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Feasibility Study for Establishing a Portland Cement Manufacturing Plant in Libya

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ABSTRACT

Background: The cement industry is important to the country`s economic along with the infrastructure development, with Portland cement leading the global constructions. In Libya, cement demand has recently grownup sharply due to infrastructure projects and reconstruction efforts, however, domestic supply is inadequate. Several local plants operate below their capacity due to operational inefficiencies, logistics problems, and reliance on imports. Consequently, local production falls short of rising demand of million tons annually, leading to supply shortages, price instability, and foreign exchange pressure. These challenges highlight the need to reinforce domestic cement production to support sustainable development. **Aim:** This study aims to investigate the feasibility of establishing a new plant for the manufacture of Portland cement in Libya, addressing the identified gap between the supply and domestic demand for cement. The primary aim was to assess the viability of such a project through an analysis of market conditions, technical requirements, and financial implications. **Methods:** The methodology followed a feasibility study technique, combining market analysis, technical assessment, and financial evaluation to determine the project's overall viability **Results:** The market analysis revealed a noteworthy annual cement demand gap of approximately 1.7 million tons, with the proposed plant targeting a production capacity of 255,000 tons per year (15% of the gap). The technical study detailed the phases required for cement manufacturing from site selection to raw material along with description of machinery, energy and labor force requirements. The financial analysis shows a positive Net Present Value (NPV) of 18,964,827 Libyan Dinars over a 15-year period at a discount rate of 10%, alongside an Internal Rate of Return (IRR) of 32%, which is significantly bigger than the required rate of return. The payback period for the initial investment is anticipated within 6 years, and the analysis shows that the project is economically viable with a profit margin of 20%. **Conclusion:** The study concludes that founding a new cement factory in Libya is feasible and has the potential to contribute to the domestic economy, reduce reliance on imports, and create new employment opportunities.

1. INTRODUCTION

The cement industry is foundational to infrastructure development and economic growth, and Portland cement remains the most widely used binder in structural construction worldwide. In Libya, the demand for cement has been steadily increasing due to ongoing reconstruction efforts, urban expansion, and infrastructure projects have intensified cement demand, yet local supply remains constrained by underperforming plants, logistical bottlenecks, and reliance on imports, factors that expose the market to price volatility and foreign exchange pressures. Recent reporting indicates Libyan cement plants operate well below design capacity, with only a subset of production lines active, while domestic output lags behind an estimated demand that has risen to several million tons annually in recent years. However, the country currently faces challenges related to supply shortages, reliance on imports, and fluctuating market prices, which hinder sustainable development. These dynamics have contributed to price surges and distribution challenges, underscoring the urgency of enhancing domestic manufacturing capacity (Onsongo et al.,2025), The Libyan cement sector has undergone historical expansion and restructuring, with major players such as Libyan Cement Company and Arabian Cement Co. driving much of domestic supply. Historical mission reports point to both production capacity development and the planning of new facilities, emphasizing the strategic role of cement in economic development, Despite the presence of existing cement manufacturing plants, current production capacity remains insufficient to meet the rapidly growing demand driven by infrastructure development, therefore, establishing a new Portland cement manufacturing plant in Libya offers a strategic opportunity to reduce dependency on imports, stabilize local supply, and stimulate economic activity through job creation and industrial diversification (Libyan Express,2025). This study aims to assess the feasibility of such an investment by analyzing market demand, raw material availability, production costs, and potential profitability. The findings will provide valuable insights for investors, policymakers, and stakeholders seeking to enhance Libya's industrial capacity and contribute to long-term economic resilience.

Problem Statement

The construction and building sector in Libya have witnessed significant growth, driven by ongoing reconstruction efforts and infrastructure development. However, domestic cement production remains limited and insufficient to meet local demand. As a result, cement imports have become a partial solution to bridge this supply gap, leading to increased costs and heightened exposure to fluctuations in global markets. Establishing a local cement manufacturing plant would contribute to meeting domestic cement demand, reducing the existing market deficit, and strengthening national economic security. Moreover, such a project would create numerous employment opportunities, thereby contributing to the reduction of unemployment rates.

