



Analysis Of Economics For Feasibility Study In The Preliminary Design Of A Lactic Acid Factory With A Capacity Of 11,500 Tons/Year In Indonesia

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Abstract:

The Lactic Acid Factory is designed with a capacity of 11,500 tons per year. The factory is located in the industrial area of Krakatau II Industrial Zone, Tegalratu, Ciwandan, Cilegon City. The company will be established as a Limited Liability Company (PT), with a total of 172 employees. The factory operates for 330 days a year, with a 24-hour production process each day. Lactic Acid is produced by reacting Acetaldehyde Cyanohydrin, Sulfuric Acid, and Water in a Stirred Tank Reactor (R-01) at a temperature of 125°C and a pressure of 1 atm. The reaction is exothermic, so cooling is applied to maintain the reaction temperature. The reactor output consists of a mixture of Lactic Acid, Sulfuric Acid, Water, Acetaldehyde Cyanohydrin, and by-products such as Ammonium Bisulfate. The plant requires a Fixed Capital of IDR 247,578,592,949 and Working Capital of IDR 356,875,821,038. Economic analysis of this Lactic Acid plant shows a pre-tax ROI of 72.7% and an after-tax ROI of 58.2%. The pre-tax Payback Period is 1.2 years, and the after-tax Payback Period is 1.47 years. The Break-Even Point (BEP) is at 35.18% of production capacity, and the Shutdown Point (SDP) is at 13.8% of production capacity. The Discounted Cash Flow (DCF) is 28.53%. Based on these calculations, the pre-design of the Lactic Acid plant is deemed worthy of further consideration.

Keywords: Lactic Acid, *Fixed Capital*, *Working Capital*, ROI, POT, BEP, DCF

INTRODUCTION

The development of the chemical industry in Indonesia is progressing rapidly, as evidenced by the establishment of numerous chemical plants. The development of the chemical industry in Indonesia is aimed at enhancing the national capacity to meet the demand for chemicals domestically and internationally, in preparation for the era of free markets. Additionally, it addresses domestic employment challenges.

The lactic acid industry, as one of the sectors in the organic industry branch, has comparative advantages that demonstrate the wisdom of developing the national industry, thereby reducing dependence on downstream industries for imports. However, planning the development of the lactic acid industry in Indonesia requires consideration of its comparative advantages. Microscopically, the development of this industry is expected to provide economic benefits.

The purpose of designing this plant is to understand the financial overview of the Pre-Design of a Lactic Acid Plant with a capacity of 11,500 tons per year, including production costs, utility costs, and other expenses. Additionally, it aims to assess the feasibility of the Pre-Design results, determining whether the plant is viable for construction or not.

LITERATURE REVIEW AND HYPOTHESIS DEVELOPMENT

Determination of Location

The geographical location of a factory will affect its activities, including both the production process and product distribution, which, in turn, will impact the development and sustainability of the factory. Numerous factors must be considered in determining the location of a factory. The factory's location is generally determined based on the orientation of raw materials and market orientation, as this is economically significant. The chosen location for the factory is the Krakatau II Industrial Zone, Tegalratu, Ciwandan, Cilegon City, Banten, Indonesia, with the following considerations:

1. **Raw Material Procurement:** Raw materials play a crucial role in location selection because proximity to raw materials is advantageous. The raw material for this Lactic Acid plant is obtained from PT. Asahimas Chemical, PT. Indo Acidatama Chemical, and PT. Indonesian Acids Industries, which are situated near the planned factory location.
2. **Marketing:** Lactic acid is a material not consumed directly by the public but is needed as a semi-finished product in the food industry and as a component in pharmaceutical manufacturing. Therefore, the factory's location is strategically placed near industries requiring lactic acid. Placing the factory in Cilegon, close to the Jabotabek region with convenient access to the Cilegon East toll gate, ensures a good market reach, facilitating widespread distribution throughout Indonesia.
3. **Transportation Facilities:** The impact of transportation factors on the factory location includes the transport of raw materials, fuel, supporting materials, and the products produced. To facilitate the transportation of raw materials, supporting materials, and the products produced, the factory's location should be in an area easily accessible by large vehicles. The chosen location is close to the port (Pelindo II), directly connected to the Cilegon East Toll Road to streamline the distribution of raw materials and products.
4. **Labor:** Labor is a significant factor in selecting a factory location, as it can influence the factory's operational sustainability. Choosing a factory location in an area with a population possessing sufficient education ensures the availability of a skilled workforce in the vicinity, minimizing labor costs. Cilegon is deemed advantageous as it has numerous accredited educational institutions in Banten and surrounding areas, producing a well-educated workforce available for recruitment.
5. **Utilities:** Utility facilities include water supply, fuel, and electricity. Electricity needs can be met through PLN (Perusahaan Listrik Negara). Water supply facilities can be obtained from river water or the local water company (PDAM) in the Banten Province.
6. **Climate:** The climate in the Cilegon area is generally favorable and conducive to the establishment of a factory.
7. **Soil Type:** The soil structure in the Cilegon area is good, with dry and friable soil types that pose no difficulties in project development.

