basalt rocks (Statistic of Lampung Province, 2014).

In the crushing plant, preparation of layouts based on the type of product-oriented layout, because the production process is carried out in sequence so that the preparation of heavy equipment machines are arranged in sequence, starting with taking the material to production processes and loading to consumers (Mardianingsih Y, 2000). Layout for this project can be seen in Figure-1.

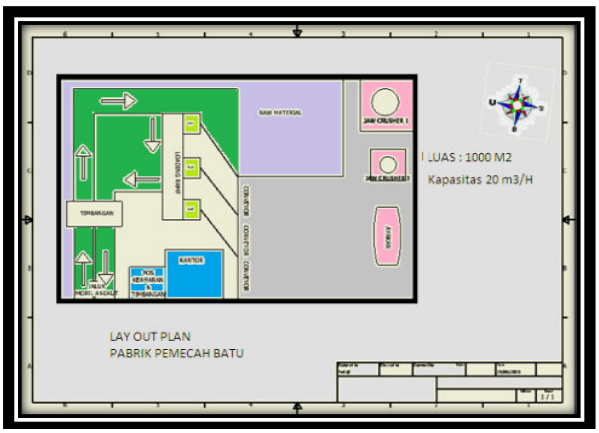

Figure-1. Layout of crushing plant unit.

To get the basalt rocks as a raw material for stone split, it's carried out by open-pit mining system using heavy equipment such as excavators. Obtained the raw material no significant problems, because the thickness of the overburden is only about 0-1 meters and vegetation at the site only in the form of grass, or short-term seasonal crops, as shown in Figure-2.

Figure-2. Raw material.

Raw material is basalt rock with colored dark black-gray, have the form of massive boulders. Analysis test of the raw material are presented in the Table-1.

Table-1. Report of analysis.

No.	Parameters	Value	Method
1.	Hardness	8.3 HBN	Rockwell
2.	Density	2.69 Gram/cm³	Archimedes

Machinery and equipment needed to during this process can be seen in the Table-2.

Table-2. Equipment.

No	Type of Equipment	Quantity
1.	Excavator	1 Unit
2.	Dump truck	1 Unit
3.	Jaw Crusher	2 Unit
4.	Grizlly	1 Unit
5.	Vibrating Screens	1 Unit
6.	Conveyor	5 Unit
7.	Wheel loader	1 Unit
8.	Generator set	1 Unit

Primary and secondary jaw crusher used toggle single type, each with a capacity of 10-20 m^3 / hour, and 4-10 m^3 / hour, as illustrated jaw crusher used can be seen in Figure-3.

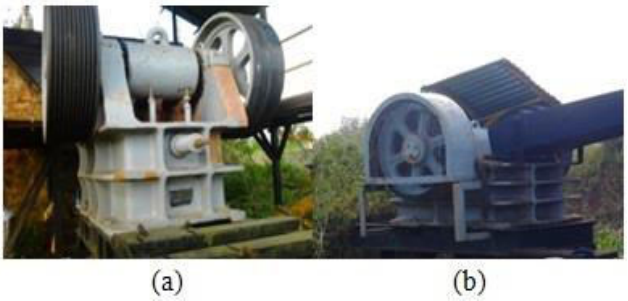

Figure-3. (a) Primary Jaw crusher ; (b) Secondary Jaw crusher.

Grizzly is used as a raw material transporter to the primary jaw crusher. Vibrating screen has three levels for classifying the various sizes of products. Powered generator set used 150 KVA. The generator is used when the electricity supply is disrupted.

b) Financial feasibility analysis

i. Initial investment

Total value of the initial investment is IDR 2,395,000,000.00 with the details as shown in Table 3. Lifetime economical pad equipment is expected for 10 years. All initial investments acquired through a loan with an interest rate of 13% per year.

Table-3. Initial investment.

Allocation	Total (IDR)
Land	150.000.000
Wheel loader	750.000.000
Stone Crusher Machine	1.120.000.000
Electricity	250.000.000
Building	125.000.000
	2.395.000.000

ii. Proceeds

Proceeds are net cash inflows obtained sums earnings obtained from stone-breaking effort, the number of depreciation by taking into account the tax and cost of capital that must be borne by Investment / Initial investment, so that the information can be obtained from Income statement below (Afandi P, 2014).

Table-4. Profit of The Project.

Parameters	Total (IDR)
Total Sales	520.000.000
Total Production Cost	455.000.000
Gross Profit	65.000.000
Comercial Expenditure	3.000.000
Earning before interest and taxes (EBIT)	62.000.000
Interest expense	25.945.833
Net profit before taxes	36.814.167
Taxes (25%)	766.962
Earning after taxes	36.047.205

From the Table-4, obtained earnings after taxes are IDR 432,566,458/year. Estimated economic lifetime equipments is 10 years, depreciation of all equipment is IDR 11,113,000/month or IDR 133,356,000/year. Net Cash Flow is defined the value of proceeds or the amount of net revenue that covers EBIT (Earnings before interest and taxes) multiplied by (1-tax rate of 25% per year) plus the amount of depreciation in one year (Afandi P, 2014). For this project value of proceeds is IDR 698,196,000/year.

iii. Payback Period (PBP)

Payback Period indicates how long a period of time hinted to restore the value of investments by dividing total initial investment with total proceeds per year. Furthermore, the calculation proceeds assuming constant PBP (annuity) per year, it can be calculated PBP her as follows (Afandi P, 2014) :

$$\text{Payback period} = \frac{initial\ investment}{total\ proceeds} \quad (1)$$

PBP for this project = 3,43 ≈ 4 years.

iv. Net Present Value (NPV)

Net present value is the value on the basis of net present value time money that would come to be assessed at the present time. It will obtained from the difference of the present value of proceeds by the present value of the initial investment by taking into account the economic life and certain of discount rate (Afandi P, 2014). From the calculations, the NPV positif for this project is IDR 1,109,106,085. It means, crushing plant unit is feasible for set up in Lampung Timur regency.

v. Profitability Index (PI)

Profitability index (PI), can be calculated by comparing PV of Cash Inflow to the PV of initial Investment (Afandi P, 2014).

$$\text{PI} = \frac{PV\ of\ cash\ inflow}{PV\ of\ investment} \quad (2)$$

The results of calculations of profitability index (PI) obtained a value is 1.46, it's greater than the number 1, so that crushing plant unit is feasible for set up in Lampung Timur regency.

vi. Internal rate of return (IRR)

Internal rate of return used to calculate the interest rate that equates the present value of the value of proceeds. IRR is used as a benchmark level in the project's ability to generate proceeds equal to the initial investment and then compared to the level of its cost of capital. To obtain these values do interpolation approach by calculating the NPV is positive with a negative NPV, so will be obtained a certain discount factor that results in NPV value equal to 0, with the formula (Afandi P, 2014) :

$$\text{IRR} = \sum_{t=0}^{n} + \frac{net\ cash\ inflow}{(1+r)^n} = 0 \quad (3)$$

Where; n is last period that expected; $\sum_{t=0}^{n} +$ is

he amount of cash flow that discounted-right at the end of the year. From the calculation, obtained value IRR for this project is 24.08%, greater than the rate of interest used in the calculation (13%). It means, crushing plant unit is feasible for set up in Lampung Timur regency.

CONCLUSIONS

The presence of crushing plant is needed in Lampung Timur regency. Due to rich in raw material, the lack of competitor is still rare in that region. More over with crushing plant can improve the production of split stone which is currently done by man power. Based on financial feasibility analysis, this project is feasible to be done with payback period almost less than 4 years.

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