

**80. PROFILE ON PRODUCTION OF  
CALCINATED GYPSUM**

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## **I. SUMMARY**

This profile envisages the establishment of a plant for the production of calcinated gypsum with a capacity of 3,000 tonnes per annum.

The present demand for the proposed product is estimated at 2,254 tonnes per annum. The demand is expected to reach at 6,219 tonnes by the year 2022.

The plant will create employment opportunities for 22 persons.

The total investment requirement is estimated at Birr 6.39 million, out of which Birr 4.06 million is required for plant and machinery.

The project is financially viable with an internal rate of return (IRR) of 31 % and a net present value (NPV) of Birr 6.19 million discounted at 8.5%.

## **II. PRODUCT DESCRIPTION AND APPLICATION**

Calcinated gypsum is hydrated calcium sulphate. It is used in interior finishing, partition wall, ceilings and aquatic boards. Gypsum is found in the form of calcium sulphate and calcium sulphate dehydrate. The calcium sulphate dehydrate becomes commercially useful substance by calcining (i.e. driving out the chemically bonded water) by heating and then grinding it to the required grain size (or fineness).

The demand for calcinated gypsum is met by import and local production. The educational materials production and distribution agency (EMPEDA) is a public enterprise, located in Addis Ababa that produces calcinated gypsum, mostly for own consumption. Private small-scale producers produce very small quantity of the product that it can be considered negligible. On the other hand the imported calcinated gypsum has exorbitant price, and is less preferred by consumers. The product has close linkage with activities in the construction sector.

### **III. MARKET STUDY AND PLANT CAPACITY**

#### **A. MARKET STUDY**

##### **1. Past Supply and Present Demand**

Gypsum is a natural hydrated sulphate of calcium ( $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$ ). Gypsum, when pure, contains  $\text{SO}_3$  (46.5%),  $\text{CaO}$  (32.6%) and water (20.9%). It has a specific gravity of 2.35 when pure, and 2.95 in an anhydrite form.

It is used for orthopedic treatment on limbs with fractured bones. It has wide application in ceramic industry for preparation of models and moulds. Besides, it is extensively used in the interior decoration of buildings, in making decorative picture frames, etc.

The most general use of gypsum products is in those structures where their light weight and fire-resistant qualities make them especially desirable. Special hard-finish plasters are used for controlling the setting time of Portland cement. Wall plaster is mixed with two parts of sand for use as wall covering. Mixed with sawdust, cinders or other lightweight aggregates, and often reinforced with wire-mesh, it is cast into structures for use as a column for fire proofing, curtain walls in buildings, roof slabs, etc.

Best quality, finely ground white gypsum is used as a base in cold-water paints and in the manufacture of certain cheaper grades of pigments. Plaster of Paris is a basic ingredient of many plastic paints as a hardening agent being added to make the material more durable.

In the textile industry, gypsum in its ground form is used in the finishing of cotton and cloth to give weight to a product when a lustrous or glossy surface is required.

Gypsum is also used to a small extent as filler in the manufacture of certain writing papers, boards and speciality goods. Ground gypsum is commonly used as a filler or distributor in many insecticides. Common grades of gypsum are also largely used in the manufacture of artificial fertilizers, both as a carrier of the more concentrated chemical and as a drier for those containing liquid constituents, such as blood or animal offals.

Calcined gypsum is also widely used in the pottery industry as moulding plaster. In dentistry and orthopedics, gypsum is used as a moulding and casting material.

Plaster board or gypsum board, which consists of sheets of slabs of gypsum mixed with fibers, is employed as fire resistant material for walls, ceilings or partitions. In the chemical industries, gypsum is used in the manufacture of sulphuric acid and ammonium sulphate.

Demand for calcinated gypsum in Ethiopia is being met from two sources: domestic production and imports. The domestic producers fall into three categories:

- Public Sector,
- Formal Private Sector, and
- Informal Private Sector.

The sole public sector of calcinated gypsum producer is Educational Materials and Distribution Enterprise (EMPDE) which was established in 1978 E.C. with the purpose of manufacturing and selling chalk to educational institutions in the country. Although the primary purpose of its establishment was to produce writing chalk, EMPDE has also been producing and marketing gypsum, ever since it was founded, as a co-product.