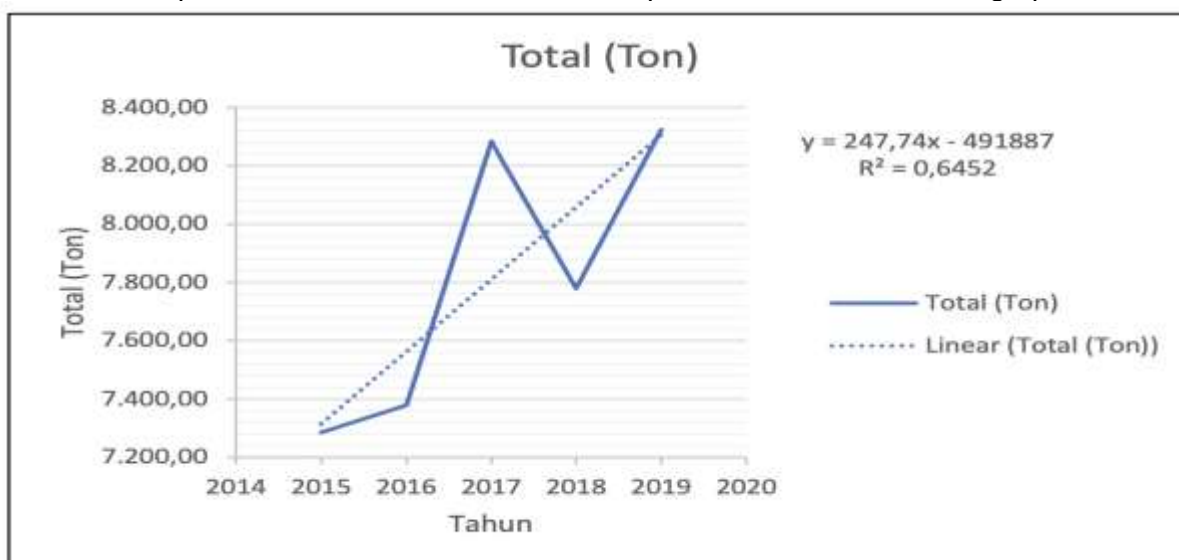
Determination of Capacity

Based on data obtained from the Central Statistics Agency (BPS) in 2019, the demand for lactic acid in Indonesia tends to increase each year, and until now, there is no domestic production facility. Consequently, the domestic demand for lactic acid is still met through

imports from several countries, including China. Below is the import data for lactic acid from 2015 to 2019:

No	Year	Total (Ton)
1	2015	7.285,40
2	2016	7.378,00
3	2017	8.284,55
4	2018	7.779,99
5	2019	8.323,12

Here is the import data for lactic acid in Indonesia presented in the form of a graph:



Based on the lactic acid import graph, the equation obtained is $y = 247.74x - 491,887$, where x represents the import year, and y is the annual lactic acid demand (tons/year).

According to the calculations, the lactic acid demand in 2024 is 9,538.76 tons. Therefore, the determination of the lactic acid factory's production capacity adjusted to the predicted demand in 2024 is 11,500 tons/year.

Company Management

Company Structure The chosen form of the company is a Limited Liability Company (Perseroan Terbatas/PT), which is a legal entity. It is referred to as a "perseroan" because the capital consists of share sales and banking. A limited liability company must be established using an authentic deed. This company structure is led by a director responsible for the smooth operation of production, while the responsibilities of the shareholders are limited, and their wealth is separated from the company's assets.

