

**181. PROFILE IN PRODUCTION OF ALUMINUM  
SULPHATE**

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## **I. SUMMARY**

This profile envisages the establishment of a plant for the production of aluminum sulphate with a capacity of 600 tonnes per annum.

The present demand for the proposed product is estimated at 479.19 tonnes per annum. The demand is expected to reach at 2001 by the year 2022.

The plant will create employment opportunities for 30 persons.

The total investment requirement is estimated at Birr 9.26 million, out of which Birr 5.6 million is required for plant and machinery.

The project is financially viable with an internal rate of return (IRR) of 21 % and a net present value (NPV) of Birr 4.31 million discounted at 8.5%.

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

Aluminium sulphate is a metallic salt formed for commercial purposes by the action of 98% sulphuric acid on an aluminium source such as bauxite, kaolin, or aluminium oxide or hydroxide. The alum is produced at an Al<sub>2</sub>O<sub>3</sub> content of 14-18% in the form of slabs, lumps or powder. The main uses are in water and effluent treatment, and in paper making. In addition to the major applications, aluminium sulphate can be used in a variety of industrial processes including tanning, dyeing, fire extinguisher materials, pharmaceuticals and electroplating.

### III. MARKET STUDY AND PLANT CAPACITY

#### A. MARKET STUDY

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

Aluminum sulphate is widely used in the paper industry, construction and boiler water treatment. It is also used as mordant for dyeing, foaming agent in fire foams, fire proofing cloth, catalyst in the manufacture of ethane, tanning white leather, clarifying agent for fats and oils and lubricating compositions. The country's requirement for aluminum sulphate is essentially met through imports. The amount of imports of the product during 1997-2006 is shown in Table 3.1. As can be seen from the information depicted in the Table, the amount of imports was fluctuating with a rising trend. During the period under reference, imports varied from 20.16 tonnes in 1997 to 1022.10 tons in 2006. Imports averaged 435.63 tonnes during the period.

**Table 3.1**  
**IMPORTS OF ALUMINUM SULPHATE (TONNES)**

<b>Year</b>	<b>Imports</b>
1997	20.16
1998	80.38
1999	26.13
2000	-
2001	197.52
2002	90.00
2003	570.00
2004	913.08
2005	1001.31
2006	1022.10
<b>Average</b>	<b>435.63</b>

*Source: Customs Authority, External Trade Statistics, 1997-2006.*

Assuming supply was driven by demand, the average annual supply for the period under reference, which constitutes only imports, is considered as the effective demand for the product for the year 2006. As stated above, aluminum sulphate is widely used in various industries including the construction industry, paper industry, and water treatment. Given the substantially remarkable economic growth that has been achieved in the country and the developments that are observed in many of the industries where the product is used as an input, a conservative estimate of 10% rate of growth is adopted in estimating the demand for the product. The present demand for the product (i.e. 2007) is, thus, estimated at 479.19 tonnes.

## 2. Projected Demand

As stated above, a growth rate of 10% is considered in projecting the domestic for aluminum sulphate. The projected demand for the product is shown in Table 3.2.

**Table 3.2**

**PROJECTED DEMAND FOR ALUMINUM SULPHATE (TONNES)**

<b>Year</b>	<b>Projected Demand</b>
2007	479.19
2008	527.11
2009	579.82
2010	637.80
2011	701.58
2012	771.74
2013	848.91
2014	933.81
2015	1,027.19
2016	1,129.90
2017	1,242.90
2018	1,367.18
2019	1,503.90
2020	1,654.29
2021	1,819.72
2022	2,001.70

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

Based on the CIF price of the external trade statistics for 2006 (the latest data available), and allowing 30% for import duty and other clearing expenses, the factory gate price for the envisaged plant is estimated at Birr 8,000 per tonne.

The envisaged plant can supply its product directly to users. The plant can also appoint agents at selected locations

## **B. PLANT CAPACITY AND PRODUCTION PROGRAMME**

### **1. Plant Capacity**

Based on the market study, the envisaged plant will have annual production capacity of 600 tonnes assuming the plant will be put into operation by the year 2010. The plant will operate in a single shift of 8 hours a day, and for 300 days a year. The capacity of the plant can be increased by increasing the number of shifts per day to two or three.

