41. PROFILE ON PRODUCTION OF PARTICLE BOARD

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I. SUMMARY

This profile envisages the establishment of a plant for the production of particle board with a capacity of 5,000 m^3 per annum.

The present demand for the proposed product is estimated at 5,000 m^3 per annum. The demand is expected to reach at 10,795 m^3 by the year 2017.

The plant will create employment opportunities for 36 persons.

The total investment requirement is estimated at Birr 23.79 million, out of which Birr 8.67 million is required for plant and machinery.

The project is financially viable with an internal rate of return (IRR) of 15.45 % and a net present value (NPV) of Birr 5.59 million, discounted at 8.5%.

II. PRODUCT DESCRIPTION AND APPLICATION

Chip wood or particle board is produced by gluing wood particles. It is used in the construction industry as prefabricated houses or as ceiling materials in monolithic structure. Chip wood is also used in the furniture and wood industries where it is used as a substitute for wooden boards.

Chip wood is produced in standard sizes of 1.2 meters by 2 meters. The thickness range is 8mm, 12mm, 13mm, 15mm,17mm, and 20mm.

The major end user of chip wood is the building construction sector. Thus the demand for chip wood is related to the expansion and growth of the building construction sector. The current demand for chipboard is met through local production and import.

III. MARKET STUDY AND PLANT CAPACITY

A. MARKET STUDY

1. Past Supply and Present Demand

Particle board to the Ethiopian market is supplied both from local precaution and import. Domestic production and import of particle production board few in the past years is given in Table 3.1 and 3.2, respectively.

Table 3.1

DOMESTIC PRODUCTION OF PARTICLE BOARD

Year	Volume (Cub.mt)
1999/00	7,200
2000/01	10,289
2001/02	747
2002/03	2,231
2003/04	7,950
2004/05	1,300

Source:- *Statistical Abstract of the Central Statistical Agency.*

Domestics production of particle board during year 1999/00 and 2000/01 was very high as compared to the next two years. During 1999/00-2000/01, a total of 17,489 cub.mt have been produced. But in the following two years, i.e. 2001/02-2002/03, the total amount has substantially reduced to 2,978 cub.mt. Production of particle board has again shown a modest increase during the last two years of the period covered by the data set. The average yearly production during 2003/04-2004/05 was 4,625 mt.cub.

Table 3.2

IMPORT OF PARTICLE BOARD (TONNES)

Year	Quantity
1997	617.4
1998	1,694.6
1999	1,524,7
2000	1,771.2
2001	3,709.9
2002	3,128.5
2003	9,638.8
2004	1,938.8
2005	3,595.3
2006	4,522.1

As could be seen from Table 3.2., import of particle board has shown a general increase in the past 10 years with some fluctuation. During 1997-1999 the annual average quantity imported was about 1,279 tonnes. In the following three years i.e. 2000-2002, the annual average has increased to 2,870 tonnes. A sharp increase has been observed in the recent four years. The annual average amount imported during 2003- 2006 has reached to a level of 4,924 tonnes. This sharp increase is mainly due to the boom of the construction sector in the past few years and the inability of domestic production to satisfy the growing demand.

Since import is one of the indicators for unsatisfied demand, current (2007) unsatisfied demand is estimated at 5,000 tonnes.

2. Projected Demand

Particle board is mainly used for ceilings, partitions, etc. Hence, its demand is mainly associated with the growth of the building construction sector. Since the government as

well as the private sector are undertaking various developmental projects, demand for building construction materials is believed to increase by a substantial amount. For the purpose of this project, annual growth rate of 8% is applied by taking the current unsatisfied demand. The projected unsatisfied demand is given in Table 3.3.

Table 3.3

PROJECTED UNSATISFIED DEMAND FOR PARTICLE BOARD

Year	Qty (Tonnes)
2008	5,400
2009	5,832
2010	6,298
2011	6,802
2012	7,347
2013	7,934
2014	8,569
2015	9,255
2016	9,995
2017	10,795

3. Pricing and Distribution

Based on average producers price (CSA) the factory-gate price of particle board is proposed to be Birr 2,705 per cub mt. The product can find its market outlet through the existing building materials distributors.

