

252. PROFILE ON PRODUCTION OF ALKYD RESINS

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I. SUMMARY

This profile envisages the establishment of a plant for the production of alkyd resins with a capacity of 600 tonne per annum.

The present demand for the proposed product is estimated at 2,268 tones per annum. The demand is expected to reach at 4,896 tonnes by the year 2017.

The plant will create employment opportunities for 34 persons.

The total investment requirement is estimated at about Birr 10.29 million, out of which Birr 6.93 million is required for plant and machinery.

The project is financially viable with an internal rate of return (IRR) of 22 % and a net present value (NPV) of Birr 6.87 million discounted at 8.5%.

II. PRODUCT DESCRIPTION & APPLICATION

Alkyd resins are any of a large group of thermoplastic resins that are essentially polyesters made by heating polyhydric alcohol with polybasic acids or their anhydride and used chiefly in making protective coatings and good weathering properties.

These resins are useful as film forming agents in paint, varnished and enamels & as thermosetting plastics that can be moulded into solid objects. Hence, alkyd resins are one of the important ingredients in the synthetic paint industry.

The paint factories in Ethiopia currently produce a variety of paint which can broadly be categorized as emulsion (plastic) paint and synthetic paint. The former type is water soluble paint for the exclusive use in internal walls and ceilings. The latter type consists of alkyd based products which are used as metallic & wood paints, varnishes & lacquers, antirust, etc.

Different types of alkyd resins, mainly characterized by their oil content, are used for different synthetic paint products.

III. MARKET STUDY AND PLANT CAPACITY

A. MARKET STUDY

1. Past Supply and Present Demand

Alkyd resin, which is used in the production of a wide variety of paint is supplied to the Ethiopian market both from domestic production and import. The product is produced locally by a factory known as Alkyd Resin S.C. located in Addis Ababa. According to the feasibility study of the project the plant has an annual production capacity of 1500 tonnes. With regard to import data obtained from the Customs Authority is presented in Table 3.1.

Table 3.1
IMPORT OF ALKYD RESIN(TONNES)

Year	Import
2000	193.4
2001	263.9
2002	518.4
2003	1111.5
2004	1200.5
2005	315.3
2006	446.1

Source :- Customs Authority

Import of alkyd resin during the period 2000-2004 has exhibited an increasing trend. The imported quantity which was 193.4 tonnes in the year 2000 has reached to a level of 1200.5 tonnes by the year 2004. Annual average growth rate of import during the first five years was more than 50%. But during the last two recent years the imported quantity has declined substantially. The imported quantity during 2004 and 2005 was 315.3 tonnes and 446.1 tonnes respectively. This is believed to be because of the high stock during the previous two years.

By considering the increasing trend observed between year 2000-2004 and declining trend during the last two years the average of the recent four years is believed to reflect the demand that emanates from import. Accordingly, the unsatisfied demand that is met through import is calculated at 768 tonnes. When the imported quantity added to the domestic production total current effective demand for the product is estimated at 2,268 tonnes.

2. Projected Demand

Alkyd resin is mainly used as an intermediate input for production of paint. The production of paint in turn is influenced by the growth of the construction sector. The construction sector has been growing by more than 8% in the past few years. Assuming the past trend to continue for the future demand for alkyd resin is forecasted by applying an 8% annual average growth rate. The total projected demand and the unsatisfied demand is given in Table 3.2.

Table 3.2
PROJECT DEMAND FOR ALKYD RESIN (TON)

Year	Total Demand	Domestic Production	Unsatisfied Demand
2008	2449	1500	949
2009	2645	1500	1145
2010	2857	1500	1357
2011	3086	1500	1586
2012	3332	1500	1832
2013	3599	1500	2099
2014	3887	1500	2387
2015	4198	1500	2698
2016	4534	1500	3034
2017	4896	1500	3396

3. Pricing and Distribution

Currently the existing factory in Addis Ababa sells its product at Birr 7.50 kg . This price is adopted for sales revenue projection. The product has to be sold to the end user industries, mainly paint factories.

