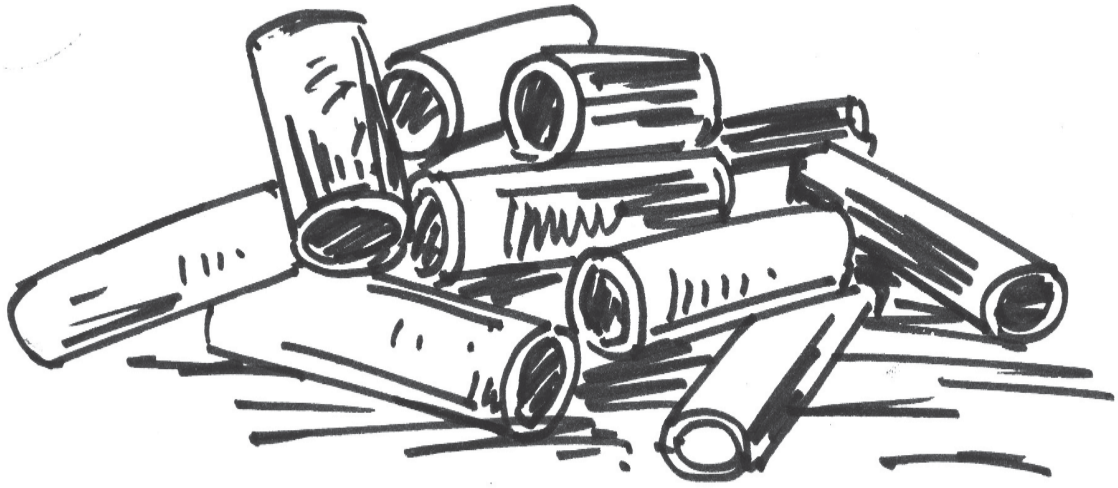
BAMBOO CHARCOAL



1.0 INTRODUCTION

Charcoal made from bamboo finds ready uses and markets. It has been made for thousands of years in pits and even shallow depressions. Specially designed brick kilns, developed and tested by the National Mission on Bamboo Applications (NMBA), provide an opportunity to make high-quality charcoal from bamboo in an efficient, safe and reliable manner.

Charcoal is a product with many uses, in industry and in the domestic sector. It is utilised:

- at the village level, by blacksmiths and to meet household energy requirements;

- in the domestic sector, as fuel for cooking and heating;

- in the service sector, by dhobis and in dhabas;

- in the industrial sector, at different scales of activity, in furnaces, for forging and metal-working;

- as raw material for further processing into activated carbon and other industrial products.

Charcoal made from bamboo has good properties, similar to wood and other ligno-cellulosic material in terms of high carbon content and calorific value.

Charcoal is produced by heating biomass with a controlled supply of air. This can be done by the conventional pit method, in brick or metal kilns, or in drums. Heating can be direct by igniting the biomass or it can be indirect. Carbonisation in a brick kiln produces uniform-quality charcoal with good yield and low investment.

2.0 RAW MATERIAL

- Any species of bamboo can be used for making charcoal.

- 4–5-year-old bamboo makes the best charcoal. It has by then attained its maximum bio-mass, and its moisture and starch levels have lowered.

- To get the best yield of charcoal, the moisture content of bamboo should be around 20 to 25 per cent. In the monsoon or other rainy periods, bamboo will have higher moisture content. At such times, the bamboo should be left to dry for some time before conversion to charcoal. (For large-scale operations, dryers can be used to bring down the moisture levels.)

- In many applications, the upper and lower portions of bamboo culms are not used, and are often thrown away. These can be used in charcoal-making. Lops and tops of bamboo culms and thicker branches can be used too. Processed waste from stick and sliver units consists of a large amount of particulate matter. Such particulate matter cannot be used in these kilns to make charcoal.

3.0 KILN STRUCTURE

The kiln is hemispherically shaped and has a diameter of 3 metres, made of clay bricks, mud and mortar. It has a rectangular opening at the bottom. Through this opening,

raw bamboo is loaded into the kiln. After conversion, charcoal is taken out through the same opening. The capacity of the Kiln is 2.5–3.5 tons while the volume capacity is 14 cubic metres.

4.0 PROCESS DETAILS:

Step 1: Sizing of Bamboo

- Sizing of bamboo is the first step. The size of the end-product (charcoal) is related to the size of the bamboo placed in the kiln.

- Whole bamboo culms need to be cut to the required size. If the bamboo section is too large, it will not fit into the kiln. The maximum length of any section should be 2.5 metres. The minimum acceptable size is 5 centimetres.

- Homogeneity of size in a batch will make stacking easier and produce better results.