Presently, the maximum attainable capacity of EMPDE for gypsum production is 1,300 tones per annum, while during years 1990 – 1996 E.C, production of gypsum by the Enterprise vary from 314.3 tones in 1990 to 744.2 tones in 1996 ( See Table 3.1).

**Table 3.1**  
**PRODUCTION OF GYPSUM BY EMPDE**  
**(1990 - 1996 E.C)**

Year (E.C)	Production (Tonnes)
1990	314.3
1991	408.1
1992	479.1
1993	438.5
1994	550.2
1995	459.8
1996	744.2

*Source: "Feasibility Study for the Rehabilitation / Expansion of the Plaster of Paris and Chalk Production Plant of EMPDE, November 2005" by IPS.*

In estimating the current (1999) production level of EMPDE it is assumed that the last three years in the data set (1994 – 1996) average annual production (585 tonnes) approximates current production level of the enterprise.

Formally established private sector producers currently, are ADK, and Ehtio-gypsum which produce about 1,200 tonnes of gypsum annually.

There are also small informal sector producers who do not have standard plant and machinery but rather carry out the process of production using crude makeshift methods. Such cottage producers number about 5, and the combined supply of calcinated gypsum originating from the informal sector is estimated at 400 tonnes per annum.

Although the bulk of demand for calcinated gypsum is met through local production, some amount is also imported for various purposes. The gypsum imported from overseas

is generally of a higher quality and fineness; and is mainly used for medical (bone casting), ornamental and industrial purposes.

The import data of gypsum during a ten years period of time (1997 - 2006) is shown in Table 3.2.

**Table 3.2**  
**IMPORT OF GYPSUM (1997 - 2006)**

Year	Quantity Imported (Tonnes)
1997	60.7
1998	17.2
1999	0.2
2000	88.4
2001	132
2002	163.7
2003	76.4
2004	4.93
2005	5.48
2006	109.63
<b>Average</b>	<b>65.86</b>

*Source : Customs Authority, External Trade Statistics, Annual Issues.*

As can be seen from Table 3.2 import of calcinated gypsum shows a highly fluctuating trend form year to year. However, during the period of analyses the average annual import was 65.86 tonnes, which is assumed to indicate the present level of import.

Aggregating all the above source of supply to the local market of gypsum, the present total supply of the product is thus estimated at 2,254 tonnes. Assuming supply is in equilibrium with demand, this figure could fairly approximate present effective demand.

## 2. Projected Demand

The demand for gypsum, like many other construction materials, is a function of a number of interrelated variables. These variables that are essential in determining the magnitude and trend of the demand for gypsum are:

- the overall economic development level and growth trend of the country,
- the pattern and trend of the construction industry in general and the building construction sector in particular,
- expected technological change that affects the structure of the construction industry,
- government policies and regulations that have impact on the future level and trend of construction activities, and
- Size of population and its growth rate.

In view of trends in the above variables, it is not difficult to conclude that the demand for construction materials, including calcinated gypsum, will grow in the future. Overall GDP of the country had exhibited an average annual growth rate of 6.6% during the five years period i.e., 1999/2000 - 2003/2004. This is adjusted to 7% and applied on the present effective demand that was estimated earlier, as base year figure, in order to forecast future demand of calcinated gypsum. The result is shown in Table 3.3.

**Table 3. 2**  
**PROJECTED DEMAND FOR CALCINATED GYPSUM**

<b>Year</b>	<b>Projected Demand (Tonnes)</b>	<b>Existing Local Supply</b>	<b>Demand Gap</b>
2008	2412	2185	227
2009	2581	2185	396
2010	2761	2185	576
2011	2955	2185	770
2012	3161	2185	976
2013	3383	2185	1198
2014	3619	2185	1434
2015	3873	2185	1688
2016	4144	2185	1959
2017	4434	2185	2249
2018	4744	2185	2559
2019	5076	2185	2891
2020	5432	2185	3247
2021	5812	2185	3627
2022	6219	2185	4034

### **3. Pricing and Distribution**

The price of gypsum produced by EMPDE is Birr 140/quintal (Birr 1.40/kg). Other producers sell inferior quality gypsum at much lower price, Birr 0.5 - 0.6 per kilograms. Imported gypsum, on the other hand, fetches a price of Birr 3/kg. Assuming that good quality product will be produced by the envisaged plant a factory-gate price of Birr 115/quintal is adopted.