The company's capital is obtained from the sale of shares. If the company incurs losses, shareholders will only lose their invested capital, and it does not affect their personal assets to settle the company's debts. Moreover, the continuity of the company is not affected by the departure of shareholders, directors, or employees.

Basis for Choosing the Limited Liability Company (Perseroan Terbatas) Form:

1. **Company Continuity:** Legal continuity of the company is more assured as it is not dependent on shareholders, who may change over time.
2. **Limited Liability of Shareholders:** Shareholders have limited responsibility for the company's debts. This means that the risk for shareholders is limited to the amount of capital they have invested.
3. **Business Expansion:** Easier access to additional capital by issuing new shares allows for business expansion.
4. **Transfer of Ownership Rights:** Ease of transferring ownership rights by selling shares to others.
5. **Efficient Capital Management:** Good management and socialization allow for efficient management of capital resources.
6. **Shareholder Decision-Making:** Shareholders, through general meetings, can select a capable Board of Directors to run the company. The company is led by a Board of Directors consisting of a managing director and assisted by managers. The managing director is chosen by the general meeting of members and may not necessarily be a shareholder; it can be someone else. The day-to-day tasks of the directors are overseen by the general meeting of shareholders.

The Board of Commissioners has the right to conduct its own examination or be assisted by factory accountants if the company does not operate as it should. The directors and commissioners are re-elected by the general meeting of shareholders after their terms expire. The highest authority in the limited liability company is the general meeting of shareholders, usually held annually.

Organizational Structure

To achieve high company efficiency, a well-structured organizational system is required. This organizational structure can determine the smoothness of the company's day-to-day activities in achieving maximum profit, continuous production, and growth. The company's organizational structure is designed similar to a business entity in the industrial and trade sectors, dividing units within the organization functionally. The organizational structure of the lactic acid factory consists of functions and relationships that represent the entirety of activities to achieve objectives. In the planning of this lactic acid plant, the selected organizational structure is line and staff. The advantages of this organizational structure are:

1. **Simplicity and Clarity:** The organizational structure is simple and clear.
2. **Clear Task Division:** Tasks are clearly divided between those performing core duties and those performing supporting tasks.
3. **Clear Authority and Responsibility:** Authority and responsibility are easily understood, minimizing command and responsibility discrepancies for employees.
4. **Improved Decision-Making:** Better and more efficient decision-making as staff can provide advice, perspectives, calculations, and more to their superiors.
5. **Effective Work Discipline:** Work discipline can be well-executed.

METHODS

Economic Evaluation is used as the basis for decision-making on whether the factory is feasible to establish or not. The level of profitability and feasibility of the factory can be determined through calculations such as Return On Investment (ROI), Pay Out Time (POT), Break Even Point (BEP), Shut Down Point (SDP), and Interest (i) in the Discounted Cash Flow Rate (DCFR) calculation.

RESULT AND DISCUSSION

1. Fixed Capital Investment (FCI)

Fixed Capital Investment is the investment required to establish production facilities and their construction. FCI amounts to IDR 247,578,592,949.

2. Working Capital (WC)

Working Capital is the investment needed to operate the business/capital of a factory for a certain period. WC amounts to IDR 356,875,821,038.

a. Production

- Manufacturing Cost

Manufacturing Cost is the cost directly related to the production process. Manufacturing Cost amounts to IDR 658,847,669,610.

- General Expenses

General Expenses are the factory's general expenditures not directly related to the production process, such as administration, laboratory, and research costs. General Expenses amount to IDR 101,744,534,268.22.

b. Product Selling Price

The selling price of the Lactic Acid product is determined based on the base price and the desired profit. The selling price of Lactic Acid is IDR 82,800 per kg, while the market price ranges from IDR 90,000 to 100,000.

3. Feasibility Analysis

a. Return on Investment (ROI)

Return on Investment is the estimated profit that can be obtained each year based on the rate of return on the invested.

ROI before tax : 72,7%

ROI after tax : 58,2%

b. Pay out Time (POT)

Pay Out Time is the time required (in years) for the return of fixed capital invested based on the annual profit plus depreciation.

