Feasibility Study for the Erection of a Ceramic Plant Made from Gold and Copper Mining Tailings in Timika District, Papua Province

Dedy Setyo Oetomo, Rizky Fajar Ramdhani, Asep Hermawan

Wastukancana Technological College of Purwakarta, Indonesia

Jl. Alternative Bukit Indah - Purwakarta, Mulyamekar, Kec. Babakancikao, Kabupaten Purwakarta, Jawa Barat 41151

***Abstract*: Wider use of tailings to overcome a large amount of waste from mining activities at P.T. Freeport-Timika, in this case, use is to make ceramics made from gold mining waste tailings of P.T. Freeport-Timika. Physically, the tailings composition consists of a 50% fine sand fraction with a diameter of 0.075 – 0.4 mm; the rest is a clay fraction with a diameter of 0.075 mm.**

The process of conducting a feasibility study for the construction of a ceramic factory made from the primary raw material of mining tailings begins with determining the raw materials to be used, namely: Plastic Material (Clay), Silica Sand, Dolomite, U5, Water Glass (Na2SiO3) and Tailings. The next step is to unravel. The process of making ceramics consists of two kinds: techniques for Single Firing and Double Firing. The Double Firing production process consists of seven methods: Body Preparation, Pressing, Biscuit Firing, Glaze Preparation, Glaze Application, Glost Firing, Sorting & Packing. Whereas in the Single Firing process, the production process does not go through the Biscuit Firing process but goes directly to the Glaze Application process. The optimal tailings composition for ceramics is 62.5%. The rest are Feldspar, Ball Clay, and Talc raw materials. The installed production capacity of the planned ceramic factory is 2000 M^2/day or 600,000 M^2/year, and the total demand for tailings for production per day is 35 tons

The investment requirement for constructing a ceramic plant in Timika is Rp. 46,183,318,981. The biggest financing is the construction of civil construction factories, warehouses, workshops, and others, amounting to Rp.21,700,000,000. The Feasibility Value of the investment in constructing a ceramic plant in Timika is an NPV of Rp. 230,070,369, and the IRR value is 38%, so constructing a ceramic plant in Timika is said to be Financially Feasible.

***Keywords*: Tailing, Ceramic plant, Single Firing, Double Firing ceramics, Investation**

I. INTRODUCTION

Tailings are materials that are disposed of after the process of separating valuable materials from ore. Tailings waste from ore processing is no longer potentially utilized, but with the results of current research and technological advances, these tailings can still be used for building materials.

The existence of tailings in the mining world cannot be avoided from excavation or mining where only <3% of ore becomes the main product, by-product, and the rest becomes waste and tailings. Physically, the tailings composition consists of a 50% fine sand fraction with a diameter of 0.075 – 0.4 mm; the rest is a clay fraction with a diameter of 0.075 mm. Generally, mining tailings contain minerals that directly depend on the composition of the ore cultivated.

The background of this activity is how the broader utilization of tailings as a solution to overcome the large amount of tailings waste resulting from mining activities at P.T. Freeport-Timika, in this case, use is to make ceramics made from gold mining waste tailings of P.T. Freeport-Timika. The activities carried out are conducting experimental simulations, creating prototypes, and determining the type and quality of the ceramics produced using tailings as raw materials. Where to prepare a report on the financial feasibility of using tailings as a raw material for making ceramics

II. MATERIALS AND METHODOLOGY

Tailings are a by-product of the ore beneficiation processes. After minerals or metals of value has extracted from ore, the residuals rich in gangue minerals are discharged as tailings with the associated process water, which contains processing chemicals. However, with the efficient grinding of ores, the sizes of tailings particles are becoming finer and finer, coupled with certain clay minerals absorbing water into its internal structure. Thus the tailings are extremely difficult to separate from the water [1]

Some of the tailings in the slurry contain metals, sulfide mineralization, and processing chemicals, which affect groundwater and surface water. When dry tailings are stacked together, they occupy a lot of land area and may affect the air and water quality at the borrow area. Tailings are materials that are disposed of after the process of separating valuable materials from ore. Tailings waste from ore processing is no longer potentially utilized, but with the results of current research and technological advances, these tailings can still be used for building materials such as ceramic.