Objectives of the Study

The primary objectives of this study are to:

- Analyze cement supply and demand in Libya and determine the production capacity and anticipated market share of the proposed plant.
- Examine the technical feasibility of establishing a cement manufacturing plant in Libya, taking into account factors such as the availability of raw materials, machinery, and energy requirements.
- Evaluate the potential economic indicators of the proposed project

2. METHODS

This study adopts a techno-economic feasibility approach to evaluate the establishment of a Portland cement manufacturing plant in Libya. The methodology integrates market, technical, financial and economic analysis to determine overall project viability.

Data are collected from secondary sources, including academic literature, industry reports, government publications, and international cement industry benchmarks, complemented by expert consultations where available. Market analysis assesses current and projected cement demand, existing production capacity, and supply–demand gaps to determine the appropriate plant capacity.

Technical feasibility is evaluated through analysis of process technology selection, raw material availability, energy requirements, and infrastructure accessibility. Financial feasibility is assessed using discounted cash flow analysis, incorporating capital and operating cost estimates to compute Net Present Value (NPV), Internal Rate of Return (IRR), Payback Period, and Profitability Index Gonzalez et al.,2013)

Feasibility studies in the cement sector typically integrate technical, financial, market and economic analyses. Standard feasibility frameworks include assessment of capital expenditures (CAPEX), operating costs (OPEX), market demand, pricing dynamics, financing structures, and risk factors (e.g., equity–debt mix, sensitivity to key cost drivers) (Gonzalez et al.,2013; Cementis,2020). Economic feasibility analyses explicitly incorporate indicators such as Net Present Value (NPV), Internal Rate of Return (IRR), Payback Period, and Profitability Index to determine viability under various cost and sales price scenarios. Studies on related industrial projects have applied these metrics to quantify financial viability and evaluate risks under changes in operating conditions and market prices (Yahya et al.,2024).

Academic research on feasibility studies for the establishment of cement factories in Libya is scarce or virtually nonexistent, however, a study by ARDI Cement PLC proposes the development of a 5,000 TPD greenfield cement plant in Dire Dawa, Ethiopia, to address the country's chronic cement shortage and meet rising infrastructure demands. The project leverages abundant limestone reserves (48.65 million m³, sufficient for 119 years) and employs modern dry-process technology for efficiency and environmental compliance. Market analysis reveals a persistent demand-supply gap averaging 8.17 million tons annually through 2030, ensuring strong growth potential. With an estimated investment of Birr 15.95 billion, financed equally by equity and bank loans, the project demonstrates exceptional financial viability—IRR of 59%, NPV of Birr 85.85 billion, and a payback period under two years—alongside socio-economic benefits such as job creation and technology transfer. Environmental impacts are minimal and manageable, making the project technically feasible, financially sound, and strategically aligned with Ethiopia's industrialization goals (ARDI Cement PLC,2024)

Another study by UNIDO to assess the establishment of a new cement plant in Amboanio, Madagascar, to meet rising domestic demand and reduce import dependence. Two technical alternatives were analyzed: a rotary kiln (dry process) and four shaft kilns, both targeting 250,000 tons of cement annually. The study evaluated raw material availability, energy requirements, investment costs (USD 64.7–66.9 million), and financial indicators, finding Alternative 1 (rotary kiln) superior with an IRR of 9.86%, a payback period of 9.3 years, and lower break-even capacity. Implementation is projected over 36 months, leveraging local resources and rehabilitating Boanamary Port for logistics. The report concludes that the project is economically viable and recommends immediate adoption of the rotary kiln option for its technical efficiency, cost-effectiveness, and reduced foreign currency exposure (UNIDO,2025).

