DETAILED PROJECT REPORT
ON
ENERGY EFFICIENT MELTING AND REHEATING FURNACE
(250 KG CAPACITY – RICE HUSK COMMON FACILITY)
(BHUBANESHWAR BRASS CLUSTER)











ENERGY IS LIFE
BEE
CONSERVE IT

Bureau of Energy Efficiency

Prepared By

Energy
Environment
Let's conserve

Reviewed By

ISTSL

Bureau of Energy Efficiency (BEE)
(Ministry of Power, Government of India)
4th Floor, Sewa Bhawan, R. K. Puram, New Delhi – 110066
Ph.: +91 – 11 – 26179699 (5 Lines), Fax: +91 – 11 – 26178352
Websites: www.bee-india.nic.in, www.energymanagertraining.com

SEE-Tech Solutions Pvt. Ltd
11/5, MIDC, Infotech Park,
Near VRCE Telephone Exchange,
South Ambazari Road,
Nagpur – 440022
Website: www.letsconserve.org

India SME Technology Services Ltd
DFC Building, Plot No.37-38,
D-Block, Pankha Road,
Institutional Area, Janakpuri, New Delhi-110058
Tel: +91-11-28525534, Fax: +91-11-28525535
Website: www.techsmall.com

ENERGY EFFICIENT MELTING AND REHEATING FURNACE (250 KG-RICE HUSK COMMON FACILITY MODERN UNIT)

BHUBANESHWAR BRASS CLUSTER

BEE, 2010

Detailed Project Report on Energy Efficient Melting and Reheating Furnace (250 kg Rice Husk Common Facility Modern Unit)

Brass SME Cluster, Bhubaneshwar, Orissa (India)

New Delhi: Bureau of Energy Efficiency;

Detail Project Report No.: ***BUB/BRS/CFU/15***

For more information

Bureau of Energy Efficiency
Ministry of Power, Government of India
4th Floor, Sewa Bhawan, Sector – 1
R. K. Puram, New Delhi -110066

Ph: +91 11 26179699 Fax: 11 26178352
Email: jsood@beenet.in
pktiwari@beenet.in
WEB: www.bee-india.nic.in

Acknowledgement

We are sincerely thankful to the Bureau of Energy Efficiency, Ministry of Power, for giving us the opportunity to implement the 'BEE SME project in "Bhubaneswar Brass Cluster". We express our sincere gratitude to all concerned officials for their support and guidance during the conduct of this exercise.

Dr. Ajay Mathur, Director General, BEE

Smt. Abha Shukla, Secretary, BEE

Shri Jitendra Sood, Energy Economist, BEE

Shri Pawan Kumar Tiwari, Advisor (SME), BEE

Shri Rajeev Yadav, Project Economist, BEE

See-Tech Solution Pvt. Ltd. is also thankful to "Shri Lingaraj Sahoo, Secretary, Brajamohanjee Yuvak Sangh" for their valuable inputs, co-operation, support and identification of the units for energy use and technology audit studies and facilitating the implementation of BEE SME program in Bhubaneswar Brass Cluster.

We take this opportunity to express our appreciation for the excellent support provided by Brass Unit Owners, Local Service Providers, and Equipment Suppliers for their active involvement and their valuable inputs in making the program successful and in completion of the Detailed Project Report (DPR).

See-Tech is also thankful to all the SME owners, plant in charges and all workers of the SME units for their support during the energy use and technology audit studies and in implementation of the project objectives.

See-Tech Solution Pvt. Ltd.

Nagpur

Contents

List of Annexure

List of Tables

List of Figures

List of Abbreviations

BEE	Bureau of Energy Efficiency
MSME	Micro Small and Medium Enterprises
DPR	Detailed Project Report
PG	Producer Gas
GHG	Green House Gases
CDM	Clean Development Mechanism
DSCR	Debt Service Coverage Ratio
NPV	Net Present Value
IRR	Internal Rate of Return
ROI	Return on Investment
WHR	Waste Heat Recovery
MoMSME	Ministry of Micro Small and Medium Enterprises
SIDBI	Small Industries Development Bank of India

EXECUTIVE SUMMARY

SEE-Tech Solution Pvt. Ltd. has executed BEE-SME program in Bhubaneshwar Brass Cluster, supported by Bureau of Energy Efficiency (BEE) with an overall objective of improving the energy efficiency in cluster units.

Bhubaneshwar cluster is one of the brass clusters in India; accordingly this cluster was chosen for energy efficiency improvements by implementing energy efficient measures / technologies, so as to facilitate maximum replication in other brass clusters in India.

The main energy forms used in these cluster units are Hard Coke and Charcoal. Hard Coke is used in the melting furnace and Charcoal is used in the reheating furnace. Operations involved in manufacturing of brass utensils like Thali, ghara, lamp etc in majority of the brass units are manual and are carried out by hand operated machines. Production of brass utensils is totally dependent on the availability of the skilled manpower.

Project implementation will lead to reduction in energy consumption cost in melting and reheating furnace due to huge difference in the cost of rice husk and the presently used fuels as Hard Coke and charcoal in this cluster. Also improves the final product quality due to use of the modern technologies for casting and the finishing of the brass utensils thereby increase in the annual turnover of the brass unit.