B. PLANT CAPACITY AND PRODUCTION PROGRAMME

1. Plant Capacity

The feasible normal capacity of particle board to be used as panels for walls is 5,000 m^3. This production capacity is assumed to be arrived at by operating the plant for 300 days, and single shift operation for 8 hours per day.

2. Production Programme

The envisaged plant will operate at 65% of full capacity during the first year. Such start up of production at low capacity is very important inorder to facilitate the development of market outlets, ensure the availability of raw material, and skill development of production workers. The plant will then raise production to 75% and 85% during the second and third year of operation. The plant will reach full capacity (100%) production during the fourth year and will continue at full capacity production during the successive years. Table 3.4 below indicates production build-up programme of the particle board plant.

Table 3.4

PRODUCTION PROGRAMME

Year	**1**	**2**	**3**	**4 and above**
Capacity utilization (%)	65	75	85	100
Production (m^3)	3250	3750	4250	5000

IV. MATERIALS AND INPUTS

A. RAW AND AUXILIARY MATERIALS

The basic raw materials required for the production of particle board are wooden particles, wax and resin. The wooden particles are prepared from logs of trees that contain low concentration of sugar and other poisons. When trees are felled, the log normally contains high concentration of sugar, molecular carbohydrate and tanin. In order to reduce this high poison concentration, it is necessary to debark the logs immediately and store them in a log yard for two to three months.

The sugar content in wood decreases linearly with storage time, allowing the fungus ascomyceles to attack and assimilate the free sugar. However, a further extension of the storage time enables the fungus to activate more, which has the effect of breaking down the hemicelluloses into glucose, increasing the sugar content.

In Ethiopia, two species have been tested and found to be suitable for particle board production. These are eucalyptus globules and cypress.

These are fast growing species suitable for industrial use. Of the two, eucalyptus globules grows much faster than cypress. The total wood requirement of the envisaged plant will be 35 solid metre cube per day or 10,500 solid metre cube per year when working at full capacity. But since the plant will start operations with only 65% capacity, increasing to 75%, 85% and 100% in the 2^{nd}, 3^{rd} and 4^{th} year, respectively, the corresponding requirement of wood will be 6825, 7875, 8925 and 10,500 solid metre cube per year, respectively.

Other major raw materials are wax and resin. These are used as a bonding agent for wood particles.

Auxiliary materials for the envisaged particle board plant include barrels for holding resin, and plastic containers for wax.

Annual requirement of raw and auxiliary materials together with annual costs are given in Table 4.1 below.

Table 4.1

ANNUAL REQUIREMENT OF RAW AND AUXILIARY MATERIALS (AT FULL CAPACITY)

Sr. No.	Description	Qty	Cost ('000 Birr)
	A. Raw Material		
1	Wood (M3)	2,625	1,706.25
2	Resin (kg)	8,500	102.425
3	Wax (kg)	1,250	58.125
	Sub-total		1,866.80
	B. Auxiliary Materials		
1	Metallic barrels (pcs)	100	15
2	Other inputs (plastic containers)	Req.	30
	Sub –total		**45**
	Total		**1,911.80**

B. UTILITIES

Inputs required for the particle board plant are electricity, water, furnace oil, grease and lubricant. Annual requirement at full production capacity is given in Table 4.2.

Table 4.2

ANNUAL REQUIREMENT OF UTILITIES AND COST

Sr. No.	Description	Qty	Cost (000 Birr)
1	Electricity (kWh)	280,000	132.72
2	Water (M^3)	20,000	200
3	Furnace oil (tonne)	1,100	5,951
4	Grease and lubricants	Reqd	25
	Total		**6,308.72**

V. TECHNOLOGY AND ENGINEERING

A. TECHNOLOGY

1. Production Process

The production process consists of storage of raw materials and auxiliaries, flaking, storage, milling, screening, storage, mixing, forming, pressing curing, maturing and climatizing.

