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Feasibility Study of Nickel Mixed Hydroxide Precipitate (MHP) Smelter Construction Plan with High Pressure Acid Leaching (HPAL) Technology

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Abstract

This study evaluates the feasibility of building a nickel Mixed Hydroxide Precipitate (MHP) plant of PT. X with a capacity of 12,000 tons per year. The analysis shows that the potential demand for MHPs in the national and global markets continues to increase, driven by the growth of the nickel battery-based electric vehicle industry. The planned production capacity is projected to be optimally absorbed. The plant is designed using High Pressure Acid Leaching (HPAL) technology that utilizes low-grade nickel ore from multiple locations to reduce dependence on a single mine. Other supporting factors include adequate infrastructure, manpower, regulatory support, and market potential. Raw material requirements per year include 414,000 tons of laterite ore, 148,100 tons of H_2SO_4, 41,700 tons of CaO, and 2,870 tons of MgO. Initial investment (CAPEX) is estimated at $108.8 million with an annual operating expense (OPEX) of $93.5 million. The main equipment includes an autoclave, thickener, filter press, and rotary dryer. Financial analysis shows the project is feasible with a Payback Period of 4.85 years, an IRR of 19% above the MARR of 15%, and a positive NPV of $14.03 million at a discount of 19%. The sensitivity test showed that the project remained viable despite increased operational costs, so it was considered technically and financially prospective to support Indonesia's nickel downstreaming.

Keywords: mixed hydroxide precipitate (MHP), financial feasibility, nickel downstream.

INTRODUCTION

Indonesia has the largest nickel reserves in the world, making it a major player in the global mining industry. The increasing demand for nickel, especially for electric vehicle batteries, is encouraging the construction of nickel processing plants as a strategy to support national economic growth and downstream of natural resources. The government through its downstream policy targets increasing domestic added value, reducing exports of raw materials, and creating jobs.

Several previous studies have examined the technological aspects of HPAL and laterite nickel processing in Indonesia with various methodological approaches. Heijlen, Bullock, Golev, & Werner (2024), conducting an environmental land footprint analysis of nickel laterite mining in Indonesia, showed that Indonesia experienced a twenty-fold increase in primary nickel production between 2000 and 2020, with the expansion of processing facilities from 2 facilities in 2000 to 32 facilities in 2022. The research focuses on the regional impact of mining operations and projected infrastructure development of up to 44 facilities by 2026. Meanwhile, a recent study on nickel extraction from nickel laterite analyzed the efficiency and economic feasibility of the HPAL process with a nickel recovery rate of 83%-90%, an investment cost of

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approximately $56,000 per ton of nickel metal production capacity, and an operating cost of $15,000 per ton with the main product for electric vehicle batteries. On the industrial policy side, the Center for Strategic and International Studies (2024) examines Indonesia's nickel industry strategy with a focus on analyzing the impact of the government's downstream policies, assessing the impact of regional development, and analyzing the economic value chain from laterite to MHP production, noting that Indonesia's first HPAL project (PT Halmahera Persada Lygend) is located on Obi Island, North Maluku, which began operations in 2020.

The Sorong region, West Papua, has a potential significant nickel laterite reserve of around 120 million tons, with the majority in the form of low-grade limonite that is suitable for processing using High Pressure Acid Leaching (HPAL) technology. Currently, the nickel processing industry in Indonesia is still concentrated in Sulawesi, so the development of the factory in Sorong is expected to create a new economic growth center in Eastern Indonesia.

HPAL technology enables the processing of low-grade nickel ore with high efficiency, resulting in Mixed Hydroxide Precipitate (MHP) products that have higher economic value than conventional nickel products. According to Gultom & Sianipar (2020), High Pressure Acid Leaching (HPAL) technology is one of the new technologies that has begun to be applied in Indonesia to process low-grade laterite nickel ore, especially limonite. This technology has a higher level of nickel acquisition than conventional methods and produces an intermediate product in the form of Mixed Hydroxide Precipitate (MHP), which is an important raw material in the electric vehicle battery industry. The global demand for MHP continues to increase, especially from the world's battery industry, so the construction of a 12,000 tons per year plant in the Sorong SEZ is seen as strategic to meet the global market, strengthen mineral downstreaming, and support the energy transition through the provision of environmentally friendly battery raw materials.