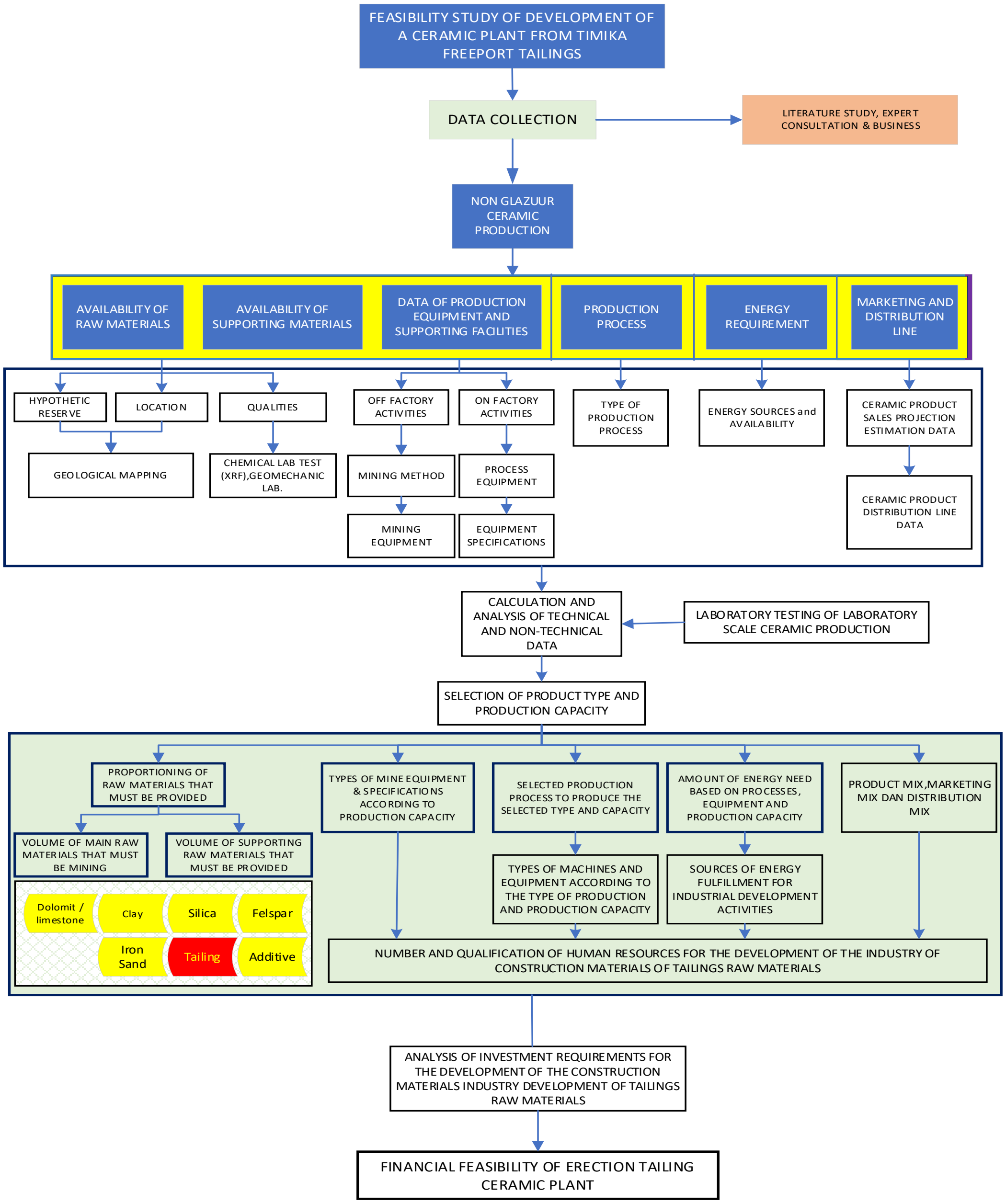


Figure 1. Metodology of study

Feasibility Study for the industrial project [12]

The feasibility study describes the required investments, the projected return, and external impacts on the project, such as state regulations, competition, and technological advancement, as well as the gathering of basic facts and information about the economy in general and the project in particular. The report primarily consists of costs and pricing. Water, power, energy, workers' salary, sources of funding, land prices, buildings, equipment, and other fixed assets

The main point to clarify the feasibility of any project (commercial, industrial, or service) to provide its products or services to the most significant number of consumers and the ability of the project to continue and continue to work is to conduct a detailed market survey for all the information that helps the owner of the investment opportunity. To confirm their viability before investing, to see the profit potential, to design the product optimally, to identify the raw materials they require, to decide the suitable price, and to understand consumer behavior and wants.

Market research includes the following steps:

1. Product: Provide a clear and complete description of the product (s), samples, images, and brochures, as well as a statement of the product's specifications and standards.
2. Demand and supply: calculating the percentage of opportunities and production capacities of local

companies, as well as the quantities imported, their products and products, and their predicted market share The size of demand can be calculated by subtracting the volume of product exports from a total local producer and import sales, i.e., the difference between what was put on the market and what was demanded. This information can also be obtained from the General Department of Statistics' statistics on foreign commerce, as well as the products manufactured

3. Price: Researching and analyzing the product's current price structure in the local market and any other markets relevant to the project, as well as the cost of selling the product from local factories and the cost of import, and then pricing the new product in light of these costs and expected production costs.
4. Sales and market share projections Estimates of total demand volume for the project's products, specifications, and future demand expectations, followed by an estimated production volume and capacity based on the project's expected share of local and international markets.
5. Competition: Whether internal or external, studying the effects of competition and knowing competitors and their strengths are necessary to attain a strong presence in the market; both domestic and external competitors have strengths and weaknesses.
6. Distribution: Identify sales and distribution channels, build a distribution-specific marketing strategy and procedures, look for wholesale deals or sign a marketing agreement, and get the product from production to the end user through the most efficient and low-cost distribution channels.

Technical and procedural details :