POT before tax : 1,208 years

POT after tax : 1,47 years

c. Break Event Point (BEP)

Break Even Point is the condition where the company can only sell (%) the intended product capacity, and the sales revenue is just enough to cover the total expenditure, making the factory neither profitable nor loss-making. BEP is achieved at 35.18% of production capacity.

d. Shut Down Point (SDP)

Shut Down Point is the condition where the sales revenue of the (%) intended capacity can only cover Fixed Costs and cannot cover other expenses, making it better for the factory to close. SDP occurs at 13.8% of production capacity.

e. Discounted Cash Flow Rate (DCF)

DCF is a calculation system for the business interest rate from periodic cash flow receipts calculated every 1 year with a compound interest system over the service life (10 years of the plant's life) in a future-to-present manner from the invested capital. From the analysis results, the obtained DCF is 28.53%.

CONCLUSIONS

1. From a technical standpoint, covering the procurement of production equipment, raw materials, production processes, production results, and labor, the Synthesis Technology is chosen in the pre-design of the Lactic Acid Chemical Plant with a production capacity of 11,500 tons per year.
2. From an economic perspective, this Lactic Acid plant requires Fixed Capital of IDR 247,578,592,949, and Working Capital of IDR 356,875,821,038. The economic analysis of this Lactic Acid plant indicates an ROI of 72.7% before tax and 58.2% after tax. The Pay Out Time (POT) before tax is 1.2 years, and after tax is 1.47 years. The Break Even Point (BEP) is at 35.18% of production capacity, and the Shut Down Point (SDP) is at 13.8% of production capacity. The Discounted Cash Flow Rate (DCF) is 28.53%. Based on the calculations conducted, the pre-design of this Lactic Acid Chemical Plant is considered feasible for establishment.

REFERENCE

- Aries, R. S., and Newton, R. D., 1955, "Chemical Engineering Cost Estimation", McGRAW-HILL, New York.
- Biro Pusat Statistik, 2010-2015, "Statistik Perdagangan Luar Negeri Indonesia, Ekspor dan Impor Menurut Jenis Barang dan Negara Asal"
- Brown, G. G., 1978, "Unit Operation", Modern Asia Edition, Charles E Tuttle Co., Tokyo.
- Brownell, L. E., and Young, E. H., 1979, "Process Equipment Design", Wiley Eastern Limited, New Delhi.
- Coulson, J. M., and Richardson, J. F., 1983, "Chemical Equipment Design", John Wiley & Sons, New York.
- Gupta, R.K.1987, Industrial Chemical Handbooks, small business publication, Roop Nagae, delhi india
- <http://www.che.com/>, diakses pada 28 Desember 2021. <https://upahminimum.info> , diakses pada 28 Desember 2021.
- <http://www.ejbiotechnology.info/content/vol7/issue1/full/7/index.html>.ISSN 0717 3458.
- <http://www.icis.com> diakses pada tanggal 28 Desember 2021. <http://www.alibaba.com> diakses pada tanggal 28 Desember 2021. <http://www.bi.go.id/web/id/Moneter/KursBankIndonesia/KursTransaksi/>, diakses pada 28 Desember 2021.
- Husain, T., & Sunardi, N. (2020). Firm's Value Prediction Based on Profitability Ratios and Dividend Policy. *Finance & Economics Review*, 2(2), 13-26.
- Kadim, A., & Sunardi, N. (2022). Financial Management System (QRIS) based on UTAUT Model Approach in Jabodetabek. *International Journal of Artificial Intelligence Research*, 6(1).
- Kadim, A., Sunardi, N & Husain, T. (2020). The modeling firm's value based on financial ratios, intellectual capital and dividend policy. *Accounting*, 6(5), 859-870.
- Kern, D. Q., 1950, "Process Heat Transfer", International Student Edition, McGRAW-HILL Kogusha Ltd., Tokyo.
- Kirk, R.E. and Othmer, D.F., 1979, " Encyclopedia of Chemical Technology ", John Wiley and Sons, Inc., New York.