According to Munawaroh, Adzana, Zulhan, Yusro, & Hidayat (2022), efforts to manage laterite nickel smelting residues through sulfur removal and iron recovery show the potential to increase the added value of nickel industrial waste. This is in line with the downstream strategy of the nickel industry to optimally utilize all components of laterite processing, both in the form of MHP, cobalt, and iron-based by-products.

Although previous studies have made important contributions to the understanding of HPAL technology and the Indonesian nickel industry, there are some aspects that have not been explored in depth. First, the geographical focus on the Sorong region, West Papua as a new nickel processing center is a novelty in itself, considering that all previous research has concentrated on established areas such as Sulawesi and North Maluku. Second, the specific analysis of facilities with a capacity of 12,000 tons of MHP per year provides more granularity than existing macro industrial studies. Third, the integration between the assessment of geological resources (120 million tons of nickel laterite reserves) and the implementation of specific technologies (HPAL for low-grade limonite) in undeveloped areas represents a novel approach that bridges resource geology with the implementation of industrial technologies. Fourth, the emphasis on Eastern Indonesia's regional economic development to create new economic growth centers outside of traditional mining areas provides a different regional development perspective from previous studies that focused on environmental impacts or national policies. Therefore, this study aims to fill this knowledge gap through a comprehensive approach that integrates geological resources, technology implementation, regional development strategies, and economic impact assessments specifically for areas with significant nickel reserves that have not been optimally utilized.

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METHOD

This study uses a quantitative approach with the main instrument in the form of relevant secondary data-based literature studies. Data is collected through documents, official reports, scientific publications, and statistics from government agencies such as the Ministry of Energy and Mineral Resources, the Ministry of Industry, BKPM, and the Central Statistics Agency. The research location is focused on the Sorong SEZ, Southwest Papua, which was chosen because of the potential of laterite nickel ore reserves, supporting infrastructure, and regulatory incentives as a special economic zone. Data was also obtained from the Nickel Directorate of the Ministry of Industry related to downstream policies and industrial support, as well as BKPM for information on the investment climate. The data collection time was carried out in March-May 2025, with research variables including the feasibility of market demand, technical aspects of development, and financial feasibility of the project.

According to Ichsan, Nasution, & Sinaga (2019), a business feasibility study is a systematic step to assess whether a business or project is feasible to run, both from market, technical, management, legal, environmental, and financial aspects. The main goal is to minimize the risk of failure and ensure that the investment made is able to deliver the expected returns. Data analysis was carried out quantitatively through the calculation of investment feasibility indicators such as NPV, IRR, PBP, and BEP. Technical analysis involves evaluating infrastructure readiness, HPAL technology suitability, raw material requirements, and key equipment specifications. The data is analyzed and presented systematically in the form of tables, graphs, location maps, and flow charts of research stages that describe the process of problem identification, data collection, feasibility analysis, and conclusion drawn. This methodology ensures that research runs in a structured, data-driven, and scientifically accountable recommendation.

RESULT AND DISCUSSION

This section discusses the results of the feasibility analysis of the construction of the Mixed Hydroxide Precipitate (MHP) nickel plant of PT. X with a capacity of 12,000 tons per year in the Sorong SEZ, Southwest Papua. The results of the research are presented in the form of a table that describes the details of investment costs, raw material needs, labor structure, production cost calculations, and project financial analysis. This discussion aims to interpret the data obtained, assess the feasibility of the project from technical, market, and financial aspects, and evaluate the competitiveness of the project in supporting the downstream of the national nickel industry and meeting the global demand for MHP.