1. The technical study is concerned with the following aspects: the definition of the industry in question, economies of scale, variables impacting them, and technological sources.
2. The project's location has been chosen. Electricity, water, roads, storage, transit, and communications dictate the infrastructure requirements. The most suitable geographic and technical areas for establishing the project are examined not only in comparison to other cities but also in terms of specific specifications and requirements, such as proximity to raw material sources and the availability of regular and equipped transportation, among other things.
3. Identification of the land area, including the location of manufacturing facilities, production, storage, management, corridors, modes of transportation, and other areas designated for industrial activities; identification of project needs for machinery, spare parts, techniques, sources, raw materials, intermediate, and other necessary operating requirements The statement of sources, or how the availability and cost, as well as packaging materials Mobeian sources and costs, and the explanation of handling, transport, distribution, and storage methods
4. Machinery, equipment, and manufacturing method: The manufacturing method is studied from the entry of raw materials to the arrival of the final product, and if the product has multiple stages, each stage is analyzed separately, including detailed steps for product formation processes and additives that overlap in the production line. The investor must know the quality and quantity of equipment and machines used in the manufacturing and support processes. This includes technical parameters such as the required electrical energy, cooling or steam services, machine air pressure, and methods for controlling the industrial environment, such as entering and exiting the air to manage the proper temperature or air conditioning.
5. Waste treatment, safety, and security: The production process produces outputs or residues at each plant. Therefore, it is critical to describe the procedures for treating plant waste, whether gas, liquid, or solid, to ensure that it meets the criteria and to be familiar with the equipment used to manage undesirable industrial waste. Air purifiers and liquid waste treatment). A table showing all machines, manufacturing machines, and equipment for fire fighting, air conditioning, water treatment, safety devices, backup power generators, and laboratory equipment, as well as a unique table for the factory's internal transport equipment, such as forklifts, mobile cranes, and laboratory equipment, are included at this stage. Under the preceding heading
6. Buildings: When preparing a study of facilities, the standards and regulations of the building on the Industrial Property Authority's site must be followed. The factory's general plan depicts the site, industrial structures, service structures, and links to the principal utilities (sewage, water, and electricity). Building drawings for the building components, floors, and foundations, brief descriptions of the main features of the buildings, a diagram indicating safety equipment and equipment, minimizing the risks and methods necessary to ensure the safety of the plant and its personnel against fire hazards or any risks resulting from manufacturing or transportation operations are all required.
7. Primary raw and packaging materials that indicate their source or alternative purchase sources are searched for.
8. Furniture and fixtures: In addition to the costs of office furniture, restaurant furniture and equipment, computers, telephone systems, printers, photocopiers, and other office equipment, there are charges for furniture and fixtures.
9. Participation Agreements: There will be yearly Orsum amounts or percentages of sales, production capacity, or net profits in the event of a license or concession

deal. The agreement must spell out the licensed entity's responsibilities and participation in technical management and services for installation, operation, and maintenance, as well as design rights, drawings, and technological know-how. The proposed adjustments have been clarified.

Costs and Financial Preparedness:

One of the indications of the feasibility of establishing a company is in terms of economic and financial aspects. This is done by conducting a feasibility study of the cost calculation. In that sense, a project is called feasible if it turns out that the costs incurred follow the company's capabilities.

By conducting a feasibility study in the field of cost calculation, it will be seen how the company's money flows in and out. Likewise, in a feasibility study in the area of cost calculation, it will be seen how far the company can repay the working capital that has been spent. Whether it's for company investment or the ongoing production process

It covers estimating all investment and operational costs, as well as a financial and economic feasibility analysis for the following project:

1. Fixed assets, working capital, and operating expenses are all included in capital costs, which include expenditures for consultation studies, travel and transportation, startup charges, licensing, and so on.
2. Sources of funding: consider local and foreign costs and offer appropriate funding options, whether self-contained, through investment loans, or through participation.
3. Determination of capital structure (ratio of capital to loans) and expected cost of financing in light of available financing alternatives' terms and conditions.
4. Determine the fixed and variable costs of production.
5. Development of financial statements and forecasted flows for the project, including total and net income.
6. Financial and commercial viability metrics are examined, such as commercial profitability, internal rate of return, and recovery period.
7. Estimated cost per input unit; Estimated cost per produced unit; Estimated cost per unit generated, broken down into direct (mostly variable) and indirect (mostly fixed) costs; Direct price per unit built, broken down into foreign and local currency components (although being expressed in a single currency); Foreign and local currency components of indirect cost per unit produced.
8. Financial Investation performances such as BEP, NPV, IRR, and PBP. However, when preparing a feasibility study, how the project will be funded is rarely understood. Aside from the influence of loan financing on income tax calculations (cost of finance is deducted from the operational margin), the profitability rate for equity capital is solely dependent on the overall profitability of total capital invested and interest paid on the debt balance (leverage effect). As a result, the financial viability of the investment project as a whole must be determined first, followed by the individual feasibility of each contributing source of money (equity holders including joint venture partners, commercial banks, and development finance institutions).

Properties of Tailings

Tailings are materials that are disposed of after the process of separating valuable materials from ore. Tailings that are waste from ore processing are no longer potentially utilized, but with the results of current research and technological advances, these tailings can still be used for building materials.

The existence of tailings in the mining world cannot be avoided from excavation or mining where only <3% of ore becomes the main product, by-product, and the rest becomes waste and tailings. Physically, the tailings composition consists of a 50% fine sand fraction with a diameter of 0.075 – 0.4 mm; the rest is a clay fraction with a diameter of 0.075 mm. Generally, mining tailings contain minerals that directly depend on the composition of the ore cultivated.