- For every batch, a small quantity of bamboo need to be sized between 10 and 12 centimetres; this will help in kindling the material.

Step 2: Charging of the Feed

- Place the bamboo in the kiln through the door at the bottom. Stack the bamboo horizontally in the kiln.

- Close the door with bricks, and plaster the outer face of the door with mud to provide better insulation and prevent leakage.

- Fire the feed from the opening at the top of the kiln.

- Close the opening at the top of the kiln after the feed has been ignited.

- The openings in the wall of the kiln should be kept open during the initial stages of firing to create the required draft.

- Initially, black smoke will be emitted from the openings in the wall at the upper end. The emission of smoke will gradually spread to the openings at the lower end of the kiln.

- Close the openings in the top rows once the black smoke changes to dense white fumes.

- Close all the openings one by one starting at the top row as the black smoke changes colour.

Step 3: Carbonisation

- Initially regulate a few openings (open/close) across the kiln in both horizontal and vertical directions, to create a draft and enable uniform carbonisation.

- In case a temperature sensor is available,maintain the temperature at 400–550°C by regulating the openings. The temperature should not be allowed to drop below 350°C as this will lead to incompletecarbonisation. The temperature should not rise above 500° C as this will cause the biomass to burn and provide ash instead of charcoal.

- In case a sensor is not available, estimate the temperature. Over time, workers will acquire the necessary skills and experience to regulate the openings even without the use of sensors.

Step 4: Cooling

- Close all openings after 2 days.

- Do not allow air to enter the kiln at this juncture to prevent the charcoal from catching fire.

- Cooling will take a day. The objective is to reduce the kiln temperature to 100° C to allow the charcoal to be safely extracted.

Step 5: Extraction of charcoal

- Break through the opening at the bottom of the kiln.

- In case the char is too hot to handle, sprinkle a small quantity of water. Excessive watering will lower the quality of the charcoal.

- Remove the charcoal carefully to a storage point for disposal.

Step 6: Cleaning

- Clean the kiln of charcoal and residues.

5.0 COST OF THE PROJECT

The estimated project cost is given below.

Particulars	Amount (Rs lacs)
Land & Site Development	-
Construction of Kilns	2.50
Miscellaneous Assets	0.20
Preliminary & Pre-operative Expenses	0.38
Working Capital	4.27
TOTAL	7.35

5.1 Land & Site Development: No cost has been considered for land & site development. It is assumed that the unit will be set up in own land.

5.2 Construction of Kilns: Details of construction of kilns are given below.

Particulars	Quantity	Rate (Rs)	Amount (Rs)
Kilns (3000 kg capacity, made with clay bricks, mud and mortar)	10	25000	250000
		TOTAL	250000
		Say (Rs. in lacs)	2.50

5.3 Miscellaneous Assets: Details of miscellaneous assets are given below.

Particulars	Qty	Rate (Rs)	Amount (Rs)
Implements	LS	LS	15000
Miscellaneous items	LS	LS	5000
		TOTAL	20000
		Say (Rs. in lacs)	0.20

5.4 Preliminary & Pre-operative Expenses: Details of preliminary & pre-operative expenses are given below.

(Rs. In lacs)

Particulars	Amount (Rs)
Travelling expenses	0.10
Fees	0.10
Interest during implementation	0.08
Miscellaneous expenses	0.10
TOTAL	0.38

5.5 Working Capital: Details of working capital are given below.

(Rs. In lacs)

	Period (Months)	Amount (Rs)		
		Yr 1	Yr 2	Yr 3
Raw materials & consumables	1	1.17	1.40	1.64
Salary	1	0.20	0.20	0.20
Finished Goods	1	1.40	1.64	1.88
Receivables	1	1.50	1.80	2.10
Total		4.27	5.04	5.81
Working capital margin in Yr 1 (100%)	4.27			

6.0 MEANS OF FINANCE

The means of finance for the project is estimated as below.

Particulars	Percent	Amount (Rs. lacs)
EQUITY		
A. Equity from Promoters	40%	2.94
B. Subsidy from Central/State Govt.	-	
DEBT		
Term Loan from Banks/FIs	60%	4.41
TOTAL	100%	7.35

7.0 PROFITABILITY STATEMENT

(Rs. in lacs)