## B. PLANT CAPACITY AND PRODUCTION PROGRAMME

### 1. Plant Capacity

Based on the market information above and future market demand, the annual rated capacity of the plant will be 3,000 tonnes per 300 working days of eight hours single shift per day.

### 2. Production Programme

The plant will operate at 75% of its rated capacity in the first year, 85% in the second year and at full capacity starting from the third year. The proposed production programme is shown as follows.

## IV. MATERIALS AND INPUTS

### A. RAW MATERIALS

The main material inputs are gypsum and packing materials. The estimated annual cost of material inputs at a 100% capacity utilization is given in Table 4.1.

**TABLE 4.1**  
**ESTIMATED ANNUAL COST OF MATERIAL INPUTS**

Sr. No.	Description	Qty.	Cost ('000 Birr)
1	Gypsum	4,400 (tonnes)	134.400
2	Packing Materials	130,000 (pcs)	51.20
<b>Total</b>		-	<b>185.60</b>

## B. UTILITIES

The major utilities required by the plant are electricity, water and fuel. The estimated annual requirement at 100% capacity utilization rate and the estimated costs are given in table 4.2.

**Table 4.2**  
**ANNUAL UTILITY REQUIREMENT AND ESTIMATED COSTS**

Sr. No.	Description	Qty.	Cost ('000 Birr)
1	Electric power, kWh	275,000	130.240
2	Fuel, tonnes	84.57	457.50
3	Water, m <sup>3</sup>	1,000	10.00
<b>Total</b>		-	<b>597.74</b>

## V. TECHNOLOGY AND ENGINEERING

### A. TECHNOLOGY

#### 1. Process Description

Gypsum or calcium sulphate dehydrate is quarried from the quarry and is crushed in crushers, sized in sieves and dried in a drier which uses heat recovery system. The dried gypsum is then passed to the kiln where the calcinations process takes place. Then it is crushed and packed. During the process of calcinations, the gypsum loses 75% of its moisture thereby making it hygroscopic.

The technology uses gypsum and fuel only and its waste product is mainly gaseous water and carbon dioxide. So, the process is environmentally friendly.

## 2. Source of Technology

The technology of calcinated gypsum production is simple and the equipment can be acquired from India, China or Italy through commercial attaches of their respective embassies in Addis Ababa.

### B. ENGINEERING

#### 1. Machinery and Equipment

The production equipment required by the plant and their estimated costs are given in Table 5.1.

**Table 5.1**  
**MACHINERY AND EQUIPMENT AND ESTIMATED COST**

Sr. No.	Description	Qty.	Cost ('000 Birr)		
			FC	LC	TC
1	Kiln	1	2,560.00	-	2,560.00
2	Crusher	1	120.00	-	1520.00
3	Drier Machine	1	145.00	-	145.00
4	Packing Machine	1	360.00	-	360.00
5	Conveyor	LS	65.00		65.00
<b>Total</b>			<b>3,250.00</b>	<b>-</b>	<b>3,250.00</b>
Insurance, Bank, Customs Duty, Etc				812.00	812.00
<b>Grand Total</b>			<b>3,250.00</b>	<b>812.00</b>	<b>4,062.00</b>

## **2. Land, Building and Civil Works**

The total area of land is estimated to be 1,500m<sup>2</sup>, out of which 400m<sup>2</sup> will be a built-up area. The cost of land at the rate of Birr 0.625 per m<sup>2</sup> for 80 years is Birr 75,000. The costs of building and civil works at the rate of Birr 2,300.00 per m<sup>2</sup> is estimated at Birr 920,000. The total costs of land and building will be Birr 995,000.

## **3. Proposed Location**

The plant should be located where major raw material, infrastructure, power and utility are available.

# **VI. MANPOWER & TRAINING REQUIREMENT**

## **A. MANPOWER REQUIREMENT**

The total manpower requirement of the plant is 22 persons. Details of manpower and estimated annual labor cost including fringe benefits are indicated in Table 6.1.