Data Collection: Market Demand and Supply Gap

According to the Libyan Contractors Union, domestic cement demand is estimated at approximately 9.5 million tons annually, while current production capacity stands at about 5.82 million tons per year (Alwasat News,2024). Libya imports roughly 2,023,671 tons of cement annually from Tunisia, Egypt and Turkey (Worldbank,2022), a factor contributing to persistent price volatility and upward pressure on market prices. The Libyan market faces a structural supply-demand gap of nearly 1.7 million tons per year. The proposed plant is designed to cover 15% of this gap, corresponding to an annual output of 255,000 tons. Figure (1) illustrates the comparative trends in cement demand and supply.

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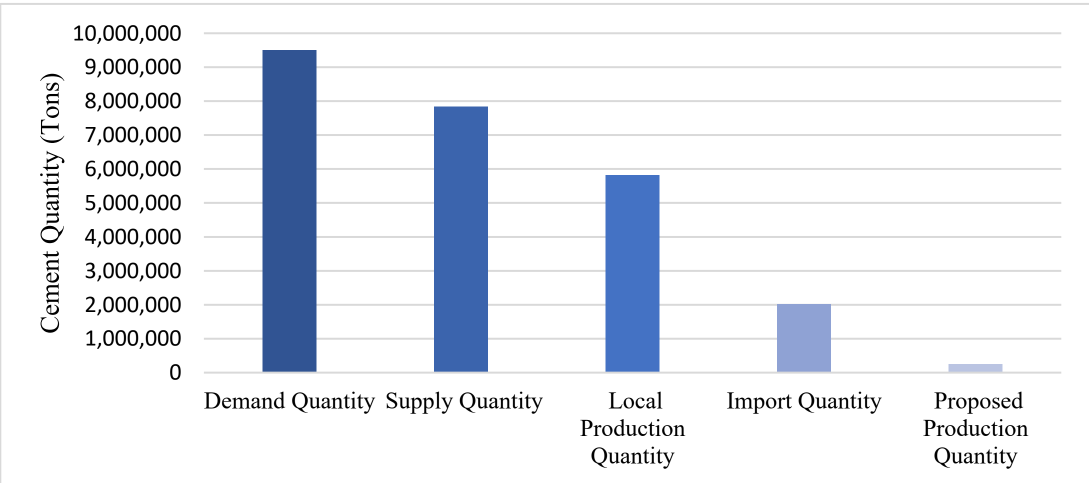

Fig 1: Cement Demand and Supply

Site Selection

The proposed site for the plant is the Fadraj area, located east of Bani Walid city, approximately 25 kilometers from the city center. This area has been designated as a zone distant from residential communities and offers competitive land prices compared to other regions. Additionally, it is strategically positioned between the sources of raw materials and the target market.

Land costs in the Fadraj area range between 70 and 80 Libyan dinars per square meter. For this project, an estimated cost of 75 Libyan dinars per square meter has been assumed. The construction cost is estimated at 1,200 Libyan dinars per square meter. Given that the total planned area for the plant is approximately 40,000 square meters, with the building structure occupying 10,000 square meters, the total cost for both land acquisition and building construction is calculated as follows:

Total Land Cost = 75 LYD/m² × 40,000 m² = 3,000,000 LYD

Building Construction Cost = 1,200 LYD/m² × 10,000 m² = 12,000,000 LYD

Other Costs=30,000 LYD

Accordingly, the total cost of land acquisition and plant construction amounts to 15,030,000 Libyan Dinars. The project lifespan is estimated at 15 years.

Raw Material

Cement production requires several key raw materials, each providing essential chemical properties for the final product. The main components include limestone, clay, iron ore concentrate, gypsum, slag, and mineral additives.

- Limestone ($CaCO_3$) supplies calcium oxide (CaO), crucial for cement strength.
- Clay provides silica (SiO_2), alumina (Al_2O_3), and iron oxide (Fe_2O_3) for clinker formation.
- Iron ore concentrate adds Fe_2O_3 to support clinker phase development.
- Gypsum controls setting time during final grinding.
- Slag improves durability as a supplementary material.
- Mineral additives enhance chemical resistance and strength.