Table 1. Total Construction Cost

Capex Fees	$108,804,784.48
Opex Fees	$93,582,811.12
Depreciation	$776,932.04
Own capital	$32,706,570.59
Borrowed capital	$76,315,331.39

Table 1 shows the total cost of building the factory of $108,804,784 as capital expenditure (CAPEX) and annual operational costs of $93,582,811 as operational expenditure (OPEX). The project capital consists of its own capital of $32,706,571 and borrowed capital of $76,315,331, with an annual depreciation value of $776,932.

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Table 2. Credit Refund

Year	Loan	Interest Credit	Principal Installment	Payment
0	$76.315.331	-	-	-
1	$71.966.566	$9.157.840	$4.348.765	$13.506.605
2	$67.095.949	$8.635.988	$4.870.617	$13.506.605
3	$61.640.858	$8.051.514	$5.455.091	$13.506.605
4	$55.531.155	$7.396.903	$6.109.702	$13.506.605
5	$48.688.289	$6.663.739	$6.842.867	$13.506.605
6	$41.024.278	$5.842.595	$7.664.010	$13.506.605
7	$32.440.587	$4.922.913	$8.583.692	$13.506.605
8	$22.826.852	$3.892.870	$9.613.735	$13.506.605
9	$12.059.469	$2.739.222	$10.767.383	$13.506.605
10	$0	$1.447.136	$12.059.469	$13.506.605

Table 2 presents a loan repayment schedule for 10 years, with details of loan balances, credit interest, principal installments, and total payments per year. A loan of $76,315,331 in year 0 is gradually repaid until the 10th year with an annual payment of $13,506,605.

Table 3. Direct Material Cost

Direct Material Cost			
Material Name	Price	Quantity (Tons)	Total
Laterite Ore	$22,00	414000	$9.108.000,00

Table 3 shows the need for laterite ore as much as 414,000 tons per year at a price of $22/ton, resulting in a total cost of direct raw materials reaching $9,108,000 per year.

Table 4. Cost of Complementary Materials

Cost of Complementary Materials			
Material Name	Price	Quantity (Tons)	Total
H2SO4 (98%)	$500,00	148100	$74.050.000,00
Tall	$143,75	41700	$5.994.375,00
MgO	$937,50	2870	$2.690.625,00

Table 4 shows the cost of complementary materials in the form of H_2SO_4 as much as 148,100 tons with a total cost of $74,050,000, CaO as much as 41,700 tons at a cost of $5,994,375, and MgO as much as 2,870 tons at a cost of $2,690,625.

Table 5. Direct Labor Costs

Direct Labor Costs				
No	Position	Wage/Month	Sum	Cost
1	Operator	$333	31	$10.317
2	Technician	$333	26	$8.653
Total				$18.970

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Table 5 shows a breakdown of direct labor costs consisting of 31 operators and 26 technicians with an average monthly wage of $333 per person, resulting in a total cost of $18,970 per month.