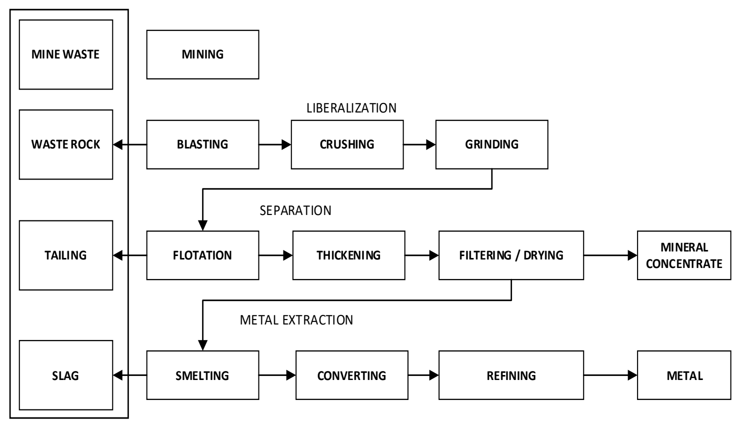


Figure 2. Mineral extraction from mining to metal [1]

Gold mining tailings typically contain inert (inactive) minerals, including quartz, calcite, and various aluminosilicates, as well as gold. Arsenic (As), Cadmium (Cd), Lead (Pb), Mercury (Hg), Cyanide (Cn), and other toxic, dangerous elements can be found in gold mining tailings. Some of the metals in the tailings include heavy metals, classified as harmful and toxic by scientists. Minerals frequently cause acid mine drainage with high sulfur content in tailings.

Calcite, dolomite, quartz, kaolinite, galena, pyrite, and gypsum are among the mineral phases found in lead-zinc tailings, according to previous research [2]. In contrast, other research [4] shows that there are two types of lead-zinc tailings: quartz, orthoclase, barite, albite, and chlorite as the main minerals phases and the other with dolomite and calcite. According to XRD patterns, the primary mineral phases of pyrite tailings are kaolinite and pyrite [5], while the main mineral phases of phosphate tailings are dolomite and apatite.

Much research focuses on the applicability of metals recovery by reprocessing tailings [9, 10], but it cannot dramatically reduce the storage amount of tailings after metals are recovered [11]

According to Xiong et al. [6], the pozzolanic reaction of tailings resulted in the formation of additional hydrates and filled pores, lowering porosity and critical pore width. Wong et al. [8] discovered that tailings as SCMs reduced the average pore diameter size. Han et al. [7] investigated the effects of coarse and fine tailings on the pore structures of a hardened paste containing tailings, concluding that coarse tailings increased the critical pore diameter and harmed the pore structure, whereas fine tailings decreased the required pore diameter and had a positive impact on the pore structure.

Tailings are a type of waste generated by mining activities, Their presence in the mining world cannot be avoided, and it is no longer potentially utilized. However, with current technological advances, it is possible that tailings materials or minerals can be obtained that can be used.

The investigation area is included in the Contract of the Work area of PT Freeport Indonesia, known as Mod ADA (Modified Ajkwa Deposition Area), geographically located at 136o 55' - 136o 58' East Longitude and 4º32' – 4o40' South Latitude, and administratively belongs to Mimika District. Baru, Timika City, Papua Province. This investigation was conducted to determine the possibility that the tailings processed by PT Freeport Indonesia still contain materials or minerals that can be utilized. The tailings sampling was carried out using a 4" Bangka drill at 13 random locations (scout drill) and panning at 3 locations, with 63 samples of sand and 66 samples of tray concentrate. Sample analysis was carried out chemically and physically

The physical properties of tailings are less different among all kinds of tailings compared to the chemical compositions and mineral phases of tailings. The size fractions of tailings are classified as "sand," "silt," and "clay" based on a variety of methods and standards in many mining operators [3]. With the progress of grinding technology, there are more and more "silt" and "clay" in the tailings, and even if tailings are used as aggregate, the maximum size of tailings is less than 1 mm in some literature [4, 5].

- ✓ Characteristics & prospects of tailings as a ceramic material:

Chemical

SiO_2 (60%), Al_2O_3 (15%), CaO (5%), Fe_2O_3 , K_2O, MgO, SO_3 , Na_2O, dan CuO (20%)

- ✓ Mineralogy

Quartz (25-27%) , K-Feldspar (25-27%), Plagioclase (19-20%), Biotite (14%), Magnetite (5.1-5.8%), Pyrite (1.7-2.4%) dan Chalcopyrite (0.6-0.7%)

- ✓ Parameter Comparison of tailings ceramic parameters with Other Common ceramics on the market :

Rheology: density, viscosity, combustion temperature, shrinkage after burning, weight loss after burning, water absorption, white level

Production Process and Equipment

The process of making ceramics consists of two kinds, namely, the process of Single Firing and Double Firing ceramics. The Double Firing production process consists of seven methods: Body Preparation, Pressing, Biscuit Firing, Glaze Preparation, Glaze Application, Glost Firing, Sorting & Packing. Whereas in the Single Firing process, the production process does not go through the Biscuit Firing process but goes directly to the Glaze Application process

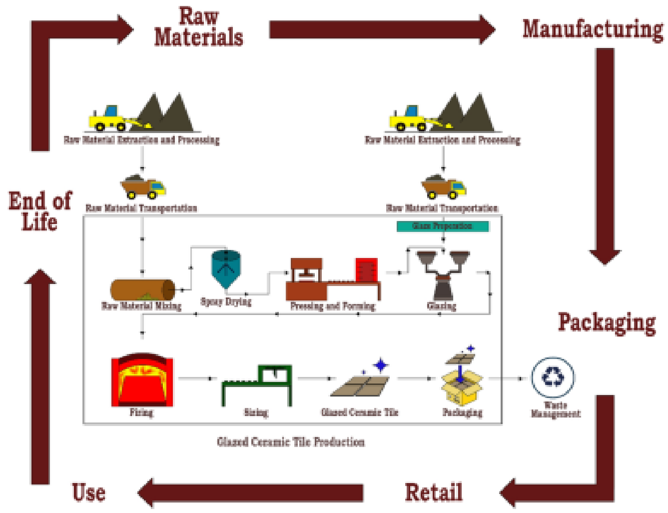


Figure 3. The Flow Process of Tailing Ceramic Making

Checks for glazuur, engobe, and pasta include checking for density, viscosity, residue, and visual checking. Density checking using a 200 cc pycnometer with the following standards:

For Engobe: 1800 – 2000 gram/liter

For E.U.T : 1100 – 1500 gram / liter

For Glazing: 1800 – 2000 gram/liter

For Pasta: 1600 – 2000 grams/liter

In addition to the above checks, checks carried out by the central laboratory were also carried out, which included: fusion flow, Gallen Kamp spindle, E, H. E, and H checking for the suitability of the dye from the paste to the predetermined standard. Standard < 0.5. In the Glaze Preparation work process, after milling in the ball mill, checks are carried out, including:

- Color

Color checking is done with a tool called a chronometer.

- Surface

Checking the surface or surface defects is carried out with the naked eye, for example, defects pinhole (pinhole).

- Glossiness

Checking glossiness/glossiness is done with a gloss meter.

- Autoclave

Autoclave checking (autoclave) is checking whether the ceramic has good weather resistance. This is done using an autoclave. This tool is for testing hair-cracking defects (crazing)

III. DATA ANALYSIS AND INTERPRETATION

The investigation area is included in the Contract of the Work area of PT Freeport Indonesia, known as Mod ADA (Modified Ajkwa Deposition Area), geographically located at 136o 55’ - 136o 58’ East Longitude and 4º32’ – 4o40’ South Latitude, and administratively belongs to Mimika District. Baru, Timika City, Papua Province. This investigation was conducted to determine the possibility that the tailings processed by PT Freeport Indonesia still contain materials or minerals that can be utilized. The tailings sampling was carried out using a 4” Bangka drill at 13 random locations (scout drill) and panning at 3 locations, with a total of, for example, 63 samples of sand and 66 samples of tray concentrate. Sample analysis was carried out chemically and physically.

The results of the analysis of 3 samples of PT Freeport Indonesia’s tailings sand showed the content of Cu 0.16 % - 0.25 %, Pb 65 ppm - 103 ppm, Zn 0.015 - 0.05 %, Fe 6.14% - 8.88%, As two ppm – 28 ppm, Ag 2.00 ppm - 3.66 ppm, Sb < 2ppm – 5 ppm, Au 22 ppb - 355 ppb, and Hg 0.2ppb – 57 ppb. The results of the significant element analysis showed high average levels of several elements, especially SiO_2, Al_2O_3, and Fe_2O_3. Magnetite mineral content varies horizontally and vertically, with the highest value being 84.97% and the lowest value being < 16%. The results of radiation contamination analysis on 2 (two) selected samples on PT Freeport tailings showed levels below the detection limit for Uranium (238U).

Evaluating resources obtained a hypothetical resource of Cu 993,798 tons, Zn 140,660.64 tons, Au 12,4861,800 gr (± 12.4 tons), and a hypothetical magnetite resource of 1,659,120,000 kg (1,659,120 tons).

PT Freeport Indonesia’s ore processing is a physical process in which the ore is finely ground, and minerals containing copper and gold are separated from rock particles with no economic value. Due to the topography, seismic activity, and annual rainfall exceeding 10 meters at some locations, we implemented a tailings management system that utilizes rivers to drain tailings to a designated area in the lowlands and the coastal regions called Modified Deposition. Area/ModADA). The depositional area forms part of the river's floodplain and is an engineered and managed system for tailings deposition and control. Sediment retained in ModADA during the study period was 130,525,279 m3/day or 80,409%. The carrying capacity of ModADA from the calculation results is 10,528.054 km3, so if no dredging is carried out within 80.659 days, it will be filled. River discharge to the total sediment transported has a positive and strong correlation. The average sediment load that entered ModADA during the study period received a contribution from non-tailings deposition of 26,603.306 m3/day or 30.939%.

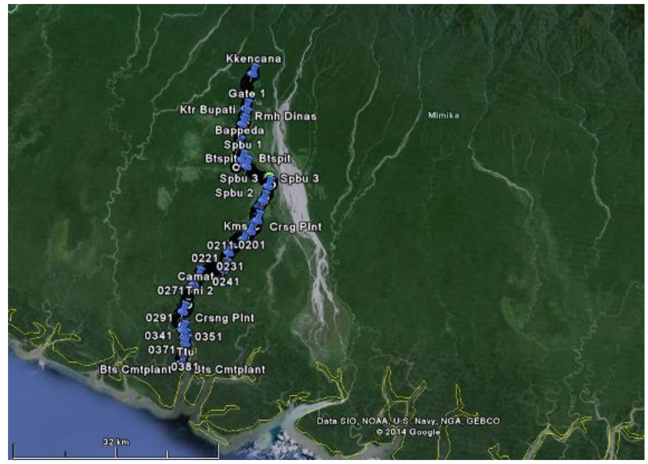


Figure 4. Tailings sampling location.

The Development of the Ceramic Industry in Indonesia

The Association of Various Indonesian Ceramic Industries (Asaki) admitted that they were pretty satisfied with the performance of the ceramic industry in 2021 ago. This is because the ceramics industry rebounded amid the Covid-19 pandemic, which was marked by an increase in national production utilization to 75%, the highest since 2015. This success was supported by government policies related to the industrial gas price of US$ 6 per MMBTU. , thereby helping the ceramic industry to increase competitiveness and re-energize the domestic ceramic industry optimism.