This bankable DPR also found eligible for subsidy scheme of MoMSME for “Technology and Quality Upgradation Support to Micro, Small and Medium Enterprises” under “National Manufacturing and Competitiveness Programme”. The key indicators of the DPR including the Project cost, debt equity ratio, monetary benefit and other necessary parameters are given in table:

S.No	*Particular*	*Unit*	*Value*
1	Project cost	₹ (in Lakh)	37.76
2	Monetary benefit	₹ (in Lakh)	14.02
3	Debit equity ratio	Ratio	3:1
4	Simple payback period	years	2.69
5	NPV	₹ (in Lakh)	11.58
6	IRR	%	18.70
7	ROI	%	24.47
8	Process down time	Days	NA*

The projected profitability and cash flow statements indicate that the project implementation will be financially viable and technically feasible.

* Due to construction of new unit process down time is not applicable but due to shifting of plant & plant material it would take two days as shut down time.

ABOUT BEE'S SME PROGRAM

Bureau of Energy Efficiency (BEE) is implementing a BEE-SME Programme to improve the energy performance in 25 selected SMEs clusters. Bhubaneshwar Brass Cluster is one of them. The BEE's SME Programme intends to enhance the energy efficiency awareness by funding/subsidizing need based studies in SME clusters and giving energy conservation recommendations. For addressing the specific problems of these SMEs and enhancing energy efficiency in the clusters, BEE will be focusing on energy efficiency, energy conservation and technology up gradation through studies and pilot projects in these SMEs clusters.

***Major activities in the BEE -SME program are furnished below*:**

Energy Use and Technology Audit

The energy use technology studies would provide information on technology status, best operating practices, gaps in skills and knowledge on energy conservation opportunities, energy saving potential and new energy efficient technologies, etc for each of the sub sector in SMEs.

Capacity Building of Stake Holders in Cluster on Energy Efficiency

In most of the cases SME entrepreneurs are dependent on the locally available technologies, service providers for various reasons. To address this issue BEE has also undertaken capacity building of local service providers and entrepreneurs/ managers of SMEs on energy efficiency improvement in their units as well as clusters. The local service providers will be trained in order to be able to provide the local services in setting of energy efficiency projects in the clusters

Implementation of Energy Efficiency Measures

To implement the technology up gradation projects in clusters, BEE has proposed to prepare the technology based detailed project reports (DPRs) for a minimum of five technologies in three capacities for each technology.

Facilitation of Innovative Financing Mechanisms for Implementation of Energy Efficiency Projects

The objective of this activity is to facilitate the uptake of energy efficiency measures through innovative financing mechanisms without creating market distortion.

1 INTRODUCTION

1.1 Brief Introduction about Cluster

Bhubaneshwar brass cluster is a household & age old business which is slowly diminishing and is restricted to certain tribes / communities. In short, they are artisians. These units are in operation since 35 -40 years. Since its an low value business and an family run business wherein all the family members are engaged hence very few avail the bank facilities, that too Gramin Bank. The general turnover of the brass units is approximately ₹ 3 Lacs to ₹ 7 Lacs.

In this cluster, brass units are located in 4 different villages named as Balakati, Pratap Sasan and Rathijema - these three villages are adjacent to each other at a distance of about 22 Kms from the old city of Bhubaneshwar while the fourth village Bainchua is around 8 Kms from the old city of Bhubaneshwar. This cluster is traditional and community based, can also be called as “Kutir-Udyog”. Manufacturing activity in this cluster takes place at the backyard of the unit owner’s house.

There are approximately 200 brass units in this cluster which are engaged in manufacturing of brass articles like Thali, Goddess Idol, Aasan, Bati, Bela, Ghara, Lota, Diya and others. The brass units have not registered under any; these units are identified by the names of the fore-fathers.

As there is neither association nor any organized form of the units, which are in this business, there is no one to hear their issues / problems and the brass units are gradually dying.

All these units are running in a single shift and there is no usage of any technology, neither any equipment which consumes energy to a greater extent is being used. The equipment which is being used is only for polishing of the end product.

Majority of the cluster units are of integrated type, where the raw material is processed in-house to the final product. Table 1.1 shows the total energy consumption scenario at Bhubaneshwar Brass cluster.

Table 1.1 Details of Annual Energy Consumption Scenario at Bhubaneshwar Brass Cluster

S. No	Energy Type	Unit	Value	% Contribution in Equivalent Energy Terms
1	Electricity	KWh/year	15670	0.37
2	Hard Coke	MT/year	310	35.3
3	Charcoal	MT/year	359	64.4

Classification of Units

The brass units can be categorized into following three types based on product manufacture

S. No	Category	Products
1	A	Thali
2	B	Ghara, Lota, Diya, Bela etc
3	C	Handicrafts

Products Manufactured

Different types of products manufactured and their percentage share in Bhubaneshwar Brass cluster are as shown in Table 1.2 below.