Particulars	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5
A. INCOME					
Production capacity (kg/annum)	360000	360000	360000	360000	360000
Capacity utilisation	50%	60%	70%	70%	70%
Production/annum at capacity utilisation	180000	216000	252000	252000	252000
Price/kg of charcoal (Rs)	10	10	10	10	10
Total income/annum	18.00	21.60	25.20	25.20	25.20
B. OPERATING EXPENSES					
Raw Materials & Consumables	14.04	16.85	19.66	19.66	19.66
Salary	2.40	2.40	2.40	2.40	2.40
Repair & Maintenance	0.06	0.07	0.09	0.11	0.14
Selling Expenses	0.18	0.22	0.25	0.25	0.25
Miscellaneous Expenses	0.09	0.11	0.13	0.13	0.13
Total Operating Expenses	16.77	19.64	22.52	22.54	22.57
Operating profit	1.23	1.96	2.68	2.66	2.63
C. FINANCIAL EXPENSES					
Depreciation	0.10	0.10	0.10	0.10	0.10
Interest on Term Loan	0.35	0.29	0.21	0.13	0.04
Net Profit	0.79	1.57	2.37	2.43	2.49
Net cash accruals	0.88	1.66	2.47	2.53	2.58
Principal Repayment	0.26	1.04	1.04	1.04	1.04

7.1 Estimation of Production Capacity: Production of bamboo charcoal at installed capacity is estimated as below.

Capacity of kilns (kg/batch of raw material)	3000
Charcoal yield (%)	25%
Yield of charcoal/batch/kiln (kg)	750
Batches/month	4
Months/annum	12
Production of charcoal/kiln/annum	36000
No. of kilns	10
Production of charcoal per annum at installed capacity (kg)	360000

7.2 Raw Materials & Consumables: Expenses on raw materials & consumables at installed capacity is estimated as below.

Raw material (bamboo) required/ batch (kg)	3000
Batches/month	4
Months/annum	12
No. of kilns	10
Quantity of bamboo required/annum (kg)	1440000
Average weight of individual bamboo culms (kg)	10
Quantity of bamboo culms required	144000
Price of individual bamboo culms in situ (Rs)	15
Expenses on raw material at 100% capacity (Rs)	2160000
Add: Consumables, transportation, etc @ 25%	648000
Expenses on raw materials & consumables at installed capacity (Rs)	2808000

7.3 Salary: Expenses on salary per annum is estimated as given below.

Particulars of Employees	Numbers	Salary/Month (Rs)	Cost/annum (Rs)
Manager (Self)	0	0	0
Kiln operators	4	5000	240000
Expenses on salary per annum (Rs)			240000

7.4 Repair & Maintenance: Expenses on repair & maintenance in the 1st year is estimated as given below. It is assumed that expenses on repair & maintenance will increase @ 25% every subsequent year.

Particulars	Cost (Rs)	Rate	Amount (Rs lacs)
Kilns	2.50	2%	0.05
Miscellaneous Assets	0.20	3%	0.01
Expenses on repair & maintenance in the 1st year (Rs)			0.06

7.5 Selling Expenses: Selling expenses have been assumed at 1% of sales.

7.6 Miscellaneous Expenses: Miscellaneous expenses have been assumed at 0.5% of sales.

7.7 Depreciation: Depreciation has been calculated by straight line method. The details of calculation are given below.

Description	Cost (Rs)	Rate	Amount/ annum (Rs lacs)
Kilns	2.50	3.34%	0.08
Miscellaneous Assets	0.20	7.07%	0.01
TOTAL			0.10

7.8 Interest on Term Loan & Principal Repayment: Interest rate has been assumed at 8% per annum. Duration of Loan repayment has been considered for a period of 5 years including moratorium period of 9 months with equal monthly installments. The details of calculation are given below.

(Rs in lacs)

Month	Year	1	2	3	4	5
Month 1	Opening balance	4.41	4.15	3.11	2.08	1.04
	Repayment	0.00	0.09	0.09	0.09	0.09
	Interest (8%)	0.03	0.03	0.02	0.01	0.01
	Closing balance	4.41	4.07	3.03	1.99	0.95
Month 2	Opening balance	4.41	4.07	3.03	1.99	0.95