We are starting a new expansion during 2021, with an additional production capacity of around 13 million square meters from an installed capacity of 538 million square meters per year to about 551 million square meters per year.

In addition, ceramic production in 2021 also grew positively by around 35%, from about 304 million square meters in 2020 to about 400-410 million square meters in the following year. Then, Asaki has optimism 2022 that the utilization rate of ceramic factories can increase from 75% to 85%. This is in line with the government’s success in controlling the Covid-19 pandemic and adjustments to the national economic growth target of around 5%-5.2% in 2022.

Machine Equipment Explanation

This report was made for a ceramic-making plant that produces ceramic wall and floor tiles, with a capacity of 1,500 M^2 of ceramics per day. The production equipment required is as follows :

Raw Materials → Weighing → Ball Milling → Tailing Mash Storage → Agitating → Spray Drying → Powder Storage → Shaping → Drying → Glazing → Storage → Kilning/Front Loading Refractories → Selecting → Packing → Finished Products Storage

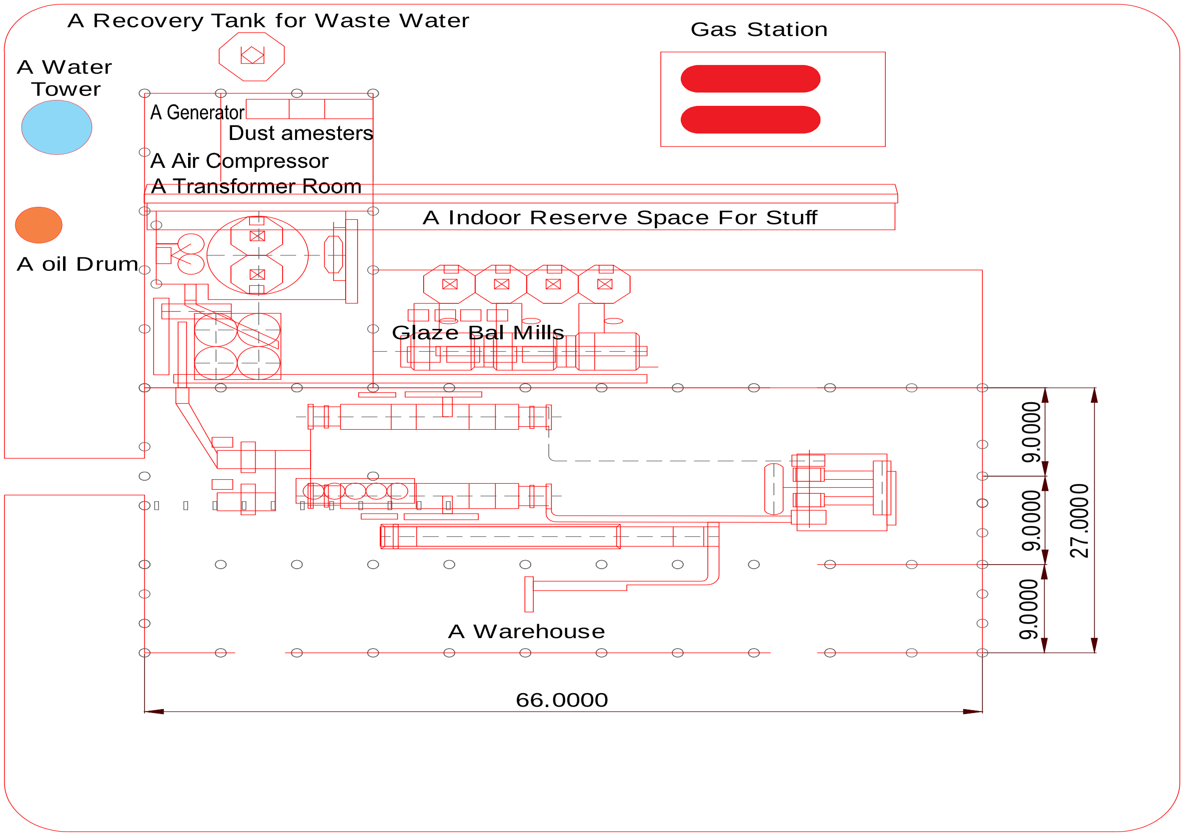


Figure 5. Plant Layout

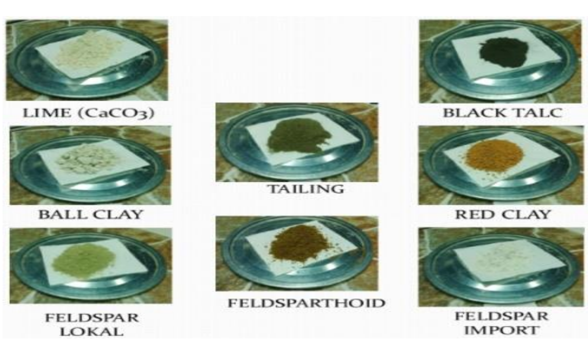
Raw Material

Tailings characterization for ceramic body raw materials :

Single Character (Baking Temp 1126/1136o C, cycle 35 minutes)

1. Natural Residue: 81% (#150 mesh)
2. PSD : 55% (<#120mesh), 13% (>#40mesh)
3. L.O.I: 7.8%
4. Burning Loss: 11.5%
5. Bending Strength Firing: 46.8 Mpa
6. Water Absorption: 8.1%
7. Burning Color: Dark Brown
8. CoE : 8.8 x 10-