Cement plants are usually located near limestone deposits, while other materials are sourced locally or imported in smaller quantities. The quantity of raw materials required per ton of cement is as follows:

Limestone: 694 kg, Clay: 125 kg, Iron Ore Concentrate: 2 kg, Gypsum: 40 kg, Slag: 40 kg, and Mineral Additive: 100 kg. Table (1) shows the cost of raw material and packaging (Worldbank,2022; Evdokimov et al.,2016).

Table 1: Cost of Raw Materials and Packaging

Raw Material	Quantity (kg/ton)	Material Cost (LYD/kg)	Cement Cost (LYD/ton)	Cement Cost (LYD/quintal)
Limestone	694	0.0825	57.255	5.7255
Clay	125	0.11	13.75	1.375
Iron Ore Concentrate	2	0.605	1.21	0.121
Gypsum	40	0.77	30.8	3.08
Slag	40	0.055	2.2	0.22
Bags	-	-	2.3	0.23
Total	-	-	107.515	10.75

Technology Configuration

The main machinery and equipment required for operating the proposed plant, covering all stages of the manufacturing process from raw material preparation to final product packaging, are as follows:

The crushing system includes a single jaw crusher for processing primary raw materials, followed by one mill for grinding the raw materials to achieve the appropriate particle size before entering the thermal processing stages.

The thermal processing stages comprise one rotary dryer for moisture removal from raw materials, one rotary kiln for clinker production, and one rotary cooler to reduce clinker temperature and enhance its physical properties. In the final grinding stage, a single cement mill equipped with one cement separator is used to control the fineness of the final product in accordance with standard specifications (Science in Cement,2025).

Supporting equipment includes two cement packing machines for packaging operations and three conveyor belts to ensure smooth material flow between production units. To minimize emissions and improve the plant's environmental performance, a single jet dust collector is incorporated into the pollution control system. Additionally, the plant includes one lime kiln to support certain auxiliary industrial processes when needed. Table (2) presents the detailed list of machinery and equipment required for the plant (Chinnakomerla et al.,2020)

Table 2: Cost of Machinery and Equipment

Equipment	Quantity	Unit Price (LYD)	Total Cost (LYD)
Jaw Crusher	1	50,000	50,000
Raw Material Mill	1	400,000	400,000
Rotary Dryer	1	5,000	5,000
Rotary Kiln	1	15,000	15,000
Rotary Cooler	1	130,000	130,000
Cement Mill	1	1,000,000	1,000,000
Cement Separator	1	900,000	900,000
Cement Packing Machine	2	100,000	200,000
Conveyor Belt	3	2,000	6,000
Jet Dust Collector	1	100,000	100,000
Lime Kiln	1	300,000	300,000
Forklift	5	50,000	250,000
Transport Truck	5	200,000	1,000,000
Total	-	-	4,356,000

5-Manpower

The plant requires a large number of employees and workers with varying skills and experience for each position. Table (3) illustrates the workforce requirements for the plant with their monthly salaries and the annual expenditure on salaries in Libyan Dinar (Topkis & Bernard,2025)

Table 3: Employee Salaries

Job Title	Number of Employees	Monthly Salary (LYD)	Annual Total (LYD)
Board of Directors	3	3,500	126,000
General Manager	1	4,000	48,000
Deputy Manager	1	3,500	42,000
Department Managers	5	3,000	180,000
Section Heads	7	2,500	210,000
Administrative & Financial Affairs	13	2,300	358,800
Production	48	2,400	1,382,400
Maintenance & Security	18	2,300	496,800
Human Resources	6	2,300	165,600
Legal Affairs	2	2,300	55,200
Total	104	28,100	3,064,800

Furniture and Electrical Appliances

The proposed plant is relatively large, Table (4) presents estimated details on the types and quantities of furniture and electrical appliances required for the proposed cement plant, based on the planned production capacity. It includes the unit price for each item, the number of units needed, and the total cost.