The eucalyptus logs cut to size will be transported to the plant by trucks. Debarking of the logs can be carried out at the site manually or by using a special debarking machine at the plant. The debarked logs will be stored in separate piles in the wood yard according to the order of the dates they are cut. They will be kept in the yard for 3 months to reduce the sugar content.

The resin will be transported to the plant in metallic barrels.

Fork lift trucks are used to handle logs to flaking machine. The rotating drum of the flaker, mounted with blades will cut the logs parallel to the grains, producing flakes of 0.3 to 0.4 mm thickness. The flakes are then fed to the hammer mill where the flake sizes will be further reduced and disintegrated. The flakes are then transported to mixer where particles & resin and wax are properly mixed. The mixers are double-deck containers, the upper decks being mixing chambers and the lower decks serving as temporary storage chambers. The flakes, resin and other ingredients are thoroughly mixed in the upper chamber, and then discharged to the lower chamber through flap valves. Then the mixture is passed to a forming machine. The forming unit consists of three forming heads (machines) located one after the other along and above the caul conveyor. The up stream and down-stream forming heads will mould the lower and upper surface layers of the mat, respectively. The forming head in the middle will mould the core or coarse layer of the mat.

The mats passing the weight control section will be stacked, with the cauls one upon the other, by a piling machine on an open clamp carriage. The clamped carriage with mats and cauls will then be conveyed to the hardening chamber by a transfer plat from on rails.

After 6 to 8 hours the clamped carriage will be removed from the chamber and returned to the hydraulic press. Then the pile passes over to the de-piling machine where the boards will be separated from the steel cauls. After depiling the boards will be passed through an edge trimming saw where the irregular and soft parts of the edges are removed.

The boards will then be stacked on pallets to facilitate transport by fork-lift trucks to the maturing storage area where they will be stored for some day till they attain final strength. Then the boards are passed to final sizing and trimming station. Sizing is done by two double end sizing disc saws in tandem. Then the boards are finally graded based on physical inspection of the surface and thickness measurement of the boards.

2. Source of Technology

Machinery for particle board manufacturing are produced in different countries in Europe and Far East. Address of a machinery supplier is given below.

Sigema Wood Working
China
Tel: +86-512-6586-8021
Fax: +86-512-6762-3397

B. ENGINEERING

1. Machinery and Equipment

The machinery and equipment required by the particle board (resin-bonded) plant is given in Table 5.1 below.

Table 5.1

MACHINERY AND EQUIPMENT REQUIREMENT AND COST

Sr. No.	Description	Qty	Cost ('000 Birr)		
			LC	FC	TC
1	Flaking machine	1			
2	Hammer mill	1			
3	Screening machine	1			
4	Intensive mixer	1			
5	Forming machine	1			
6	Conveyors (various types)	Set			
7	Down stroke press	1			
8	Piling machine	1			
9	Desctacking, machine	1			
10	Caul cleaning unit	1			
11	Caul handling station	1			
12	Hydraulic lifting plet from	1			
13	Roller and belt conveyors	Reqd			
14	Trimming saw	1			
15	Stake carriage	1			
16	Boiler plant	Set			
17	Auxiliary equipment	Reqd			
	FOB price		-	7,285	7,285
	Bank, Insurance, Customs, Material Handling Costs		1,735	-	1,735
	CIF Landed Cost		**1,735**	**7,285**	**8,675**

2. Land, Building and Civil Works

The total land requirement of particle board plant is expressed interms of land for factory building, land required for storage of raw materials and finished products, land required for non-factory buildings (such as administrative building, caferea, medical facilities and general purpose buildings.

Thus, for the purpose of this plant buildings for production, store houses, administrative houses are estimated to cover a total area of 7,000 m^2 considering the future expansion potential of the plant, and land required for other purposes, the total land requirement will be 20,000 m^2. At a land lease rate of Birr 1.0, the total land lease value for 80 years will

be Birr 1.6 million. At a unit building cost of Birr 1,500, the cost of building will be Birr 10.5 million. This cost includes expenditures on site preparation and development.

Thus, the total cost of land, building and civil works will then be Birr 12.10 million.