Table 1.2 Product Manufactured

S. No	Type of Product	Category	% share	Units (No.).
1	Thali	A	54	65
2	Different varieties of brass articles like Lota, Bati, Bela, diya etc.	B	38	45
3	Handicrafts	C	8	10
Total (No.)[1]				120

[1] – *Out of total 200 brass units only 120 brass units are in operation.*

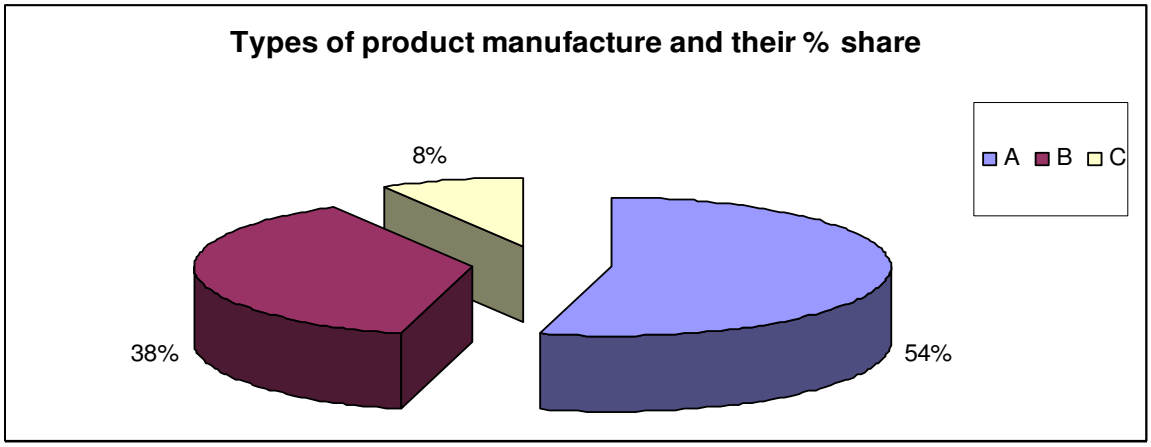


Figure 1.1: Different types products manufactured and their % share

Figure 1.2: Photographs for Overview of Bhubaneshwar Brass Cluster

Production Process

Manufacturing process and technology that are in use in Bhubaneshwar Brass Cluster are as follows.

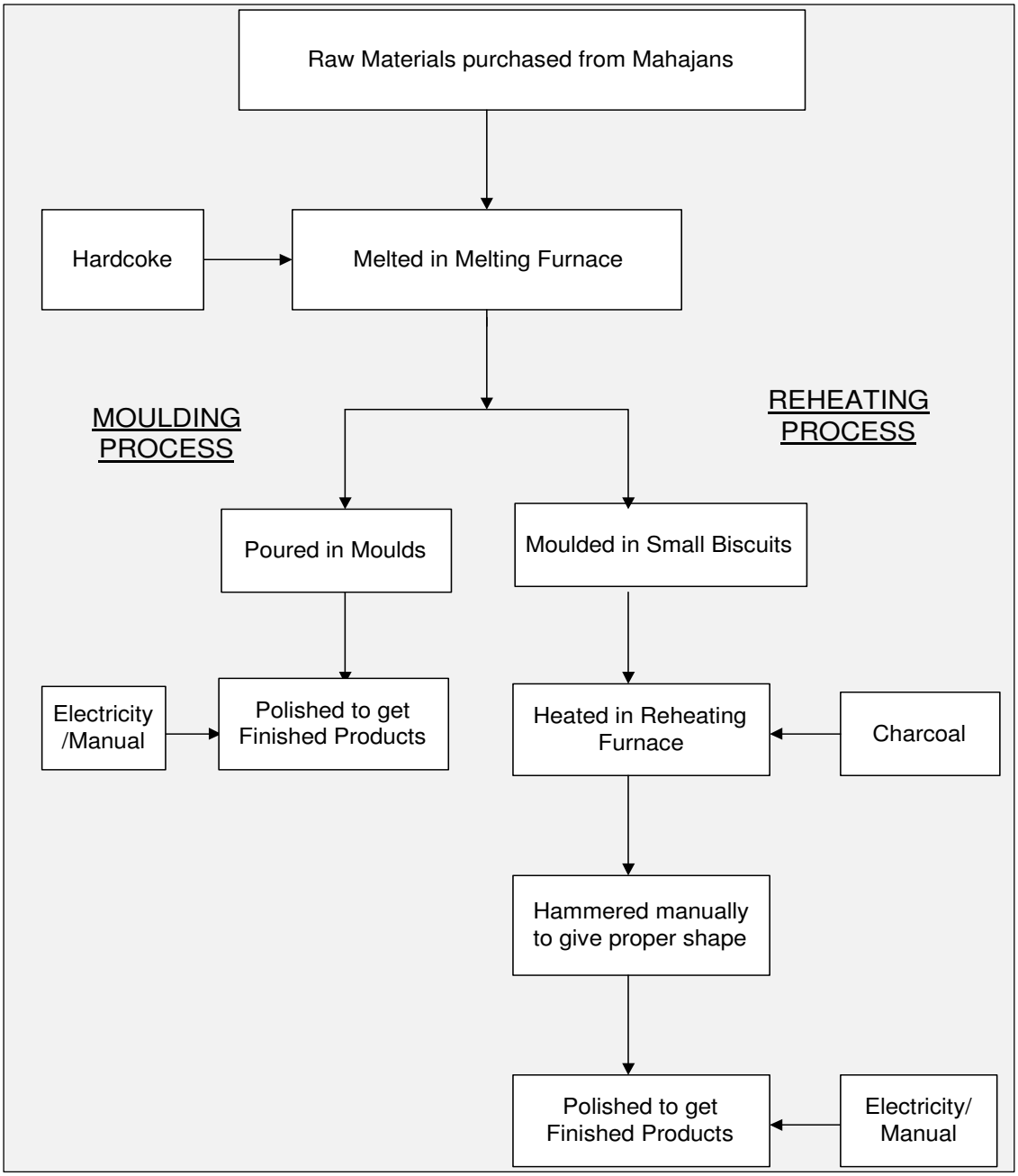


Figure 1.3 Process Flow Diagram of manufacturing of Brass Articles

Raw Materials:

The raw material for production of brass articles are Copper and Zinc and sometimes scrap vessels of Brass or Copper and Zinc, both the materials are locally sourced or obtained from Mahajans (Raw material supplier). Fuel used in melting furnace is Hardcoke; and the fuel used in reheating furnace is Charcoal. Hardcoke and Charcoal is obtained from local source at a comparatively much higher cost than available in the market.

Melting:

The melting furnace is a unique and important requirement in the processing of manufacture of brass metal products. The Melting Furnace or Chulla is utilized for the melting of raw material i.e. Copper and Zinc, scrap vessels of Brass. This melting furnace is prepared by the unit owners as per their traditional process. Melting furnace heats the raw material to a temperature of about 950 ^{o}C. At this temperature, raw material melts. Furnace is about 40-70 cms wide and 15-60 cm deep. Basic metals are kept inside the crucible and process of heating is carried on. The source of thermal energy used for melting is Hard Coke. The melting process is a batch process; it takes time around 5 to 6 hours depending upon quantity of raw material under processing. Around 2 to 4 batches carried out in a week depending on the capacity of unit.

Moulding & Casting:

The molten brass obtained from melting furnace is poured in suitable moulds i.e. Achhu for casting or moulding. The Achhu is prepared in different sizes shapes like thali, lota, bati, bela, ghara, diya etc keeping in view the quantity of the melted alloy is to be poured in it for different products. A small Koi called Dhal Koi is used for transporting the melted alloy from the Koi to pour into Achhu which is previously sterilized with Mobil oil. The molten alloy is allowed to remain sometime inside the Achhu to be cold. During the process of cooling, Tashu (rice head) is used after pouring the molten alloy. The rice head makes processing of cooling slow of the alloy. This cooled alloy is called Ghati.. The moulds of lota, ghara, diya are available so molten material can be easily transformed into these shapes.

Re - Heating:

The Reheating furnace is an open furnace build up on ground as per their traditional procedure. The furnace is built by just digging a hole of about 30-50 cm wide and 30-90 cm deep. Charcoal is used as a fuel in a reheating furnace. Temperature of about 800 ^{o}C is maintained inside the furnace.

Since in order to give the moulds a specific shape and size the moulded material are reheated in a Reheating Furnace and hammered, the moulded material are formed after moulding of melted raw

material from the melting furnace. This process requires more skill to give the ingot proper shape and size. For this different size of hammers, pincers, pathara (stone anvil), iron anvil etc. are required. This beating process also requires simultaneously heating and beating.

Beating:

The heated billet from the reheating furnace is taken out through pincers at a temperature of about 800 ^{o}C and is then hammered in a sequential and known fashion. In case of formation of Thali and other products, the beating is carried out from left to right on the heated billet by a group of hammer men. The heating & beating is a simultaneous process in order to bring it to a desired shape. The process is carried out by holding the moulded material by craftsmen over stone anvil and is beated by the hammer men to form concave size. Next step is to increase the height of the product beyond its circumferential base. Under this process, a hammer man takes the leading part in hammering of the product. The products formed by this technique are like thali, ghara, diya etc.

Scrapping:

After the process of beating the product scrapping is carried out by the artisans where if any portion of the body of the product unusually thick enough is removed. Thus scrapping is carried out for ensuring a uniformly thickness product and smoothness of product wherever required.

Polishing:

The finished products after molding or manual finishing are polished for shining look and more sooth surface. Machine used for polishing is either hand driven or electrically powered. This motor is connected to the main polishing part via pairs of flat belts. The finished products after polishing are sold to Mahajans.

1.2 Energy Performance in Existing Situation

1.2.1 Average Production

Annual production in typical unit in Bhubaneshwar brass cluster is given in Table 1.3.

Table 1.3 Annual production from a typical brass units

Sr. No	*Type of Brass Unit*	*Production (Kg/year)*	
	Scale of Unit	*Minimum*	*Maximum*
1	A	1920	4836
2	B	1728	6144
3	C	360	7680

1.2.2 Energy Consumption

Energy consumption (both electrical and thermal) in a typical brass unit for different types of product categories is given in Table 1.4.

Table 1.4 Annual Energy Consumption

Type of Brass Unit	Electricity (KWh per year)		Hard Coke (Kg per year)		Charcoal (Kg per year)	
Scale of Unit	Min	Max	Min	Max	Min	Max
A	0	378	1920	6240	3840	5760
B	0	492	1200	4200	1920	5760
C	404	893	4320	6720	0	0

Note: *Minimum electricity consumption in most of the brass units is zero because they are operating the blowers and the polishing machines manually.*

1.2.3 Specific Energy Consumption

Specific energy consumption both electrical and thermal energy per kg of product for different types of brass products manufacturing units is given in Table 1.5 below.