### **2. Production Programme**

Production will commence at 75%, and then will grow to 85% and 100% in the second year, and the third year and then after, respectively. The plant starts operation at a lower capacity due to the period needed to develop skill in the production and fine tuning of machineries and market penetration. Detail production programme is shown in Table 3.3 below.

**Table 3.3****PRODUCTION PROGRAMME**

<b>Year</b>	<b>1</b>	<b>2</b>	<b>3-10</b>
Capacity utilization (%)	75	85	100
Production (tonnes)	450	510	600

**IV. MATERIALS AND INPUTS****A. RAW AND AUXILIARY MATERIALS**

In addition to sulphuric acid, a source of aluminium is required for aluminium sulphate production and frequently pure minerals like kaolin or bauxite are used. But for the envisaged project Kaolin is used as aluminium source. Annual consumption of raw and auxiliary materials at full production capacity is given in Table 4.1 below. The total cost of raw material is estimated at Birr 1,678.896 thousand.

**Table 4.1****RAW AND AUXILIARY MATERIALS REQUIREMENT AND COST**

<b>Sr. No.</b>	<b>Description</b>	<b>Qty</b>	<b>Cost, ['000 Birr]</b>
1	Kaolin	291.6	131.22
2	Sulphuric acid	309	1,545
3	PP bag	1200	2.676
	<b>Grand Total</b>		<b>1,678.896</b>

## B. UTILITIES

Electricity, water and fuel oil are the utilities required by the envisaged plant. Details of utilities are shown in Table 4.2. The total cost of utilities is estimated at Birr 291,291.2.

**Table 4.2**  
**UTILITIES REQUIREMENT AND COST**

<b>Sr. No.</b>	<b>Description</b>	<b>Quantity</b>	<b>Unit price (Birr)</b>	<b>Total Cost (Birr)</b>
1	Electricity (kWh)	42,000	0.4736	19891.2
2	Water (m <sup>3</sup> )	10,000	5.50	55000
3	Furnace oil (lt.)	40,000	5.41	216400
	<b>Grand Total</b>			<b>291,291.2</b>

## V. TECHNOLOGY AND ENGINEERING

### A. TECHNOLOGY

#### 1. Production Process

Aluminum sulphate is prepared by the action of sulphuric acid, usually 98% H<sub>2</sub>SO<sub>4</sub>, on kaolin or other source of aluminum hydroxide. The kaolin is ground and digested by the acid at elevated temperature for several hours and then the insoluble portion of the ore separated by filtration of the solution. The liquor is then concentrated by evaporation to give an Al<sub>2</sub>O<sub>3</sub> content of 14-18%, and this solution on cooling solidifies to give a hydrated salt with the formula Al<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub> x H<sub>2</sub>O, where X=13.5 to 18.

The product is then crushed or milled and sieved to give a granulator or powder product as required and packed in 50kg.poly propylene bag.

## 2. Source of Technology

The technology of candy production is simple. Machinery can easily be purchased from India. Addresses of machinery suppliers are given below:-

### B. ENGINEERING

#### 1. Machinery and Equipment

The list of machinery and equipment required by the envisaged plant is given in Table 5.1 below. The total cost of machinery and equipment with the envisaged capacity is estimated at Birr 5.6 million, out of which Birr 4.48 million is required in foreign currency.