**Table 6.1****MANPOWER REQUIREMENT AND ESTIMATED LABOR COST**

Sr. No.	Description	No. Required	Salary (Birr)	
			Monthly	Annual
1	Manager	1	2,000	24,000
2	Secretary	1	800	9,600
3	Production Head (Supervisor)	1	1,600	19,200
4	Finance and Administration Head	1	1,500	18,000
5	Salesman	1	700	8,400
6	Store Keeper	1	700	8,400
7	Purchaser	1	700	8,400
8	Accountant/Cashier	1	750	9,000
9	Driver	2	400	4,800
10	Production	9	3,150	37,800
11	Guard	3	600	7,200
<b>Total</b>		<b>22</b>	<b>12,900</b>	<b>154,800</b>
Employee's Benefit (25% Of Basic Salary)		-	-	38,700
<b>Grand Total</b>		<b>-</b>	<b>-</b>	<b>193,500</b>

**B. TRAINING REQUIREMENT**

The production supervisor should be given a three weeks on-the-job training by skilled technician of the equipment supplier. The cost of training is estimated at Birr 30,000.-

## VII. FINANCIAL ANALYSIS

The financial analysis of the calcinated gypsum project is based on the data presented in the previous chapters and the following assumptions:-

Construction period	1 year
Source of finance	30 % equity
	70 % loan
Tax holidays	3 years
Bank interest	8 %
Discount cash flow	8.5%
Accounts receivable	30 days
Raw material local	30 days
Raw material, import	90 days
Work in progress	5 days
Finished products	30 days
Cash in hand	5 days
Accounts payable	30 days

### A. TOTAL INITIAL INVESTMENT COST

The total investment cost of the project including working capital is estimated at Birr 6.39 million, of which 17 per cent will be required in foreign currency.

The major breakdown of the total initial investment cost is shown in Table 7.1.

**Table 7.1**  
**INITIAL INVESTMENT COST**

Sr. No.	Cost Items	Total Cost (‘000 Birr)
1	Land lease value	75.0
2	Building and Civil Work	995.0
3	Plant Machinery and Equipment	4,060.0
4	Office Furniture and Equipment	125.0
5	Vehicle	450.0
6	Pre-production Expenditure*	620.7
7	Working Capital	74.3
	<b>Total Investment cost</b>	<b>6,399.9</b>
	Foreign Share	17

\* *N.B Pre-production expenditure includes interest during construction (Birr470.65 thousand ) training (Birr 30 thousand ) and Birr 120 thousand costs of registration, licensing and formation of the company including legal fees, commissioning expenses, etc.*

## **B. PRODUCTION COST**

The annual production cost at full operation capacity is estimated at Birr 2.08 million (see Table 7.2). The material and utility cost accounts for 37.67 per cent, while repair and maintenance take 4.81 per cent of the production cost.

**Table 7.2****ANNUAL PRODUCTION COST AT FULL CAPACITY ('000 BIRR)**

<b>Cost Items</b>	<b>Cost</b>	<b>%</b>
Raw Material and Inputs	185.60	8.93
Utilities	597.74	28.75
Maintenance and repair	100	4.81
Labour direct	116.1	5.58
Factory overheads	38.7	1.86
Administration Costs	77.4	3.72
Total Operating Costs	1,115.54	53.65
Depreciation	588.25	28.29
Cost of Finance	375.48	18.06
<b>Total Production Cost</b>	<b>2,079.27</b>	<b>100</b>

**C. FINANCIAL EVALUATION****1. Profitability**

According to the projected income statement, the project will start generating profit in the first year of operation. Important ratios such as profit to total sales, net profit to equity (Return on equity) and net profit plus interest on total investment (return on total investment) show an increasing trend during the life-time of the project.

The income statement and the other indicators of profitability show that the project is viable.

## 2. Break-even Analysis

The break-even point of the project including cost of finance when it starts to operate at full capacity (year 3) is estimated by using income statement projection.

$$\text{BE} = \frac{\text{Fixed Cost}}{\text{Sales} - \text{Variable Cost}} = 53 \%$$

## 3. Pay Back Period

The investment cost and income statement projection are used to project the pay-back period. The project's initial investment will be fully recovered within 3 years.

## 4. Internal Rate of Return and Net Present Value

Based on the cash flow statement, the calculated IRR of the project is 31 % and the net present value at 8.5% discount rate is Birr 6.19 million.

## D. ECONOMIC BENEFITS

The project can create employment for 22 persons. In addition to supply of the domestic needs, the project will generate Birr 3.45 million in terms of tax revenue. The establishment of such factory will have a foreign exchange saving effect to the country by substituting the current imports.