79. MINI-CEMENT PLANT

TABLE OF CONTENTS

		PAGE
I.	SUMMARY	79-3
II.	PRODUCT DESCRIPTION & APPLICATION	79-3
III.	MARKET STUDY AND PLANT CAPACITY	79-4
	A. MARKET STUDY	79-4
	B. PLANT CAPACITY & PRODUCTION PROGRAMME	79-6
IV.	RAW MATERIALS AND INPUTS	79-7
	A. RAW MATERIALS	79-7
	B. AUXILARY MATERIALS	79-7
	C. UTILITIES	79-8
V.	TECHNOLOGY & ENGINEERING	79-8
	A. TECHNOLOGY	79-8
	B. ENGINEERING	79-9
VI.	MANPOWER & TRAINING REQUIREMENT	79-11
	A. MANPOWER REQUIREMENT	79-11
	B. TRAINING REQUIREMENT	79-12
VII.	FINANCIAL ANLYSIS	79-13
	A. TOTAL INITIAL INVESTMENT COST	79-13
	B. PRODUCTION COST	79-14
	C. FINANCIAL EVALUATION	79-14
	D. ECONOMIC BENEFITS	79-15

I. SUMMARY

This profile envisages the establishment of a Mini-Cement Plant with a capacity of 60,000 tonnes per annum.

The present demand for the proposed product is estimated at 1.5 million tonnes per annum. The demand is expected to reach at 2.6 million by the year 2010.

The plant will create employment opportunities for 71 persons.

The total investment requirement is estimated at Birr 95.89 million, out of which Birr 80 million is required for plant and machinery.

The project is financially viable with an internal rate of return (IRR) of 16% and a net present value (NPV) of Birr 31.72 million, discounted at 8.5 %.

II. PRODUCT DESCRIPTION AND APPLICATION

Cement is a bonding agent for materials. It is a finely powdered substance, which possesses strong adhesive power when combined with water.

The most common and widely used in construction is the Portland cement. This cement is produced by burning a homogenized mixture of clay and limestone, resulting in intermediate product called clinker. This inturn is mixed with gypsum in a specified proportion, and ground into fine powder to form the final product called Portland cement. This product is very useful in construction and engineering works of housing, buildings, bridges and cement concrete roads.

Other applications of cement are for mortar and concrete making. In mortar making cement is mixed with sand and crushed stones of definite proportion and size. In concrete making it is mixed with sand or other fine and coarse aggregates to be used in construction.

All plants with a capacity of 200 tonnes per day or less are classified as Mini-Cement Plants (MCPs). It is well known that at present levels of technology, it is not economically feasible to build rotary kiln with a capacity of less that 200 tonnes per day. Therefore, Vertical Shaft Kilns (VSK) are appropriate for MCPs.

III. MARKET STUDY AND PLANT CAPACITY

A. MARKET STUDY

1. Past Supply and Present Demand

Cement is, by-far, the most important construction material manufactured in Ethiopia, accounting for 85% of the value in the non-metallic manufacturing sector. All local cement is produced in the three factories: Mugher, Mesebo and Dire Dawa. The combined capacity of these three factories is about 1.3 million tonnes per annum, but the largest part of the supply comes from Mugher and Mesebo (more than 95%).

In addition to domestic production, the country also imports some amount of cement from European and Asian countries. The imports are, however, mostly of such types that are required for special construction purposes (aluminous cements, hydraulic cement, etc).

The apparent consumption data of cement, comprising of domestic production and imports (1994-2003), is shown in Table 3.1.

Table 3.1
APPARENT CONSUMPTION OF CEMENT
(TONNES)

Year	Production	Import	Total
1994	464396	95	464491
1995	609260	388	609648
1996	672483	115	672598
1997	774666	2283	776949
1998	782686	7712	790398
1999	766925	162	767087
2000	815632	224	815856
2001	819047	194	819241
2002	919169	388	919557
2003	1200000	518	1200518

Table 3.1 shows that both local production and import of cement in Ethiopia is characterized by a growth trend.