Table 1.5 Specific Energy Consumption in Different Brass Units

Type of Brass Unit	Electricity (KWh/Kg of Production)		Hard Coke (Kg/ Kg of Production)		Charcoal (KWh/Kg of Production)	
Scale of Unit	Min	Max	Min	Max	Min	Max
A	0	0.12	0.56	1.79	0.8	1.78
B	0	0.15	0.23	1.4	0.8	1.67
C	0.10	1.12	0.88	2	0	0

Note: *Minimum electricity consumption in most of the brass units is zero because they are operating the blowers and the polishing machines manually.*

1.3 Proposed Equipment

1.3.1 Description of Equipment

In a brass unit in this cluster, thermal energy is consumed in the melting and reheating furnaces. Hard coke is used as a fuel in melting furnace and charcoal is used in reheating furnace.

Melting Furnace is utilized for the melting of raw material i.e. Copper and Zinc, scrap vessels of Brass. Melting furnace is manufactured by the unit owners on their own as per their traditional method. In this furnace, temperature of around 950 ^{o}C is maintained. At this temperature, raw material melts. Furnace is about 40-70 cm wide and 15-60 cm deep. Basic metals are kept inside the crucible and process of heating is carried on.

The Reheating furnace is an open furnace build up on ground for reheating of the moulded material in order to give the moulds a specific shape and size. The furnace is built by just digging a hole of about 30-50 cm wide and 30-90 cm deep. Reheating furnace is also manufactured by the unit owners on their own as per their traditional method. The moulded material is formed by pouring the melted brass material from the melting furnace in suitable moulds. The brass biscuits obtained after moulding are reheated and hammered to give the proper shape for final finishing. The biscuits moulds are reheated in a Reheating furnace at a temperature of about 800℃.

Melting and reheating both are batch processes; it takes time around 5 to 6 hours per batch depending upon quantity of raw material under processing. Around 2 to 3 batches are carried out in a week depending on the capacity of unit. The efficiency of the melting and reheating furnaces in this cluster was observed less than 5 % in all the brass units. Hard coke and charcoal is available in this cluster at much higher rate. Substitute for this fuels by lower cost fuels will results in huge quantum of savings in fuel cost in furnaces. All brass units at this cluster operate in a single shift. Melting and reheating furnaces operates alternatively for about 3 days in week.

In a brass units in this cluster, after reheating of the brass moulds it is then sent for the beating, scraping and the polishing operations for final product. All this operations is carried out manually and the machines are only used for polishing purpose only which is in almost all the units is hand driven. In a beating process, heated brass moulds from the reheating furnace is taken out through pincers which is at a temperature of about 800 ^{o}C and is then hammered by a group of hammer men in a sequential manner to give the proper desired shape. In a scrapping operation, after the process of beating, the portion of the body of the product unusually thick enough is removed. Thus scrapping is carried out for ensuring a uniformly thickness product and smoothness of product wherever required.

Implementation of this proposed project by combining 5 to 6 brass units will lead to less payback period.

1.3.2 Role in Process

Melting furnace is used for melting of the raw material so as to form the brass products of desired shapes by pouring the melted raw material in the desired shape moulds.

In order to give the biscuit moulds a specific shape and size, the moulded material are reheated in a reheating furnace and hammered. Hammering process of the reheated mould requires more skill to give the proper shape to form the desired shape final product i.e. the quality of the finished product. The process of providing the shape to the reheated mould also depends on the reheating process of the biscuit mould which can be achieve by reheating the biscuit moulds at a required temperature with a proper heating cycle time.

1.4 Benchmarking for Existing Specific Energy Consumption

Energy consumption in furnaces would depend on the following mentioned parameters

- Type of fuel used and its calorific value
- Quantity of material
- Temperature maintained in the furnace
- Operational and maintenance practices

Electricity in the existing brass units is consumed in the following

- Polishing machine in few brass units where motor driven polishing machines are used which is installed in approximately 10 % of the brass units of the total brass units in this cluster
- Lighting

1.4.1 Operation Parameters details

Operating parameters means the total fuel consumption in the furnaces for about 5 to 6 brass units having a batch capacity of about 30 to 40 is considered in this DPR in order to estimate the feasibility study of the proposed project is given Table 1.6 below.

Table 1.6 Operating Parameters in a Brass unit

Sr. No.	Particular	Unit	Value
1	Capacity of Reheating Furnace	Kg	250
2	Capacity of Melting Furnace	Kg	250
3	Hard Coke Consumption in melting furnace	Kg/year	29,952
4	Charcoal Consumption in reheating furnace	Kg/year	47,952
5	Production of a unit	Kg/year	36000
6	Reheating Furnace Temperature	°C	800
7	Melting Furnace Temperature	°C	950
8	Electricity Consumption	KWh/year	720
9	Cost of Hard Coke	₹/Kg	8.5
10	Cost of Charcoal	₹/Kg	22.5
11	Cost of Hard coke consumption	₹/year	2,54,592
12	Cost of Charcoal consumption	₹/year	10,78,920

1.4.2 Operating Efficiency Analysis

Detailed operating efficiencies estimation of the melting and reheating furnaces along with their specific fuel consumption is given in annexure – 1.

1.4.3 Specific Energy Consumption

Specific thermal energy consumption by combining a group of 5 to 6 brass units on annual basis is given in Table 1.7 below.