Table 6. Indirect Labor Costs

Indirect Labor Costs				
No	**Position**	**Wage/Month**	**Sum**	**Cost**
1	President Director	$6.250	2	$12.500
	Director:			
2	Director of Operations	$4.375	1	$4.375
3	Finance Director	$4.375	1	$4.375
4	Technical Director	$4.375	1	$4.375
5	Director of Business Development	$4.375	1	$4.375
6	Director of Industrial Relations	$4.375	1	$4.375
	Manager:			
7	Operations Manager	$2.813	2	$5.625
8	Production Manager	$2.813	2	$5.625
9	Technology Manager	$2.813	2	$5.625
10	Manager Asset	$2.813	2	$5.625
11	Risk Management Manager	$2.813	2	$5.625
12	Industrial Relations Manager	$2.813	2	$5.625
13	Manager CSR	$2.813	2	$5.625
14	Marketing Manager	$2.813	2	$5.625
15	Manager Supply Chain	$2.813	2	$5.625
16	Project Management Manager	$2.813	2	$5.625
17	Manager HSE	$2.813	2	$5.625
18	Manager SDM	$2.813	2	$5.625
19	Manager Procurement	$2.813	2	$5.625
20	Manager Outsourcing	$2.813	2	$5.625
	Assistant Manager:			
21	Assistant Operations Manager	$1.875	2	$3.750
22	Production Manager Assistant	$1.875	2	$3.750
23	Assistant Technology Manager	$1.875	2	$3.750
24	Assistant Asset Manager	$1.875	2	$3.750
25	Assistant Risk Management Manager	$1.875	2	$3.750
26	Assistant Manager Industrial Relations	$1.875	2	$3.750
27	CSR Assistant Manager	$1.875	2	$3.750
28	Marketing Assistant Manager	$1.875	2	$3.750
29	Supply Chain Manager Assistant	$1.875	2	$3.750
30	Assistant Project Management Manager	$1.875	2	$3.750
31	HSE Assistant Manager	$1.875	2	$3.750
32	HR Manager Assistant	$1.875	2	$3.750
33	Assistant Manager Procurement	$1.875	2	$3.750
34	Outsourcing Assistant Manager	$1.875	2	$3.750
	Staff:			
35	Operational Staff Manager	$1.250	2	$2.500

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36	Production Manager Staff	$1.250	2	$2.500
37	Technology Manager Staff	$1.250	2	$2.500
38	Staff Manager Asset	$1.250	2	$2.500
39	Risk Management Staff Manager	$1.250	2	$2.500
40	Staff Manager Industrial Relations	$1.250	2	$2.500
41	Staff Manager CSR	$1.250	2	$2.500
42	Marketing Staff Manager	$1.250	2	$2.500
43	Staff Manager Supply Chain	$1.250	2	$2.500
44	Project Management Staff Manager	$1.250	2	$2.500
45	Staff Manager HSE	$1.250	2	$2.500
46	HR Staff Manager	$1.250	2	$2.500
47	Staff Manager Procurement	$1.250	2	$2.500
48	Staff Manager Outsourcing	$1.250	2	$2.500
Total				$200.625

Table 6 details indirect labor costs for the board of directors, managers, assistant managers, and staff across the various divisions at a total cost of $200,625 per month.

Table 7. Indirect Labor Costs

Indirect Labor Costs				
No	**Department**	**Operator**	**Wage/Month**	**Cost**
1	Security	4	$333	$1.331
2	Cleaning Service	10	$333	$3.328
3	Driver Director	7	$333	$2.330
4	Company Driver	6	$333	$1.997
5	Production Driver	10	$333	$3.328
6	Maintenance & Utilities	5	$333	$1.664
7	Health Worker	2	$333	$666
8	Operator Forklift	5	$333	$1.664
Total				$16.308

Table 7 presents the cost of supporting labor such as security guards, cleaning services, drivers, maintenance, health workers, and forklift operators with a total cost of $16,308 per month.

Table 8. Cost of Goods Sold

Description	Year-1	Year-2	Year-3	Year-4	Year-5
Direct Materials	$9.108.000	$9.539.310	$10.063.972	$10.617.491	$11.283.215
Direct Labor	$18.970	$19.919	$20.915	$21.961	$23.059
Factory Overhead					
Indirect Materials	$82.735.000	$86.261.416	$90.783.758	$95.332.795	$100.603.918
Indirect Labor	$216.933	$221.271	$225.697	$230.211	$234.815
Office Electrical and Lighting	$19.829	$20.920	$20.920	$20.920	$20.920