Based on the data above, tailings are categorized as a mixture of feldspar and silica materials with a reasonably high Fe content



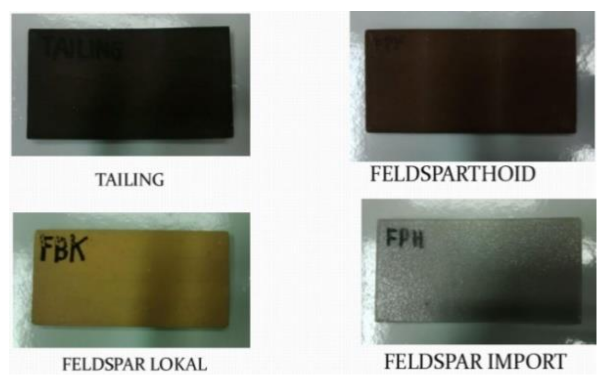


Figure 6. Natural Shape Ceramic Raw Material

A. *Taling Material Test Formulated*

1. Body Wall Tiles/Ceramic Wall

a. Formulation: tailings 35%, the rest is clay, ball
b. clay and limestone (CaCO3)
c. Temp. Bake Biscuits: 1140/1155o C, cycle 40 minutes
d. Firing shrinkage: 0.4% (STD < 0.5%)
e. Water absorption: 18.2% (STD 16 – 20%)
f. Bending strength firing: 22.13 MPa (STD min 20 MPa)
g. LoI: 12.6%
h. CoE : 6.36 x 10^{-6}
i. Burning Color: Light brown towards pink

2. Body Floor Tiles/Ceramic Floor

    a. Formulation: tailings 62.5%; the rest is clay, ball clay, and talc.
    b. Temp. Burn: 1126/1136º C, cycle 35 minutes
    c. Firing Shrinkage: 4.28%
    d. Water absorption: 9.7% (STD 6 – 10%)
    e. Bending strength firing: 29.3 MPa (STD min 25 MPa)
    f. LoI : 5.84%
    g. CoE : 7.4 x 10^{-6}
    h. Burn Color: Reddish brown

3. Homogeneous Body/Porcelain Tiles

    a. Formulation: 10% tailings, the rest is ball clay,
    b. kaolinite clay, feldspar, talc, dolomite, and bentonite.
    c. Temp. Burn: 1220/1230o C, cycle 75 minutes
    d. Firing shrinkage: 6.2%
    e. Water absorption: 0.06% (STD < 0.5%)
    f. Bending strength firing: 66.1 MPa (STD > 40 MPa)
    g. LoI : 6.9%
    h. CoE : 6.4 x 10^{-6}
    i. Burn Color: Greenish gray (STD light gray)

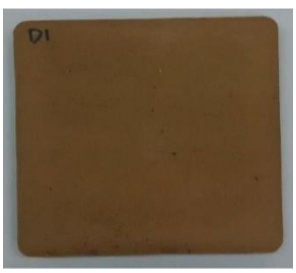


Figure 6. Body ceramic Wall with the use of 35% tailings

Figure 7. Body ceramic Floor with the use of 62.5% tailings

\

Figure 8. Body homogeneous ceramic Floor with the use of 10% tailings

Financial feasibility analysis of tailings ceramic plant erection

A. Initial Stage of Plant Construction

    a. Land Acquisition with estimated land use is around 1.5 Ha
    b. Construction of factory facilities in civil construction and M&E
    c. Its installed Production Capacity is 2000 M2/day
    d. Construction of stockpile, warehousing, and power plant facilities

B. Investment Cost

The investment cost for all of the Ceramic mentioned above Factory equipment is estimated at Rp.46,183,318,981, -(including IDC)

Tabel 1. Investment Cost

No	Item	Total Cost (Rp)
1	Land and Site Development	1,000,000,000
2	Building and Civil Works	21,700,000,000
3	Machinery and Equipment	11,095,425,000
4	Misc. Fixed Assets	1,366,200,000
5	Pre-operative Expenses	1,401,840,000
6	Power Plant Erection (250 kW)	400,000,000
7	Margin from Working Capital	771,132,960
8	Environmental Analysis Report & Permit	800,000,000
9	Permits	500,000,000
10	VAT 10%	3,903,459,796
11	Total EPC Cost	42,938,057,756
11	Interest During Construction	3,245,261,225
Total Project Cost		46,183,318,981

C. General assumptions:

    a. Inflation Rate of 10%
    b. Bank loan interest rate of 14% per year
    c. Increase in electricity tariffs by 10% a year
    d. 10% increase in the selling price of Ceramics per year
    e. Production Capacity 2000 M^2/Day
    f. The selling price of ceramics in Timika is 60,000/ton

D. Cost of depreciation

Depreciation imposed on buildings, machinery, and equipment for this project is calculated using the straight-line method; the building is 20 years, and the machinery and equipment are 15 years. The total amount of Depreciation and Amortization Expenses is Rp. 2.276.143.000

E. Financial Feasibility Analysis

    a. Break Even Point

Break Even Point (BEP) for Investment Composition, which is 25% Owner Equity and 75% loan