Table 4: Cost of Furniture and Electrical Appliances

Item	Quantity	Unit Price (LYD)	Total (LYD)
Work desks	20	750	15,000
Work chairs	45	200	9,000
Filing cabinets	15	490	7,350
Meeting tables	5	1,350	6,750
Meeting chairs	30	220	6,600
Computers	25	2,000	50,000
Printers and copiers	8	3,000	24,000
Air conditioners	20	2,000	40,000
Telephones	30	1,500	45,000
Lighting fixtures	100	2,000	200,000
Total	403,700		

Energy Availability and pricing

Libya's grid is predominantly gas-fired; subsidy reform is under discussion and peak-hour industrial tariffs have faced pushback due to factory cost impacts (Libya Observer,2025). Natural-gas retail data show extremely low end-user prices versus global averages due to legacy subsidies, requiring fuel/power sensitivity analysis for bankability (IEA,2025).Table (5) presents the estimated electrical energy requirements per ton of cement, as well as the electricity tariffs for industrial users in Libya.

Table 5: Electricity Consumption Cost

Electricity Consumption for Cement Production (kWh/ton)	Electricity Price (LYD/kWh)	Total Cost (LYD/ton)	Total Cost (LYD/quintal)
84	0.045	3.78	0.378

Environmental, Social, and Regulatory Considerations

The Portland cement industry is among the most environmentally intensive industrial sectors, contributing approximately 8–10% of global anthropogenic CO_2 emissions due to fossil-fuel combustion and limestone calcination (Jalal et al. ,2025; Bărbulescu et al,2025). In Libya, these impacts are amplified by reliance on conventional energy sources and the continued operation of aging production facilities. Life-cycle assessment studies indicate that the carbon footprint of cement consumed in Libya exceeds global averages, reflecting relatively low energy efficiency and limited use of mitigation technologies (Inweer et al.,2025). Local empirical studies further document adverse impacts such as dust emissions, soil degradation, agricultural losses, and damage to nearby aquatic ecosystems in areas surrounding existing cement plants (Poudyal & Kushal,2021). Mitigation options include lower clinker factor (PPC/PSC), WHR, alternative fuels, and preparatory CCUS-readiness. Compliance with Libyan building codes, environmental laws, and alignment with Paris Agreement NDC intentions are required. ISO 14001 EMS adoption is recommended.

From a social perspective, cement manufacturing contributes to infrastructure development and employment generation but may also impose health and livelihood burdens on surrounding communities. Evidence from Libya and comparable African contexts indicates increased respiratory illnesses, noise exposure, and deterioration of agricultural land near cement facilities (Kgosiemang,2017). To address these risks, Social Impact Assessment (SIA) should accompany Environmental Impact Assessment (EIA) processes, alongside structured community engagement and local workforce development initiatives. African case studies demonstrate that corporate social responsibility programs can significantly enhance community acceptance and long-term project sustainability (Dangote Cement Plc,2025).

The establishment of a Portland cement plant in Libya is governed by a multi-layered regulatory framework. Investment Law No. 9 of 2010 permits full foreign ownership of manufacturing projects and provides fiscal incentives, subject to licensing by the General Authority for Investment Promotion and Privatization Affairs (Chambers & Partners,2025). Simultaneously, Environmental Protection Law No. 15 of 2003 mandates EIA approval and environmental permitting for cement projects (UNECE,2025).

Although the regulatory framework is relatively comprehensive, enforcement and institutional coordination challenges persist, underscoring the importance of aligning project design and operations with international environmental and occupational safety standards to ensure long-term viability (Al-Awadhi,2002).