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Electrical Engine	$296.394	$311.213	$326.774	$343.113	$360.268
PAM Air	$2.188	$2.308	$2.435	$2.569	$2.710
The Cost of Material Handling	$391.604	$413.143	$435.866	$459.838	$485.129
Insurance	$1.563	$1.648	$1.739	$1.835	$1.936
Land and Building Taxes (0.05%)	$3.773	$3.773	$3.773	$3.773	$3.773
Maintenance	$11.250	$11.869	$12.522	$13.210	$13.937
Miscellaneous	$375	$396	$417	$440	$465
Depreciation	$776.932	$776.932	$776.932	$776.932	$776.932
Total Manufacturing Overhead	$726.976	$765.270	$804.446	$845.698	$889.138
Total Fabrication Cost	$93.582.811	$97.584.118	$102.675.720	$107.825.087	$113.811.077
Added WIP Inventory January 1	$0	$0	$0	$0	$0
Reduced December 31 WIP Inventory	$0	$0	$0	$0	$0
Cost Of Production	$93.582.811	$97.584.118	$102.675.720	$107.825.087	$113.811.077
Added Inventory of Finished Goods On January 1st.	$0	$0	$0	$0	$0
Reduced Inventory of Goods As Of December 31	$0	$0	$0	$0	$0
Cost Of Goods Sold	$93.582.811	$97.584.118	$102.675.720	$107.825.087	$113.811.077
Selling price=HPP+VAT+Profit					
PPN=HPPx11%	$10.294.109	$10.734.253	$11.294.329	$11.860.760	$12.519.218
Profit=HPPx12,5%	$9.358.281	$9.758.412	$10.267.572	$10.782.509	$11.381.108
Selling price	$113.235.201	$118.076.783	$124.237.621	$130.468.356	$137.711.403
Cost Of Goods Sold Per Ton = HPP/Amount Of Production	$7.799	$8.132	$8.556	$8.985	$9.484
Production Quantity Per Year	$12.000	$12.000	$12.000	$12.000	$12.000
Cost Of Goods Sold Per Ton	$7.799	$8.132	$8.556	$8.985	$9.484
Selling Price Per Ton = Selling Price/Quantity Of Production					
Selling Price Per ton	$9.436	$9.840	$10.353	$10.872	$11.476

Year-6	Year-7	Year-8	Year-9	Year-10
$11.817.532	$12.467.497	$13.153.209	$13.876.635	$14.746.711
$24.211	$25.422	$26.693	$28.028	$29.429
$104.497.281	$109.155.158	$113.826.482	$118.532.694	$124.130.410
$239.511	$244.302	$249.188	$254.171	$259.255
$20.920	$20.920	$20.920	$20.920	$20.920
$378.282	$397.196	$417.056	$437.908	$459.804
$2.859	$3.016	$3.182	$3.357	$3.542
$511.811	$539.961	$569.659	$600.990	$634.045
$2.042	$2.154	$2.273	$2.398	$2.530

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$3.773	$3.773	$3.773	$3.773	$3.773
$14.703	$15.512	$16.365	$17.265	$18.215
$490	$517	$546	$576	$607
$776.932	$776.932	$776.932	$776.932	$776.932
$934.881	$983.050	$1.033.774	$1.087.188	$1.143.435
$118.290.350	$123.652.361	$129.066.277	$134.555.648	$141.086.172
$0	$0	$0	$0	$0
$0	$0	$0	$0	$0
$118.290.350	$123.652.361	$129.066.277	$134.555.648	$141.086.172
$0	$0	$0	$0	$0
$0	$0	$0	$0	$0
$118.290.350	$123.652.361	$129.066.277	$134.555.648	$141.086.172
$13.011.938	$13.601.760	$14.197.291	$14.801.121	$15.519.479
$11.829.035	$12.365.236	$12.906.628	$13.455.565	$14.108.617
$143.131.323	$149.619.356	$156.170.196	$162.812.334	$170.714.268
$9.858	$10.304	$10.756	$11.213	$11.757
$12.000	$12.000	$12.000	$12.000	$12.000
$9.858	$10.304	$10.756	$11.213	$11.757
$11.928	$12.468	$13.014	$13.568	$14.226