B. PLANT CAPACITY AND PRODUCTION PROGRAMME

1. Plant Capacity

The annual production capacity of the proposed project is 600 tonnes of alkyd resins based on 300 working days and three shift per day.

2. Production Programme

Table 3.3 shows the production program of the project. At the initial stage of the production period the plant requires some years to penetrate the market. Therefore, in the first and second year of production, the capacity utilization rate will be 70% and 90%, respectively. In the third year and then after full capacity production shall be attained.

Table 3.3
PRODUCTION PROGRAMME

Sr. No.	Product	Production year		
		1	2	3-10
1	Alkyd resin (ton)	420	540	600
2	Capacity utilization rate (%)	70	90	100

IV. MATERIALS AND INPTUS

A. MATERIALS

Table 4.1 indicates the annual raw material requirement and cost of the project. Linseed oil, glycerin, phthalic anhydride, litharge and mineral spirits are the major raw material required by the envisaged plant.

Table 2**ANNUAL RAW AND AUXILIARY MATERIAL REQUIREMENT AND COST
(AT FULL CAPACITY) (FOR 63% OIL LENGTH ALKYD RESIN)**

	Material	Unit	Qty	Cost ('000 Birr)		
				FC	LC	Total
1	Linseed oil	Ton	310	-	3,720	3,720
2	Glycerin	Ton	55	577.5	247.5	825
3	Phathalic anhydride	Ton	120	480	120	600
4	Litharge	Ton	0.2	-	305.6	305.6
5	White spirit	Ton	250	-	987.5	987.50
6	Xylene	Ton	19.2	-	100.1	100.1
7	Barrel (200 lt)	Pcs	-	-	300	300
	Total			1,057.5	5,780.7	6,838.2

B. UTILITIES

Utilities of the project are electricity, furnace oil and water. The annual utility requirement and cost is indicated in Table 4.2.

Table 4.2**ANNUAL UTILITY REQUIREMENT AND COST**

Sr. No.	Utility	Unit	Qty	Cost ('000 Birr)
1	Electricity	kWh	120,000	56.88
2	Furnace oil	Lt	42,000	227.22
3	Water	M3	5,000	50
	Total			334.1

V. TECHNOLOGY AND ENGINEERING

A. TECHNOLOGY

1. Production Process

Two processes are used for the production of alkyd resins, namely the solvent and the fusion process. The solvent process uses a small amount of solvent, 5-10%, in the esterification reaction to act as a reflux medium. The advantages of this process are:

- a) Uniformity of product,
- b) Increased speed of reaction and
- c) Lower material losses.

In the solvent process, the production of alkyds can be carried out either in a single stage or a two stage process. Under the single stage process, the drying oil (linseed oil), polyalcohol and phthalic anhydride are converted simultaneously. This method of alkyd preparation is not satisfactory because of the incompatibility of the phthalic anhydride with drying oil (linseed oil) and the difficulty of controlling the reaction to produce the desired end-products.

In the first stage of the two stage solvent process, monoglyceride is produced from drying oil and polyalcohol and in the second stage the monoglyceride is converted with phthalic anhydride. This process is more satisfactory and is the one recommended for the envisaged plant because it eliminates the problems of the first option.

In the two- stage solvent process, the first operation is the alcoholysis reaction which takes place under different duration of time (varying from 40 minutes to 4 hours) and temperature (from about 240 to 260°C). The completion of this stage is shown by the solubility of the product in about twice its weight of methanol.

The second stage which takes place in the same reactor is the actual formation of the alkyd proper. The monoester formed in the first stage is cooled slightly to about 210°C and the requisite quantity of phthalic anhydride is added. The resin is then partially cooled with water coils, and at the same time a thinning solvent is added. The partially diluted alkyd solution is run into a blender, passing through a filter press to remove any gel particles that are formed. The completed alkyd solution is then pumped to a second filter press for clarification and then to storage tanks or immediate use.

2. Source of Technology

Several manufacturers and suppliers of alkyd resins plant can be requested for their offers. Among them the following company could be approached.