3. Results

Capital Investment

Total Invested Capital = Land and Buildings + Machinery + Furniture
Total Invested Capital = 15,030,000 + 4,356,000 + 403,700 = 19,789,700 Libyan Dinars
Fixed Costs = Employee Salaries + Maintenance Costs
The annual maintenance cost for the plant is estimated at approximately 400,000 Libyan Dinars per year
Fixed Costs = 3,064,800 + 400,000 = 3,464,800 LYD
Fixed Cost per Quintal = Fixed Costs ÷ Annual Production
Fixed Cost per Quintal = 3,464,800 ÷ 2,550,000 = 1.36 LYD
Variable Cost = Raw material cost + Energy cost
Variable Cost per Quintal = 10.75 + 0.378 = 11.128 LYD/Quintal
Total Variable Costs = Variable Cost per Quintal × Annual Production
Total Variable Costs = 11.128 × 2,550,000 = 28,380,225 LYD
Cost per Quintal = (Fixed Cost per Quintal + Variable Cost per Quintal)
Total Cost per Quintal = 1.36 + 11.13 = 12.5 LYD/Quintal
Total Annual Costs = Cost per Quintal × Annual Production
Total Annual Costs = 12.5 × 2,550,000 = 31,845,025 LYD
A proposed profit margin of 20% is added to the total cost, and the selling price is calculated as follows:
Selling Price = Total Cost per Quintal × Profit Margin
Selling Price = 12.5 × 1.2 = 15 LYD
Annual Revenue = Annual Production × Selling Price
Annual Revenue = 2,550,000 × 15 = 38,214,030 LYD
Cash Flow Before Tax = (Total Annual Revenue − Total Annual Costs)
Cash Flow Before Tax (Net Income) = (38,214,030 − 31,845,025) = 6,369,005 LYD
Tax = 20% of Net Income
Tax Amount = 0.2 × 6,369,005 = 1,273,801 LYD
Cash Flow After Tax = (Total Annual Revenue − Total Annual Costs) − Tax Amount
Cash Flow After Tax = (38,214,030 − 31,845,025) − 1,273,801 = 5,095,204 LYD
The estimated discount rate in this study is 10%, and all these results are presented in table (6) which presents yearly data including: invested capital, annual revenue, annual costs, net cash flow before tax, and net cash flow after tax, and table (7) which presents annual data including: invested capital, net cash flow after tax, equivalent present value, and net present value (NPV).

Table 6: Annual Revenues, Costs, and Net Present Value

Year	Invested Capital	Annual Revenues	Annual Costs	Net Cash Flow Before Tax	Net Cash Flow After Tax
0	19,789,700				
1		38,214,030	31,845,025	6,369,005	5,095,204
2		38,214,030	31,845,025	6,369,005	5,095,204
…		…	…	…	…
15		38,214,030	31,845,025		

Table 7: Net Cash Flow After Tax and Net Present Value

Year	Invested Capital	Net Cash Flow After Tax	Equivalent Present Value	Net Present Value (NPV)
0	19,789,700		38,754,527	18,964,827
1		5,095,204	4,632,004	
2		5,095,204	4,210,912	
3		5,095,204	3,828,102	
4		5,095,204	3,480,093	
5		5,095,204	3,163,721	
6		5,095,204	2,876,110	
7		5,095,204	2,614,645	
8		5,095,204	2,376,950	
9		5,095,204	2,160,864	
10		5,095,204	1,964,422	
11		5,095,204	1,785,838	
12		5,095,204	1,623,489	
13		5,095,204	1,475,899	
14		5,095,204	1,341,726	
15		5,095,204	1,219,751	

Economic Indicators

Net Present Value (NPV)

$$\mathrm{NPV} = \frac{5{,}095{,}204}{(1+0.1)^1} + \frac{5{,}095{,}204}{(1+0.1)^2} + \cdots + \frac{5{,}095{,}204}{(1+0.1)^{15}} - 19{,}789{,}700 = 18{,}964{,}827 \text{ LYD}$$

Internal Rate of Return (IRR)

$$\mathrm{NPV} = 0 = \frac{5{,}095{,}204}{(1+i)^1} + \frac{5{,}095{,}204}{(1+i)^2} + \cdots + \frac{5{,}095{,}204}{(1+i)^{15}} - 19{,}789{,}700 = 0.32$$

The calculated internal rate of return (IRR) is 32%, which is higher than the assumed profit rate. This indicates that the project's internal return exceeds the investor's capital by 22%. Since the IRR is greater than the profit rate, the project is considered economically feasible.