Over the 10 years period covered by the data set (1994-2003), local production was growing at an annual average growth rate of 11%.

Except for two exceptional years (1997&1998), imports constitute less than 1% of the total supply. Even in those exceptional years, the maximum proportion of imports did not exceed

10%. Therefore, one can conclude that the impact of imports on the domestic cement market is not significant.

Following increased construction activity allover the country, demand for cement is currently soaring at an increasing rate. As the local producers are only three large scale factories, sudden shortages are created when one of them interrupts production for technical or other reasons. As a consequence, prices shoot upward and many construction activities face problems owing to supply shortage.

It is also easy to infer from the data in Table 3.1 that, presently, the factories are working at nearly 100% of their capacity. Hence, unless new capacity is created in time a severe shortfall of supply is going to materialize in the very near future, thereby negatively impacting on construction activity in particular and the country's development in general.

Assuming the present level of supply, which is about 1.2 million tonnes, satisfies only 80% of the demand. The present effective demand for cement is estimated at 1.5 million tonnes.

2. Projected Demand

The future demand for cement, 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 demand for cement are:-

- The overall economic development level and growth trend of the country,
- The pattern and growth trend of the construction industry,
- Expected technological changes that affect 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.

Considering all the above factors and the growth trend in supply observed from the historical data, future demand is forecasted to grow at a rate of 10%, annually. Accordingly, projected demand for cement ranges from 1.6 million tonnes in the year 2005 to 5.7 million tonnes by the year 2018 (see Table 3.2).

Table 3.2
PROJECTED DEMAND FOR CEMENT
(2004-2018)

Year	Projected Demand (Million Tonnes)	Existing Capacity (Million Tonnes)	Demand Gap (Million Tonnes)
2004	1.5	1.3	0.2
2005	1.65	"	0.35
2006	1.8	"	0.5
2007	2.0	"	0.7
2008	2.2	"	0.9
2009	2.4	"	1.1
2010	2.6	"	1.3
2011	2.9	"	1.6
2012	3.2	"	1.9
2013	3.5	"	2.2
2014	3.9	"	2.6
2015	4.3	"	3.0
2016	4.7	"	3.4
2017	5.2	"	3.9
2018	5.7	"	4.4

3. Pricing and Distribution

Due to supply side constrains and increased construction activities, the recent price of cement in Ethiopia tends to fluctuate especially in the retail market. The current factory gate price of cement produced by Mugher Cement Enterprise ranges from Birr 70 to 80 /quintal, therefore, Birr 75 per quintal is proposed for this project.

B. PLANT CAPACITY AND PRODUCTION PROGRAMME

1. Plant Capacity

According to the market study, the demand gap for cement product begins with 200,000 tonnes for the year 2004, and will reach to 1,300,000 tonnes by the year 2010. Mini-Cement Plants (MCPs) can be established with varying production capacities. The technology of *VSK-based cement production is available with capacities of 20,30, 50, 100 and 200 tonnes per day for MCPs. Although the demand gap of cement in the region is, by-far, lower than that of the average national figure, it is proposed that an MCP of 200 tonnes per day capacity shall be established. Such a plant will operate 24 hours a day, and for 300 days a year, producing a total of 60,000 tonnes of cement.

* VSK is Vertical Shaft Kiln.

2. Production Programme

The anticipated mini-cement plant will start its operation at 75% in the first year, 85% in the second year, and at 100% in the third year and thenafter. The detail is shown in Table 3.3 below.

Table 3.3
PRODUCTION PROGRAMME

Year	1	2	3-10
Capacity utilization (%)	75	85	100
Cement (Tonnes)	45,000	51,000	60,000

IV. MATERIALS AND INPUTS

A. MATERIALS

The major raw materials required for the production of cement are limestone, clay, sandstone, gypsum and pumice. These raw materials are proportionally mixed at different stages of the production process inorder to produce an intermediate product called clinker and final product of cement. The details of raw materials requirement for cement production is shown in Table 4.1. below.