Doshi Engineering Works

Mogra Villa Road, Andheri (E)

Mumbai, India

Tel. +91 -22-28360802 / 28360854

Fax. +91 -22-28361748

B. ENGINEERING

1. Machinery and Equipment

The choice of the reactor depends on the heating medium used. Both hot oil heating and electric induction heating can be used for the esterification reaction. Due to higher initial investment and running cost of the induction heating, the hot oil heating method has been selected. The list of machinery and equipment is given in Table 5.1 and its cost is estimated at Birr 6,932,250 of which Birr 5,776,800 is in foreign currency.

Table 5.1
LIST OF MACHINERY & EQUIPMENT

Sr. No.	Description	No.
1	Reactor system	1 unit
2	Condenser (main)	1
3	Separator	1
4	Blender	1
5	Vent condenser	1
6	Vacuum receiver	1
7	Addition tanks	1
8	Resin pump (Reactor to blender)	1
9	Resin pump (Blender to filter)	1
10	Resin filter	1
11	Stand by elect. Generator	1
12	Thermal fluid heating system	1
13	Raw material pump	1
14	Weigh scale	3
15	Finished product tank	1
16	Steam boiler	1
17	Compressor	1
18	Cooling tower	1
19	Laboratory equipment	set

2. Land, Buildings & Civil Works

The total area of the project is 2000 m² of which the built-up area is 500 m². The cost of building is estimated at Birr 750,000. The lease value of land is about Birr 160,000 at a rate of 1 Birr /m²/annum for 80 years.

3. Proposed Location

Selamber town is selected as the best location of project, for its proximity to major raw materials sources.

VI MANPOWER AND TRAINING REQUIREMENT

A. MANPOWER REQUIREMENT

The list of manpower and annual labour cost are indicated in Table 6.1. The total cost of labour is estimated at Birr 408,000.

Table 6.1
MANPOWER REQUIREMENT WITH MONTHLY AND ANNUAL SALARIES

Sr. No.	Manpower	No.	Monthly Salary (Birr)	Annual Salary (Birr)
1	General manager	1	3,000	36,000
2	Secretary	1	800	9,600
3	Sales officer	1	1,500	18,000
4	Accountant	1	2,000	24,000
5	Production and technical head	1	2,000	24,000
6	Operators	15	10,500	126,000
7	Labourers	9	3,600	43,200
8	Laboratory technicians	3	3,000	36,000
9	Guards	2	800	9,600
	Subtotal	34	27,200	326,400
	Benefit (25% BS)		6,800	81,600
	Total		34,000	408,000

B. TRAINING REQUIREMENT

On-the-job training shall be carried out during plant erection and commissioning by experts of machinery supplier. The total cost of training is estimated at Birr 30,000.

VII. FINANCIAL ANALYSIS

The financial analysis of the alkyd resin 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	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 10.29 million, of which 49 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	160
2	Building and Civil Work	750.00
3	Plant Machinery and Equipment	6,932.25
4	Office Furniture and Equipment	100
5	Vehicle	250
6	Pre-production Expenditure*	623.87
7	Working Capital	1477.92
	Total Investment cost	10,294.0
	Foreign Share	49

* *N.B Pre-production expenditure includes interest during construction (Birr 473.87 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 8.95 million (see Table 7.2). The material and utility cost accounts for 80.11 per cent, while repair and maintenance take 1.28 per cent of the production cost.

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

Items	Cost	%
Raw Material and Inputs	6,838.20	76.38
Utilities	334.1	3.73
Maintenance and repair	115	1.28
Labour direct	195.84	2.19
Factory overheads	65.28	0.73
Administration Costs	130.56	1.46
Total Operating Costs	7,678.98	85.77
Depreciation	828.73	9.26
Cost of Finance	445.73	4.98
Total Production Cost	8,953.44	100

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.

$$\text{BE} = \frac{\text{Fixed Cost}}{\text{Sales} - \text{Variable Cost}} = 33 \%$$

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 22 % and the net present value at 8.5% discount rate is Birr 6.87 million.

D. ECONOMIC BENEFITS

The project can create employment for 34 persons. In addition to supply of the domestic needs, the project will generate Birr 3.63 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.