Year-11	Year-12	Year-13	Year-14	Year-15
$15.445.042	$16.294.520	$17.190.718	$18.136.208	$19.273.361
$30.901	$32.446	$34.068	$35.771	$37.560
$128.034.825	$132.880.377	$137.746.412	$142.658.045	$148.638.289
$264.440	$269.729	$275.123	$280.626	$286.238
$20.920	$20.920	$20.920	$20.920	$20.920
$482.794	$506.934	$532.280	$558.894	$586.839
$3.737	$3.942	$4.159	$4.388	$4.629
$668.917	$705.707	$744.521	$785.470	$828.671
$2.669	$2.816	$2.971	$3.134	$3.306
$3.773	$3.773	$3.773	$3.773	$3.773
$19.217	$20.274	$21.389	$22.565	$23.806
$641	$676	$713	$752	$794
$776.932	$776.932	$776.932	$776.932	$776.932
$1.202.667	$1.265.042	$1.330.726	$1.399.897	$1.472.738
$145.754.807	$151.519.044	$157.353.980	$163.287.478	$170.485.119
$0	$0	$0	$0	$0
$0	$0	$0	$0	$0
$145.754.807	$151.519.044	$157.353.980	$163.287.478	$170.485.119
$0	$0	$0	$0	$0
$0	$0	$0	$0	$0
$145.754.807	$151.519.044	$157.353.980	$163.287.478	$170.485.119
$16.033.029	$16.667.095	$17.308.938	$17.961.623	$18.753.363
$14.575.481	$15.151.904	$15.735.398	$16.328.748	$17.048.512
$176.363.316	$183.338.044	$190.398.316	$197.577.849	$206.286.993
$12.146	$12.627	$13.113	$13.607	$14.207
$12.000	$12.000	$12.000	$12.000	$12.000

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$12.146	$12.627	$13.113	$13.607	$14.207
$14.697	$15.278	$15.867	$16.465	$17.191

Table 8 presents the calculation of direct material costs, direct labor, factory overhead, depreciation, and annual cost of goods sold. The selling price per ton increased from $9,436 in the first year to $14,226 in the 15th year.

Table 9. Tabel Payback Period

Tabel Payback Period					
Year	Production	Inclusion		Net Cash Flow	Cumulative
		Net Profit	Depreciation		Net Cash Flow
0	$109.021.902	$0	$0	-$109.021.902	-$109.021.902
1	$4.348.765	$26.446.535	$776.932	$22.874.702	-$86.147.200
2	$4.870.617	$26.750.107	$776.932	$22.656.422	-$63.490.779
3	$5.455.091	$27.184.318	$776.932	$22.506.159	-$40.984.620
4	$6.109.702	$27.574.194	$776.932	$22.241.424	-$18.743.196
5	$6.842.867	$28.040.764	$776.932	$21.974.830	$3.231.634
6	$7.664.010	$28.192.853	$776.932	$21.305.775	$24.537.409
7	$8.583.692	$28.413.635	$776.932	$20.606.876	$45.144.285
8	$9.613.735	$28.557.815	$776.932	$19.721.012	$64.865.297
9	$10.767.383	$28.618.936	$776.932	$18.628.485	$83.493.782
10	$12.059.469	$28.743.629	$776.932	$17.461.092	$100.954.874
11	$0	$28.443.436	$776.932	$29.220.368	$130.175.242
12	$0	$29.452.518	$776.932	$30.229.450	$160.404.692
13	$0	$30.474.249	$776.932	$31.251.181	$191.655.873
14	$0	$31.513.211	$776.932	$32.290.143	$223.946.016
15	$0	$32.760.347	$776.932	$33.537.279	$257.483.295

Pay Back Period	**4,85**	**4 Years 310 Days**

Table 9 shows the calculation of annual net cash flow until reaching the break-even point (payback period) in the 4th year of more than 310 days, showing that the project can pay back in less than 5 years.