- Lange, N.A., 1946, "Lange's Handbook Of Chemistry", Hand Book Publisher, Inc., Sanduski, Ohio
- Ludwig, L. E., 1964, "Applied Design for Chemical and Petrochemical Plants" vol. 1, 2 and 3, Gulf Publishing Co., New York.
- McCabe, W. L., Smith, J. C., and Harriott, P., "Unit Operations of Chemical Engineering", Seventh Edition, McGRAW-HILL, New York.
- Narayanan, N.; Roychoudhury, P.K. And Srivastava, A. 2004," Isolation of adh mutant of Lactobacillus rhamnosus for production of L(+) Lactic acid. Electronic Journal of Biotechnology" [online]., vol. 7, no. 1]. Available from Internet:
- Nardi Sunardi Et Al (2020). Determinants of Debt Policy and Company's Performance, International Journal of Economics and Business Administration Volume VIII Issue 4, 204-213
- Perry, R. H., and Chilton, C.H., 1994, "Chemical Engineer Hand Book", 8th edition, McGRAW-HILL, Tokyo.
- Peter, M. S., and Timmerhaus, K. D., "*Plant Design and Economics for Chemical Engineering*", 5th ed., McGRAW-HILL, Singapore.
- Powell, P. T., 1954, "*Water Conditioning for Industry*", McGRAW-HILL, New York.
- Rase, F. H., 1977, "*Chemical Reactor Design for Process Plant*", vol.I and II, John Wiley & Sons, New York.
- Smith, J.M., and Van Ness, H.C., 2001, "*Introduction to Chemical Engineering Thermodynamics* ", 6th ed., McGraw Hill Book Co., Inc., New York.
- Sugiyanto, S. (2022). The effect of the audit opinion, financial distress, and good corporate governance on audit delay. *Keberlanjutan : Jurnal Manajemen dan Jurnal Akuntansi*, 7(1), 72-82
- Sugiyanto, S., & Febrianti, F. D. (2021). The effect of green intellectual capital, conservatism, earning management, to future stock return and its implications on stock return. *The Indonesian Accounting Review*, 11(1), 93.
- Sunardi, N. (2017). Determinan Intellectual Capital dengan Pendekatan iB-VAIC™ Terhadap Efisiensi Biaya Implikasinya Pada Profitabilitas Perbankan Syariah di Indonesia. *JIMF (Jurnal Ilmiah Manajemen Forkamma)*, 1(1).
- Sunardi, N. (2022). Liquidity and Asset Growth on Telecommunications Companies Value. *Jurnal SEKURITAS (Saham, Ekonomi, Keuangan dan Investasi)*, 5(3), 299-307.
- Sunardi, N., & Lesmana, R. (2020). Konsep Icepter (Wiramadu) sebagai Solusi Wirausaha menuju Desa Sejahtera Mandiri (DMS) pada Masa Pandemi Covid-19. *JIMF (Jurnal Ilmiah Manajemen Forkamma)*, 4(1).
- Sunardi, N., & Tatariyanto, F. . (2023). The Impact of the Covid-19 Pandemic and Fintech Adoption on Financial Performance Moderating by Capital Adequacy . *International Journal of Islamic Business and Management Review*, 3(1), 102–118. <https://doi.org/10.54099/ijibmr.v3i1.620>
- Syafrizal, S., & Sugiyanto, S. (2022). Pengaruh Capital Intensity, Intensitas Persediaan, dan Leverage terhadap Agresivitas Pajak (Studi pada Perusahaan Pertambangan Terdaftar Idx 2017-2021). *SCIENTIFIC JOURNAL OF REFLECTION: Economic, Accounting, Management and Business*, 5(3), 829-842.
- Treyball, R. E., "*Mass Transfer Operation*", 2nd ed., McGRAW-HILL, Tokyo.

U.S patent 19633,284,495 by J. F. GABBET, JR “*process od the continuous manufacture, purifacation and isolation of lactic acid*”

Walas, M. S., 1988, “*Chemical Process Equipment*”, Butterworth Publisher, Boston.

Widarnaka, W., Sunardi, N., & Holiawati, H. (2022). Pengaruh Pertumbuhan Perusahaan, Ukuran Perusahaan Dan Likuiditas Terhadap Nilai Perusahaan Dengan Kebijakan Hutang Sebagai Variabel Moderasi. *Jurnal Syntax Admiration*, 3(10), 1341-1352.

Yaws, C.L., 1999, “ *Chemical Properties Handbook* “ , McGraw Hill Companies, Inc., New Jersey.