Table 1.7 Specific Energy Consumption in a Brass unit

Sr.	Particulars	Unit	Value
1	Hard Coke consumption	Kg/Kg of Production	0.83
2	Charcoal Consumption	Kg/Kg of Production	1.33
3	Electricity Consumption	KWh/Kg of Production	0.02
4	Hard Coke consumption	₹/Kg of Production	7.07
5	Charcoal Consumption	₹/Kg of Production	29.97

1.5 Barriers in Adoption of Equipment

1.5.1 Technological Barrier

- Lack of awareness on the use of alternative fuel options due to unavailability of new technologies in this cluster.
- It requires much time to convince the unit owners for implementation for the proposed project

- Restrictions at this cluster to operate in a single shift by external source may also became a constraint
- Lack of technical expertise on development of technology that can be employed for the use of agro based fuel which is abundantly available in this cluster.
- No awareness or information about the new energy efficient technologies available in the market.
- Basic educational level in this cluster is very poor. Most of the unit owners are themselves workers. The cluster is more of traditional handicraft than SME industrial cluster.
- The unit owners do not have industrial culture/mindset even of MSME level.
- Actual working days per week is maximum 2 or 3 and that too one shift on that day.

1.5.2 Financial Barrier

- Implementation of the proposed project requires an investment of about ₹ 36.048 Lakh which is a significant investment as far as this cluster is concern.
- The unit owners are crafts-man work on labor rates work and earn for day to day living; their financial condition is very poor.
- Due to bare minimum margins, the unit owners are not able to make and investment.
- Due to less operating hours and seasonal dependency, payback period for implementation of the project increases if a single unit plans to implement the energy conservation projects.
- The unit owners in the cluster do not have any banking experience; they hardly have anything to offer as collateral security.

1.5.3 Skilled Manpower

- All the skills are limited to Crafts men's skills. Other than this there are no skills

1.5.4 Other Barriers

- All the operations depend on Mahajans (Persons who are providing the raw material to the unit owners for converting to finished products. The unit owners are paid for labor charges for conversion. The margin for unit owners is very low). They have to operate their units based on orders from Mahajan.
- There are some associations (Samiti's) of these craftsmen; however policies or activities in these associations have not been able to raise their living/business.