Table 10. NPV

Year	Production	Inclusion		Net Cash Flow	Discounted Cash Flow		NPV
		Net Profit	Depreciation		20%	25%	19%
0	$109.021.901,98			-$109.021.901,98	-$109.021.901,98	-$109.021.901,98	-$109.021.901,98
1	$4.348.765,37	$26.446.535,05	$776.932,04	$22.874.701,72	$19.062.251,44	$18.299.761,38	$16.056.226,76
2	$4.870.617,22	$26.750.106,85	$776.932,04	$22.656.421,68	$15.733.626,17	$14.500.109,88	$13.323.655,62

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3	$5.455.091,28	$27.184.317,91	$776.932,04	$22.506.158,68	$13.024.397,38	$11.523.153,24	$11.088.619,54
4	$6.109.702,24	$27.574.194,41	$776.932,04	$22.241.424,22	$10.725.995,47	$9.110.087,36	$9.180.846,51
5	$6.842.866,50	$28.040.764,49	$776.932,04	$21.974.830,03	$8.831.191,34	$7.200.712,30	$7.599.581,63
6	$7.664.010,48	$28.192.853,27	$776.932,04	$21.305.774,83	$7.135.260,88	$5.585.181,04	$6.173.131,37
7	$8.583.691,74	$28.413.635,39	$776.932,04	$20.606.875,69	$5.751.000,81	$4.321.575,06	$5.002.238,15
8	$9.613.734,75	$28.557.814,62	$776.932,04	$19.721.011,92	$4.586.477,08	$3.308.636,77	$4.010.748,55
9	$10.767.382,92	$28.618.935,78	$776.932,04	$18.628.484,90	$3.610.325,18	$2.500.272,92	$3.174.079,50
10	$12.059.468,87	$28.743.628,91	$776.932,04	$17.461.092,08	$2.820.063,85	$1.874.870,49	$2.492.617,82
11	$0,00	$28.443.435,90	$776.932,04	$29.220.367,95	$3.932.710,46	$2.510.010,49	$3.494.732,99
12	$0,00	$29.452.518,18	$776.932,04	$30.229.450,22	$3.390.434,01	$2.077.352,00	$3.029.023,16
13	$0,00	$30.474.248,83	$776.932,04	$31.251.180,88	$2.920.856,59	$1.718.051,84	$2.623.510,49
14	$0,00	$31.513.211,37	$776.932,04	$32.290.143,42	$2.514.968,38	$1.420.135,53	$2.271.069,23
15	$0,00	$32.760.347,22	$776.932,04	$33.537.279,26	$2.176.752,92	$1.179.988,11	$33.537.279,26
				Total	-$2.805.590,01	-$21.892.003,58	$14.035.458,57

IRR		19%
MARR		15%
NPV	$	14.035.459

Table 10 presents a positive NPV value of $14,035,459 with an IRR of 19%, higher than the MARR of 15%. This shows that the project is financially viable because it generates enough profit with controlled risk.

CONCLUSION

The results of the study show that the construction of the Mixed Hydroxide Precipitate (MHP) nickel plant of PT. The 12,000-tonne-per-year X has good market prospects as the demand for MHP nationally and globally continues to increase as the electric vehicle industry grows. From the technical side, the factory is designed using HPAL technology which is able to process low-grade nickel ore from various regions, with a flexible design and supported by adequate infrastructure, labor, and regulations. Annual raw material requirements to support production include 414,000 tons of laterite ore, 148,100 tons of H_2SO_4, 41,700 tons of CaO, and 2,870 tons of MgO, with an estimated CAPEX of $108.8 million and an annual OPEX of $93.5 million. The main equipment used includes an autoclave, thickener, filter press, and rotary dryer, customized to achieve process efficiency.

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Financially, the project is considered feasible with a Payback Period of 4.85 years, an IRR of 19% (higher than the MARR of 15%), and a positive NPV of $14 million, and remains resilient to the risk of rising operating costs. This strengthens investors' confidence in the sustainability of the project. Based on these findings, the authors recommend further development on the aspects of waste treatment and environmental management so that factory operations are not only economically profitable, but also sustainable and environmentally friendly in the future.

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