Table 4.1
RAW MATERIALS REQUIREMENT AND COST (BIRR)

Sr. No.	Description	Qty. (Tonnes)	Unit Cost	Total Cost
1	Limestone, (72-76)%	61,000	50.00	3,050,000
2	Clay, (6-10)%	10,000	1.00	10,000
3	Sandstone, (8-12)%	6,500	65.00	422,500
4	Pumice, (2-4)%	3,210	64.20	206,082
5	Gypsum, (4-5)%	2,400	120.00	288,000
	Grand Total Cost	**-**	**-**	**3,976,582**

B. AUXILIARY MATERIALS

Three-ply paper bag is required for packing cement. Addis Ababa Cement Plant is engaged in the production of this bag, and procurement can be processed locally. A total of 1.2 million sacks of 50kg each is required. The annual expenditure on paper bags is estimated at Birr 6 million.

C. UTILITIES

VSKs of MCPs do require energy in the range of 1000 - 1100 kcal of heat per kg of clinker. Similarly, consumption of electrical power in MCPs is in the order of 120 units per tonne of cement as compared to large cement plants which lies in the range of 100-110 units per tonne. Consequently, electricity and fuel oil are highly required. Water is also essential for human consumption and for production process. Annual requirement of utilities is shown in Table 4.2.

Table 4.2
ANNUAL UTILITIES REQUIREMENT AND COST

Sr. No.	Description	Qty.	Cost ('000 Birr)
1	Electricity, kWh	7,200,000	3412.80
2	Water, m^3	50,000	75.00
3	Fuel oil, litres	6,200,000	15,500.00
	Total Cost		**18,987.00**

V. TECHNOLOGY AND ENGINEERING

A. TECHNOLOGY

1. Production Process

The technology of cement production involves several unit operations, and are complex to enumerate. However, the major unit operations are the following:-

- Preparation of raw mix
  - Quarrying, crushing and transportation
  - Proportioning of the ingredients
  - Grinding of raw mix
- Calcinations and storage
  - Homogenizing of raw mix
  - Burning of raw mix in vertical shaft kiln and storing of clinker
- Production of cement
  - Grinding of clinker and gypsum (96/4%)
  - Packing of cement

The dry process of cement production is employed here although the wet process also exist. The major difference between the two is the method of raw material preparation and handling before it is fed into the calcinations unit. Wet process do require high fuel oil consumption due to which there is a high shift to dry method of cement production in

modern times. For the purpose of this project, therefore, the dry process is preferred to the wet process. In a dry process, the moisture content of the raw materials is kept below 6%.

Quarrying, crushing and transportation of limestone, sandstone and clay is carried at the site of the raw materials. These materials are, then, stored in their respective storage yards, and are fed to proportioning equipment (bunkers and weigh scales). The proportioned materials are transported by a belt conveyor and fed to raw grinding mill. The output of the mill-called raw mix or raw meal - is fed into homogenizing silos where high pressure air mixes the raw mix to a high degree of homogeneity. This is then transported to VSK, where calcinations at a temperature of $1100^{o}C$ - $1400^{o}C$ take place in order to produce the required grade of clinker.

The clinker thus produced is cooled either in a silo(s) or open air. The clinker together with gypsum are ground in a cement mill to finally produce cement. It is then packed and dispatched into market.

2. Source of Technology

Vertical shaft kiln has found wide application in India and China. Cement production equipment including VSK can be purchased from the following Indian company.