3. Proposed Location

The location of particle board plant is basically raw material oriented. The two materials, wood and resin are bulky and require a well planned transport programme. Three woredas are identified for the purpose of this study. Accordingly to the Resource Potential Assessment (IPS, 2006) Gewata, Masha and Maji are endowed with wood plantation, and there are 50 saw mills eagaged in the production of various products of wood. The required raw materials can easily be procured. Among the identified woredas, Gewata is the the one selected. Therefore, it is appropriate to establish the plant in Keboch town.

VI. MANPOWER AND TRAINING REQUIREMENT

A. MANPOWER REQUIREMENT

The plant requires manpower both for operating production equipment and for accomplishing administrative work. The details of manpower requirement including monthly salary and annual expenditure is shown in Table 6.1.

B. TRAINING REQUIREMENT

Technical personnel of the plant will have to be given appropriate training to guarantee the success of the project. The technical manager, production head, foreman, maintenance experts, quality controllers, the electrician and mechanics and machinery operators should be trained by the experts of machinery supplier. Special contractual agreement is required with the machinery supplier to include the training programme during erection and commissioning of the production equipment. It is recommended that a two-month training programme shall be conducted. To execute the training programme a total of Birr 30,000 is earmarked.

Table 6.1

MANPOWER REQUIREMENT AND LABOUR COST

Sr. No.	Job title	Qty	Monthly Salary	Annual Expenditure
	A. Administration			
1	Plant manager	1	2,200	26,400
2	Executive secretary	1	800	9,600
3	Store man	1	900	10,800
4	Sales man	1	900	10,800
5	Accountant	1	700	8,400
6	Secretary	1	450	5,400
7	Accountant	1	750	9,000
8	Clerk	1	400	4,800
9	General services	6	250	18,000
	Sub-total	**14**		**103,200**
	B. Production			
1	Production head	1	1,500	18,000
2	Technical manager	1	1,500	18,000
3	Foreman	1	1,000	12,000
4	Operators	10	700	84,000
5	Unskilled labor	4	280	13,440
6	Technician	2	650	15,600
7	Quality controller	1	1,000	12,000
8	Maintenance expert	2	650	15,600
	Sub-total	**22**		**188,640**
	Workers Benefit (25% BS)			72,960
	Total Cost	**36**		**364,800**

VII. FINANCIAL ANALYSIS

The financial analysis of the particle board 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	8.5 %
Discount cash flow	8.5 %
Accounts receivable	30 days
Raw material local	30 days
Work in progress	3 days
Finished products	30 days
Cash in hand	10 days
Accounts payable	30 days

A. TOTAL INITIAL INVESTMENT COST

The total investment cost of the project including working capital is estimated at Birr 23.79 million, of which 23 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	1,600.0
2	Building and Civil Work	10,500.0
3	Plant Machinery and Equipment	9,020.0
4	Office Furniture and Equipment	75.0
5	Pre-production Expenditure*	1,715.8
6	Working Capital	887.5
	Total Investment cost	**23,798.4**
	Foreign Share	23

** N.B Pre-production expenditure includes interest during construction (Birr 1.41 million) training (Birr 30 thousand) and Birr 270 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 11.21 million (see Table 7.2). The material and utility cost accounts for 73.32 per cent, while repair and maintenance take 2.23 per cent of the production cost.

Table 7.2

ANNUAL PRODUCTION COST AT FULL CAPACITY ('000 BIRR)

Items	Cost	%
Raw Material and Inputs	1,911.80	17.05
Utilities	6308.72	56.27
Maintenance and repair	250	2.23
Labour direct	261.6	2.33
Administration Costs	103.2	0.92
Total Operating Costs	8,835.32	78.81
Depreciation	1434.5	12.80
Cost of Finance	941.27	8.40
Total Production Cost	**11,211.09**	**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) is estimated by using income statement projection.

$$BE = \frac{\text{Fixed Cost}}{\text{Sales} - \text{Variable Cost}} = 16\ \%$$

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 15.45 % and the net present value at 8.5 % discount rate is Birr 5.59 million.

D. ECONOMIC BENEFITS

The project can create employment for 36 persons. In addition to supply of the domestic needs, the project will generate Birr 4.54 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.