	Repayment	0.00	0.09	0.09	0.09	0.09
	Interest	0.03	0.03	0.02	0.01	0.01
	Closing balance	4.41	3.98	2.94	1.90	0.86
Month 3	Opening balance	4.41	3.98	2.94	1.90	0.86
	Repayment	0.00	0.09	0.09	0.09	0.09
	Interest	0.03	0.03	0.02	0.01	0.01
	Closing balance	4.41	3.89	2.85	1.82	0.78
Month 4	Opening balance	4.41	3.89	2.85	1.82	0.78
	Repayment	0.00	0.09	0.09	0.09	0.09
	Interest	0.03	0.03	0.02	0.01	0.01
	Closing balance	4.41	3.81	2.77	1.73	0.69
Month 5	Opening balance	4.41	3.81	2.77	1.73	0.69
	Repayment	0.00	0.09	0.09	0.09	0.09
	Interest	0.03	0.03	0.02	0.01	0.00
	Closing balance	4.41	3.72	2.68	1.64	0.61
Month 6	Opening balance	4.41	3.72	2.68	1.64	0.61
	Repayment	0.00	0.09	0.09	0.09	0.09
	Interest	0.03	0.02	0.02	0.01	0.00
	Closing balance	4.41	3.63	2.59	1.56	0.52
Month 7	Opening balance	4.41	3.63	2.59	1.56	0.52
	Repayment	0.00	0.09	0.09	0.09	0.09
	Interest	0.03	0.02	0.02	0.01	0.00
	Closing balance	4.41	3.55	2.51	1.47	0.43
Month 8	Opening balance	4.41	3.55	2.51	1.47	0.43
	Repayment	0.00	0.09	0.09	0.09	0.09
	Interest	0.03	0.02	0.02	0.01	0.00
	Closing balance	4.41	3.46	2.42	1.38	0.35
Month 9	Opening balance	4.41	3.46	2.42	1.38	0.35
	Repayment	0.00	0.09	0.09	0.09	0.09
	Interest	0.03	0.02	0.02	0.01	0.00
	Closing balance	4.41	3.37	2.34	1.30	0.26
Month 10	Opening balance	4.41	3.37	2.34	1.30	0.26
	Repayment	0.09	0.09	0.09	0.09	0.09
	Interest	0.03	0.02	0.02	0.01	0.00
	Closing balance	4.32	3.29	2.25	1.21	0.17
Month 11	Opening balance	4.32	3.29	2.25	1.21	0.17
	Repayment	0.09	0.09	0.09	0.09	0.09
	Interest	0.03	0.02	0.01	0.01	0.00
	Closing balance	4.24	3.20	2.16	1.12	0.09
Month 12	Opening balance	4.24	3.20	2.16	1.12	0.09
	Repayment	0.09	0.09	0.09	0.09	0.09
	Interest	0.03	0.02	0.01	0.01	0.00
	Closing balance	4.15	3.11	2.08	1.04	0.00
Principal Repayment		0.26	1.04	1.04	1.04	1.04
Interest		0.35	0.29	0.21	0.13	0.04

8.0 DEBT SERVICE COVERAGE RATIO (DSCR)

(Rs. in lacs)

Year	1	2	3	4	5	TOTAL
Profit After Tax (Net Profit)	0.79	1.57	2.37	2.43	2.49	
Depreciation	0.10	0.10	0.10	0.10	0.10	
Interest	0.35	0.29	0.21	0.13	0.04	
Total	1.23	1.96	2.68	2.66	2.63	11.16

Interest	0.35	0.29	0.21	0.13	0.04	
Loan repayment	0.26	1.04	1.04	1.04	1.04	
Total	0.61	1.33	1.25	1.17	1.08	5.44
DSCR	2.02	1.47	2.14	2.28	2.43	

Average DSCR = 2.05

9.0 BREAK EVEN POINT (BEP)

(Rs. in lacs)

Year	1	2	3
A. Net sales (Rs. lakh)	18.00	21.60	25.20
B. Variable cost			
Raw Materials & Consumables	14.04	16.85	19.66
Selling Expenses	0.18	0.22	0.25
Miscellaneous Expenses	0.09	0.11	0.13
Total variable cost	14.31	17.17	20.03
C. Contribution (A-B)	3.69	4.43	5.17
D. Fixed & Semi-fixed Costs			
Salary	2.40	2.40	2.40
Repair & maintenance	0.06	0.07	0.09
Interest on Term Loan	0.35	0.29	0.21
Depreciation	0.10	0.10	0.10
Total fixed cost	2.90	2.86	2.80
E. BREAK EVEN POINT	78.72%	64.63%	54.13%
F. BEP at operating capacity	39.36%	38.78%	37.89%
G. Cash BEP	38.04%	37.45%	36.57%

10.0 INTERNAL RATE OF RETURN (IRR)

(Rs. in lacs)

Year	0	1	2	3	4	5
CASH OUTFLOW						
Capital Expenditure	2.70	0.00	0.00	0.00	0.00	0.00
Working Capital	0.00	4.27	0.77	0.77	0.00	0.00
Total (A)	2.70	4.27	0.77	0.00	0.00	0.00
CASH INFLOW						
Profit After Tax		0.79	1.57	2.37	2.43	2.49
Add: Depreciation		0.10	0.10	0.10	0.10	0.10
Add: Interest		0.35	0.29	0.21	0.13	0.04
Add: Salvage Value						
Total (B)	0.00	1.23	1.96	2.68	2.66	2.63
NET FLOW (B-A)	-2.70	-3.03	1.18	2.68	2.66	2.63

IRR = 16%

TECHNICAL CONSULTANT

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