MOVERS (INDIA) PRIVATE LTD
BASAVA BHAVAN, HIGH GROUNDS
FAX: 91-802263606

B. ENGINEERING

1. Machinery and Equipment

Most of the machinery required by a cement manufacturing plant are huge and heavy - duty type. This is mainly due to the nature of the mineral inputs used in the production. Normally evacvation, transportation and handling of these solid bulk materials require various types of heavy - duty machinery. Some of these machinery and equipment are grouped under three major sections depending upon unit operations they perform.

The list of machinery and equipment required is provided in Table 5.1. The total investment cost of these machinery and equipment is estimated at Birr 80 million, of which Birr 75 million is required in foreign currency.

Table 5.1
MACHINERY AND EQUIPMENT REQUIREMENT AND COST

Sr. No.	Description	Qty.	Cost, (000 Birr)		
			LC	FC	TC
I	**Preparation Section**				
1	Drilling Rig.	1			
2	Loaders	2			
3	Crusher	1			
4	Bucket Elevator	As req.			
5	Silos	As req.			
6	Grinding Mill	1			
7	Dust collector	As req.			
8	Pumps	"			
9	Roller mill	1			
10	Dump trucks	2			
II	**Burning Section**				
1	Fan	As req.			
2	Dust collector	set			
3	Preheater	1 set			
4	Vertical shaft kiln	1 set			
5	Grate cooler	1 set			
6	Bucket elevator	As req.			
7	Storage tanks	1			
III	**Clinker Grinding**				
1	Silos	As req.			
2	Grinding mill	1			
3	Air separator	As req.			
4	Dust collector	As req.			
5	Bucket elevator	As req.			
IV	**Auxiliaries**				
1	Power supply system (inc. dieselgen)	set	Birr 5 Million	Birr 75 million	
2	Fuel storage tanks	2 sets			
3	Water supply unit	2 sets			
4	Compressed air system	1 set			
5	Workshops	As req.			
	Grand Total		**5000.00**	**75,000.00**	**80,000.00**

2. Land, Buidling and Civil works

Cement production relatively requires wider space than any construction materials production plants. This is attributed to the massive natural materials used both in quantity and quality. Hence, site area of 10,000 m^2 is required for the plant under consideration. Of this, an area of about 1,500m^2 will be covered by production buildings, including auxiliary buildings. At the rate of Birr 2000 per m^2, the investment cost for buildings will be Birr 3 million. The cost of land leasing, at the rate of Birr 2.0 per m^2 and for 70 years land holding, will be Birr 1.40 million. Thus, the total cost of land, building and civil works assuming that the total land lease cost will be paid in advance is Birr 4.4 million.

3. Proposed Location

Proximity to raw materials and markets are the two important factors to be examined inorder to determine the location (site) of the mini-cement plant. For a cement plant like this, the optimal location will be at a site close to lime stone quarry. Resource potential study of the region indicates limestone and other inputs for cement production are available abundantly in areas like Menge and Oda Gudera. Most likely, the envisaged cement plant will have to be established at Oda Gudera since limestone is abundantly available at this site.

VI. MANPOWER AND TRAINING REQUIREMENT

A. MANPOWER REQUIREMENT

The envisaged mini-cement plant requires 71 employees. The manpower requirement and corresponding labour cost including employees' benefits is shown in Table 6.1.

Table 6.1

MANPOWER REQUIREMENT AND ANNUAL LABOUR COST

Sr. No.	Description	Req. No.	Salary, Birr	
			Monthly	Annual
	A. Administration			
1	General Manager	1	2,000	24,000
2	Secretary	1	500	6,000
3	Administrative & Finance	1	1,200	14,400
4	Accountant	1	750	9,000
5	Clerks	3	350	12,600
6	Store keeper	1	600	7,200
7	Personnel Officer	1	750	9,000
8	Purchaser	1	750	9,000
9	General Services	10	350	42,000
10	Guards	6	250	18,000
	Sub -total	**26**		**151,200**
	B. Production & Technical			
1	Production & Technical Head	1	1800	21600
2	Supervisors	3	1200	43200
3	Instrumentation Engineer	1	1200	14400
4	Mechanical Engineer	1	1200	14400
5	Electrical Engineer	1	1200	14400
6	Foreman	3	900	32400
7	Technicians (shift)	6	600	43200
8	Operators (skilled)	15	600	108,000
9	Unskilled Workers	10	200	24,000
10	Chemist	1	1000	12,000
11	Laboratory Technicians	3	500	18,000
	Sub - total	**45**		**345,600**
	Total	**71**		**496,800**
	Employees' Benefit			124,200
	Grand Total			**621,000**