2 Proposed Equipment

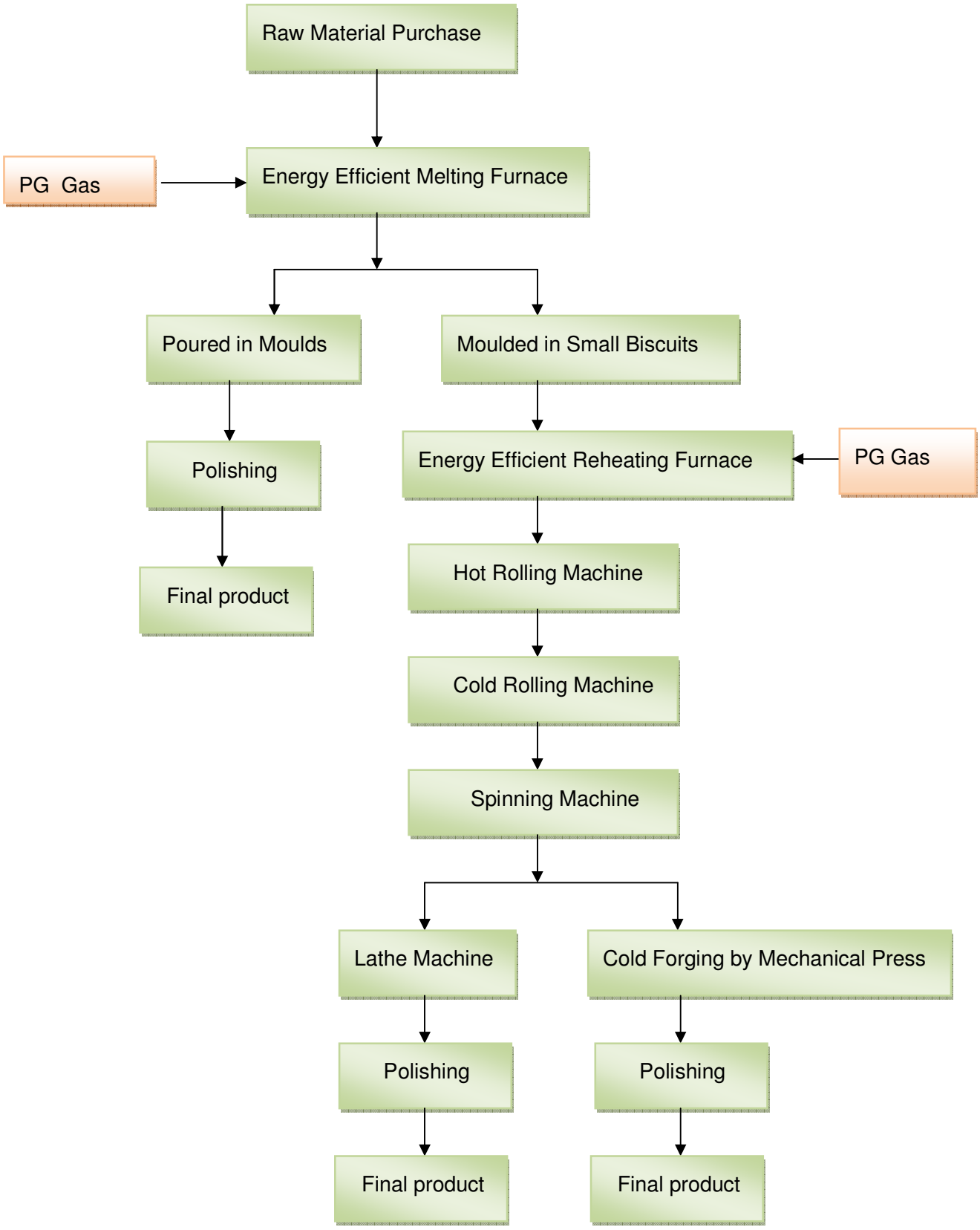
2.1 Detailed Description of Equipment

2.1.1 Description of Equipment

In the proposed project in this DPR includes the following

1. Installation of the rice husk fired Gasifier along with the new redesigned energy efficient melting and reheating furnaces of higher capacity of about 250 Kg batch so that at a time 5 to 6 brass units can put their raw material for melting and reheating operation i.e one common facility. This will decrease the investment required for the proposed project compared to if the units wish to separately implement this project for the same production. Switching from the fossil fuel to the agro – based fuel i.e. rice husk will give a huge quantum of saving in terms of rupees in the melting and reheating processes because the fossil fuels at Bhubaneshwar brass cluster to the brass unit owners is available at a very higher cost. In a Gasifier, producer gas is generated by partial combustion of rice husk which is then used as a fuel in the furnaces. Rice husk is easily available at this cluster as most of the unit owners belong to farming background and are also engaged in rice cultivation. Therefore the rice husk is available at a very cheaper rate at this cluster and it can be easily used as a fuel for melting and reheating process. Implementation of this project also requires the redesign of producer gas fired (which is generated from Gasifier) melting and reheating furnaces with waste heat recovery system. Gasifier achieves efficiency of about 75 % and the gas fired furnaces achieves efficiency of about 25 %. Hence the overall efficiency that can be achieved is 19 %. Preheating of combustion air also contributes in the saving additional to the saving that can be achieved due to fuel cost difference.
2. After reheating, use of the modern machineries for the rolling and the forging operation following by the final polishing.

   Process flow in the case of proposed modern brass unit as given below:


Raw Material Purchase
PG Gas
Energy Efficient Melting Furnace
Poured in Moulds
Moulded in Small Biscuits
Polishing
Energy Efficient Reheating Furnace
PG Gas
Final product
Hot Rolling Machine
Cold Rolling Machine
Spinning Machine
Lathe Machine
Cold Forging by Mechanical Press
Polishing
Polishing
Final product
Final product

2.1.2 Equipment Specification

A detailed engineering drawing of the rice husk fired Gasifier, Gas fired melting and reheating furnaces with waste heat recovery system, specifications of the other accessories required along with their dimensions is given in annexure 4.

2.1.3 Suitability over Existing Equipment

Implementation of this project will require the installation of Gasifier along with the redesign of melting and reheating furnaces and the installation of machineries for the rolling and forging operation. The redesign of the furnaces will includes the design of new structure for furnace along with burner assembly and the waste heat recovery system i.e. recuperator, proper insulation and refractory of the furnace, blower of very small capacity and adjustment of stoichiometric air to fuel ratio. Details are given in annexure 4.

This project implementation is suitable because of the following reasons

1. It will improve the quality of the final product
2. Rice husk is available in plenty at this cluster at a very lower cost
3. It will decrease the capital investment for the proposed project for the same production
4. It will reduce the energy consumption cost in melting and reheating process
5. It will increase the efficiency of the furnaces
6. It will also reduce the flue gas losses due to installation of waste heat recovery system (i.e. recuperator) for combustion air preheating.
7. It will reduce the specific fuel consumption in the furnace
8. It will reduce the GHG emissions.

2.1.4 Superiority over Existing Equipment

Implementation of this project will involve the use of renewable fuel thereby replacement of fossil fuel. Proposed fuel is easily available at Bhubaneshwar brass cluster as the most of the persons including the unit owners belongs to the farming background involving in cultivation of rice. Installation of this project will require the redesign of the gas fired melting and reheating furnaces. Preheating of combustion air by the flue gases through installation of recuperator in melting and reheating furnaces leads to reduction in fuel consumption. This project improves the technology in the brass unit and also proper instrumentation helps in reducing the operating energy consumption cost and improves the quality of the product by maintaining proper temperature in the furnaces.

Also the installation and use of the modern machineries for rolling and forging operation increases the final quality of the product.

Installation of one common facility reduces the capital investment cost required as compared if the same project will installed separately by each brass unit owner.

2.1.5 Availability of Equipment

A Rice husk fired Gasifiers supplier is easily available by the well known suppliers. Melting and reheating furnaces of the proposed capacity is also easily available with the well known furnace suppliers. Also the local furnace fabricators is available in this cluster who can fabricate the melting and reheating furnaces according to the drawings provided by the technical expert.

Technologies suppliers suggested in the proposed project is easily available in the Bhubaneshwar itself

2.1.6 Source of Equipment

In Bhubaneshwar brass cluster, melting and reheating furnaces are manufactured by their own traditional method which is highly inefficient. Technologies of use of agro based fuel are already in operation for melting and reheating processes in other industries through Gasification.