Descriptions	Years - 1 (Rp)	Years - 2 (Rp)	Years - 3 (Rp)	Years - 4 (Rp)	Years - 5 (Rp)
Sales	25,200,000,000	29,700,000,000	34,560,000,000	39,780,000,000	45,360,000,000
Total Fixed Costs	7,857,804,014	7,754,727,222	7,632,327,020	7,487,408,865	7,316,282,050
Total Variable Costs	9,852,750,000	11,035,080,000	12,359,289,600	13,842,404,352	15,503,492,874
Break Even Point (BEP in Rp)	12,902,419,727	12,339,479,543	11,881,296,457	11,483,297,399	11,115,384,408
Break Even Point (BEP In Unit)	30,720	27,421	24,753	22,516	20,584

b. Internal Rate Of Return (IRR) and Net Present Value (NPV)

For the Investment Scenario with a 75% loan percentage and 25% investment with a 10-year loan term, the results obtained in the calculation of the IRR for a Tailing Ceramic plant in Mimika Regency are predicted to be 38%, much higher than the desirable interest rate for investment (MARR) which is the bank interest rate. And the NPV is IDR 230,070,369,- So the decision is that the Project is Eligible/competent in realization.

c. Payback Periode

For the calculation of feasibility on the old side of the return on investment, in the scenario of building a ceramic plant with raw materials that are tailings used in ceramic production, the investment payback period is four years.

IV. CONCLUSION

After conducting a series of studies and experimental activities in assessing the use of tailings as ceramic raw material, it is concluded that:

1. Tailings have minerals which are minerals that are in the raw materials commonly used for the manufacture of ceramics
2. Tailings, mining waste from PT Freeport Indonesia, can be used as raw materials for making ceramics.
3. The optimal composition of tailings for ceramics is 65%; the rest is made of Feldspar, Ball Clay, and Talc.
4. Timika's raw material for tailings can be used for ceramic production for more than 200 years.
5. The area of land for constructing a ceramic plant in Mimika requires about 1.5 hectares of land.
6. The installed production capacity of the planned ceramic factory is 2000 M^2/day or 600,000 M^2/year
7. The investment requirement for constructing a ceramic plant in Timika is Rp. 46,183,318,981, -
8. The most significant financing is the construction of civil construction plant, warehouses, workshops, and others, amounting to Rp.21,700,000,000-
9. The planned power plant to support operations is a 250 kW generator.
10. The depreciation and amortization value of the investment in constructing a ceramic plant in Timika is Rp. 2,276,143,000,-
11. The investment financing scheme for constructing a ceramic Plant in Timika is 25% own capital and 75% bank loan, with an interest rate of 14% with a loan term of 10 years.
12. The Feasibility Value of the investment in constructing a ceramic plant in Timika is an NPV of Rp. 230,070,369, - and the IRR value is 38%, so the construction of a ceramic factory in Timika is said to be Financially Feasible.
13. The payback period for constructing a ceramic factory in Timika is three years and seven months.

REFERENCES

[1] C. Wang, D. Harbottle, Q.X. Liu, Z.H. Xu, Current state of fine mineral tailings treatment: A critical review on theory and practice, Minerals Engineering 58 (2014) 113-131.

[2] J. Nouairi, W. Hajjaji, C.S. Costa, L. Senf, C. Patinha, E.F. da Silva, J.A. Labrincha, F. Rocha, M. Medhioub, Study of Zn-Pb ore tailings and their potential in cement technology, Journal of African Earth Sciences 139 (2018) 165-172

[3] R. Argane, M. El Adnani, M. Benzaazoua, H. Bouzahzah, A. Khalil, R. Hakkou, Y. Taha, Geochemical behavior and environmental risks related to the use of abandoned base-metal tailings as construction material in the upper-Moulouya district, Morocco, Environmental Science and Pollution Research 23(1) (2016) 598-611.

[4] J.N. Santana, S.N. Da Silva, G.C. Silva, J.C. Mendes, R.A.F. Peixoto, Technical and Environmental Feasibility of Interlocking Concrete Pavers with Iron Ore Tailings from Tailings Dams, Journal of Materials in Civil Engineering 29(9) (2017).

[5] C.S. Xiong, W.H. Li, L.H. Jiang, W. Wang, Q.X. Guo, Use of grounded iron ore tailings (GIOTs) and BaCO3 to improve sulfate resistance of pastes, Construction and Building Materials 150 (2017) 66-76

[6] F.H. Han, L. Li, SM Song, J.H. Liu, Early-age hydration characteristics of composite binder containing iron tailing powder, Powder Technology 315 (2017) 322-331

[7] R.C.K. Wong, J.E. Gillott, S. Law, M.J. Thomas, C.S. Poon, Calcined oil sands fine tailings as supplementary cementing material for concrete, Cement and Concrete Research 34(7) (2004) 1235-1242.

[8] S.H. Yin, L.M. Wang, A.X. Wu, E. Kabwe, X. Chen, R.F. Yan, Copper recycle from sulfide tailings using combined leaching of ammonia solution and alkaline bacteria, Journal of Cleaner Production 189 (2018) 746-753.

[9] T. Asadi, A. Azizi, J.C. Lee, M. Jahani, Leaching of zinc from a lead-zinc flotation tailing sample using ferric sulfate and sulfuric acid media, Journal of Environmental Chemical Engineering 5(5) (2017) 4769-4775.

[10] C. Li, HH Sun, Z.L. Yi, L.T. Li, Innovative methodology for comprehensive utilization of iron ore tailings Part 2: The residues after iron recovery from iron ore tailings to prepare cementitious material, Journal of Hazardous Materials 174(1-3) (2010) 78-83

[11] W.Behren, P.M.Hawranek, Manual for the Preparation of Industrial Feasibility Studies, UNIDO Newly Revised and Expanded Edition