Payback Period

$$N_1 = -19{,}789{,}700(1+0.1)^1 + 5{,}095{,}204 = -16{,}673{,}466$$
$$N_2 = -16{,}673{,}466(1+0.1)^1 + 5{,}095{,}204 = -13{,}245{,}608$$
$$N_3 = -13{,}245{,}608(1+0.1)^1 + 5{,}095{,}204 = -9{,}474{,}965$$
$$N_4 = -9{,}474{,}965(1+0.1)^1 + 5{,}095{,}204 = -5{,}327{,}258$$
$$N_5 = -5{,}327{,}258(1+0.1)^1 + 5{,}095{,}204 = -764{,}779$$
$$N_6 = -764{,}779(1+0.1)^1 + 5{,}095{,}204 = 4{,}253{,}946$$

Since the cash flow becomes positive in Year 6, the payback period is six years.

4. Discussion

The Net Present Value (NPV) serves as a key indicator of investment profitability. It is calculated by determining the present value of future cash flows and subtracting the initial investment. Over a 15-year period at a discount rate of 10%, the computed NPV is 18,964,827 Libyan Dinars. This positive NPV indicates that the investment is profitable.

The Internal Rate of Return (IRR) is defined as the discount rate at which the NPV of all project cash flows equals zero. An IRR of 32% was achieved, exceeding the required rate of return, which demonstrates that the project is economically viable. An IRR that surpasses the cost of capital by 22% suggests a strong potential return on investment.

The Payback Period refers to the time required for the investment to recover its initial cost. For this project, cash flow is expected to become positive by the sixth year, indicating that the initial investment will be recovered within six years. This timeframe provides investors with insight into the risk duration before the project begins generating profit. A six-year payback period for a long-term project is considered a positive indicator of profitability.

5. Conclusion and Recommendations

Conclusion

The economic feasibility study concludes that establishing a cement production plant in Libya is both feasible and potentially profitable. The analysis indicates that current local production capacity is insufficient to meet the growing demand driven by infrastructure projects and urban expansion. The availability of raw materials and the strategic location further support the viability of the project

Summary of key financial indicators:

- The calculated Net Present Value (NPV) is 18,964,827 LYD, indicating a profitable investment.
- The Internal Rate of Return (IRR) is 32%, significantly higher than the target rate of return, suggesting strong investment returns.
- The payback period is expected within six years, reflecting a relatively quick return on investment.
- The project's break-even point is 898,456 quintals, representing 35% of annual production, which indicates the minimum production volume required to achieve profitability.

All economic indicators point to the project being profitable and economically viable.

Recommendations

- While the study includes financial indicators, it would benefit from a sensitivity analysis to assess how changes in key variables—such as raw material costs, selling price, or discount rate—affect NPV, IRR, and payback period.
- Conduct a detailed competitive landscape analysis, identifying current cement producers in Libya, their capacities, market share, and pricing strategies.
- Provide a comprehensive risk assessment for the project, covering both technical and financial risks.
- Undertake a preliminary environmental study specifically addressing the potential impact of a cement plant in the proposed area.

Finally, The Project is found to be operationally profitable & has significant socio-economic benefits. The income statement and other profitability indicators show that the project is viable. The project is believed to have significant social and economic benefits that accrue to the society beyond those financial returns to its owner. Therefore, considering the technical/financial viability of the project, the requested long-term loan is recommended.

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