B. TRAINING REQUIREMENT

Training is required on technology of cement production, and on specialized equipment and instrumentation. Training programme shall be made part of contractual agreement on the supply, erection and commissioning of the production equipment. Therefore, three months training programme shall be executed for engineers, technicians, operators, chemist, foremen, supervisors and head of production and technical department. It shall be carried on site during erection / commissioning period. A total of Birr 100,000 shall be earmarked as expense to execute the training programme.

VII. FINANCIAL ANALYSIS

The financial analysis of the Mini-Cement Plant project is based on the data presented in the previous chapters and the following assumptions:-

Construction period	1 years
Source of finance	30 % equity
	70 % loan
Tax holidays	3 years
Bank interest	7.5 %
Discounted cashflow	8.5 %
Repair and maintenance	3 % of the total plant and machinery
Accounts receivable	30 days
Raw material, local	30 days
Raw materials, import	90 days
Work in progress	days
Finished products	30 days
Cash in hand	5 days
Accounts payable	30 days

A. TOTAL INITIAL INVESTMENT COST

The total initial investment cost of the project including working capital is estimated at 95.89 million, of which 88 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 ('000 BIRR)
1	Land lease value	1,400
2.	Building and Civil Work	3,000
3.	Plant Machinery and Equipment	80,000
4.	Office Furniture and Equipment	75
5.	Vehicle	375
6.	Pre-production Expenditure*	5,304.1
7	Working Capital	5,740.90
	Total Investment cost	**95,895.02**
	Foreign share	**88.39%**

* *N.B Pre-production expenditure includes interest during construction (Birr 5,199 thousand), training (Birr 100 thousand), and (Birr 5 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 38.9 million (see Table 7.2). The material and utility cost accounts for 65.1 per cent while repair and maintenance take 1.3 per cent of the production cost.

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

Items	Cost	%
Raw Material and Inputs	3976	10.88
Utilities	18,987	51.95
Maintenance and repair	500	1.37
Labour direct	345.6	0.95
Factory overheads *	20	0.05
Administration Cost **	151.2	0.41
Total Operating Costs	**26304.0**	**71.97**
Depreciation	8,248.5	22.57
Cost of Finance	4,318.4	11.82
Total Production Cost	**36,547.31**	**100.0**

**Factory overhead cost includes salaries and wages of supervisors, insurance of factory workers, social costs on salaries of direct labour, etc.*

*** Administrative cost includes salaries and wages, insurance, social costs, materials and services used by administrative staff etc.*

C. FINANCIAL EVALUATION

1. Profitability

According to the projected income statement, the project will start generating profit in the 1st 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 lifetime 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 operates at full capacity (year 3) is estimated by using income statement projection.

$$BE = \frac{\text{Fixed Cost}}{\text{Sales} - \text{Variable cost}} = 63\%$$

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 6 years.

4. Internal Rate of Return and Net Present Value

Based on the cash flow statement, the calculated IRR of the project is 16% and the net present value at 8.5% discount rate is Birr 31.72 million.

D. ECONOMIC BENEFITS

The project can create employment for 71 persons. In addition to supply of the domestic needs, the project will generate Birr 3.8 million per annum in terms of tax revenue when it starts to operate at full capacity. Moreover, the Regional Government can collect employment, income tax and sales tax revenue. The establishment of such factory will have a foreign exchange saving effect to the country by substituting the current imports.