**Table 5.1**  
**MACHINERY AND EQUIPMENT REQUIREMENT**

Sr. No.	Description	Qty. (No.)
1	Kaolin feed hopper	1
2	Feeder	1
3	Kaolin crusher	1
4	Bucket elevator	1
5	Screw conveyor	1
6	Ball mill	1
7	Pumps	6
8	Digesters	1
9	Filter press	1
10	Slurry holding tank	1
11	Acid measure tank	1
12	Dilution tank	1
13	Process water tank	1
14	Evaporators	2
15	Liquid alum tank	1
16	Belt conveyor	1
17	Crushed alum Elevator	1
18	Mill feed hopper	1
19	Alum crusher	1
20	Alum mill	1
21	Packing machine	1

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

The total land requirement, including provision for open space is 2,000 m<sup>2</sup>, of which 1,000 m<sup>2</sup> will be covered by building. Estimating unit building construction cost of Birr 2,300 per m<sup>2</sup>, the total cost of building will be Birr 2,300,000. The cost of land leasing is Birr 0.35 per m<sup>2</sup>, and for 80 years land holding will be Birr 56,000. Thus, the total investment cost of land, building and civil works will be Birr 2,356,000.

## **3. Proposed Location**

The most appropriate location for the aluminium sulphate plant is at Hossaena, lemo worda due to the presence of basic raw material, kaolin, availability of infrastructure and its proximity to the market.

# **VI. MANPOWER AND TRAINING REQUIREMENT**

## **A. MANPOWER REQUIREMENT**

The plant requires 30 workers, and their annual expenditure, including fringe benefits, is estimated at Birr 215250. For details see Table 6.1.

## **B. TRAINING REQUIREMENT**

The production operators will be trained on the operation and maintenance of machinery for about two weeks during commissioning by the expert of machinery supplier. The total cost of training is estimated at Birr 30,000.

**Table 6.1**  
**MANPOWER REQUIREMENT AND ANNUAL LABOUR COST**

Sr. No.	Description	Req. No.	Salary, Birr	
			Monthly	Annual
1	Plant manager	1	1500	18000
2	Secretary	1	700	8400
3	Accountant	1	900	10800
4	Clerk	1	350	4200
5	Production supervisor	1	900	10800
6	Technician Operator	6	3000	36000
7	laborers	10	3000	36000
8	Store keeper	1	500	6000
9	Sales man	1	900	10800
10	Purchaser	1	900	10800
11	Driver	2	700	8400
12	Guard	2	600	7200
13	Cleaner	2	400	4800
	<b>Sub-total</b>	<b>30</b>	<b>14350</b>	<b>172200</b>
	Employee benefit (20% BS)	-	-	43050
	<b>Total</b>		<b>-</b>	<b>215250</b>

## VII. FINANCIAL ANALYSIS

The financial analysis of the aluminum sulphate 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	30days
Raw material, import	90days
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 9.26 million, of which 52 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	56.0
2	Building and Civil Work	2,300.0
3	Plant Machinery and Equipment	5,600.0
4	Office Furniture and Equipment	100.0
5	Vehicle	200.0
6	Pre-production Expenditure*	621.3
7	Working Capital	383.7
	<b>Total Investment Cost</b>	<b>9,260.9</b>
	Foreign Share	52

\* N.B Pre-production expenditure includes interest during construction ( Birr 521.26 thousand ) training (Birr 30 thousand ) and Birr 70 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 3.55 million (see Table 7.2). The material and utility cost accounts for 55.5 per cent, while repair and maintenance take 4.23 per cent of the production cost.

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

<b>Items</b>	<b>Cost</b>	<b>%</b>
Raw Material and Inputs	1,678.90	47.29
Utilities	291.29	8.21
Maintenance and repair	150	4.23
Labour direct	129.15	3.64
Overheads	53.81	1.52
Administration Costs	86.1	2.43
Total Operating Costs	2,389.25	67.30
Depreciation	745	20.99
Cost of Finance	415.86	11.71
<b>Total Production Cost</b>	<b>3,550.11</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.

$$\text{BE} = \frac{\text{Fixed Cost}}{\text{Sales} - \text{Variable Cost}} = 31 \%$$

## 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 5 years.

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

Based on the cash flow statement, the calculated IRR of the project is 21 % and the net present value at 8.5% discount rate is Birr 4.31 million.

## D. ECONOMIC BENEFITS

The project can create employment for 30 persons. In addition to supply of the domestic needs, the project will generate Birr 3.15 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.