In brass units other than the units in the Bhubaneshwar brass cluster, the above proposed modern technologies is already in operation and is running successfully with the expected results of the getting the quality of the product.

2.1.7 Terms and Conditions in Sales of Equipment

Performance guarantee of one year will be provided by the vendor.

Guarantee of about one year will be provided and the ready stock of spare parts will be available whenever required for the machineries like Hot and Cold rolling machine, Spinning Machine, Press etc.

2.1.8 Process down Time during Implementation

Implementation of the proposed project is a completely new separate setup. This project will require a maximum shutdown period of 2 days for trial.

2.1.9 Life Cycle Assessment

Life cycle assessment of the proposed project is about 10 to 15 years. Maintenance or replacement of the refractories will be required on a periodic basis i.e. after every 5 years.

2.1.10 Suitable Unit for Implementation of Proposed Equipment

For estimation of saving potential in operating energy cost consumption in melting and reheating processes, common facility for a batch capacity of about 250 Kg is considered..

3 Economic Benefits from Proposed Equipment

3.1 Technical Benefits

3.1.1 Fuel Saving

Implementation of this proposed project will results in reduction in energy cost in melting and reheating furnaces due to use of rice husk instead of hard coke and charcoal consumption where the rice husk is available at a much lower cost. Fuel saving will also be achieved due to installation of new redesign producer gas fired melting and reheating furnaces. Estimated energy cost reduction by implementation of this project considering increased electricity consumption cost and increase in annual turnover due to product quality improvement in a common facility for a group of 5 to 6 units will be ₹ 14,01,748 per year.

3.1.2 Electricity Saving

Implementation of this project will lead to increase in electricity consumption due to use of electrical blowers by replacing the present hand driven blowers and the use of the electrical driven machines including hot and cold rolling machines, spinning machine, Press etc. However, the cost of electricity consumption is very small as compared to the cost reduction achieved due to this project installation. The cost of electricity consumption will be ₹ 55,026 per year.

3.1.3 Improvement in Product Quality

Product quality will definitely improve as compare to the present condition due to the use of the rolling and cold forging technology instead of doing manual operation for the same product. Implementation of this technology will increase the annual turnover by 10 % on the present turnover of the brass units.

3.1.4 Reduction in Other Losses

This project will reduces the flue gas losses of the melting and reheating furnaces thereby utilization of flue gas waste heat for combustion air preheating due to installation of recuperator. This project also reduces the losses of the damage products.

3.2 Monetary Benefits

Monetary benefits after implementation of the proposed project is given in the following table 3.1.

Table 3.1 Energy and Monetary Benefit due to Project Implementation

Sr.	*Parameter*	*Unit*	*Melting Furnace*	*Reheating Furnace*
			Value	*Value*
1	Present type of fuel used	UOA	Hard Coke	Charcoal

Sr.	Parameter	Unit	Melting Furnace	Reheating Furnace
			Value	Value
1.	Quantity of fuel consumption	Kg/year	29,952	47,952
2.	Annual operational hours	Hours/year	432	864
3.	Existing Furnace Efficiency	%	3.91%	0.99%
4.	Gasifier Efficiency	%		75%
5.	Proposed Furnace Efficiency	%	25%	25%
6.	Rice husk Consumption after implementation of the project	Kg/year	11,243	6583
7.	Fuel consumption cost after project implementation	₹./year	16864	9874
8.	Gasifier Blower power Consumption	KW		3.7
9.	Rated Blower Power	KW	3.7	3.7
10.	Electricity Consumption	KWh/year		7992
11.	Rated power of hot rolling machine	KW		5.5
12.	Rated power of cold rolling machine	KW		7.46
13.	Rated power of spinning machine	KW		3.7
14.	Rated power of motorized mechanical press	KW		11
15.	Working hours of each machine	Hrs/year		576
16.	Total Electricity Consumption	KWh/year		23,924
17.	Cost of Electricity	₹./KWh		2.3
18.	Electricity cost	₹./year		55,026
19.	Cost of Fuel	₹./Kg	8.5	22.5
20.	Monetary Saving due to fuel change	₹	2,37,728	10,69,046
21.	Net increase in annual turnover due to product quality improvement	₹		1,50,000
22.	Net Monetary saving	₹		14,01,748

3.3 Social Benefits

3.3.1 Improvement in Working Environment in the Plant

This project results in reduction in the surrounding temperature around the furnaces. In the proposed equipment, melting and reheating process is carried out in a closed enclosure and also the proper insulation will be provided due to which it will reduce the heat loss from the surface of

the furnace. Thus it will reduce the temperature of the room thereby providing the comfortable atmosphere to work for the workers. Due to installation of the proper designed system, it will also reduces the accidents which may happen due to manual handling as presently used practice. Also helps to keep the clean environment around the furnace. This project also generates the revenue for the farmers due to sell of rice husk to the brass unit owners. This project also reduces the burden of investment for this project on an individual brass unit owner.

3.3.2 Improvement in Workers Skill

This project creates the awareness among the workers about the use of new technologies available for use of agro based fuel. Use of proper monitoring system provides the guidelines to the workers for the proper operation of the equipment in order to get the good quality final product in a lesser cycle time. They also learn about the new technologies employed in the furnace which helps in reduction in energy consumption cost in the furnaces. Also inspire the brass units to adopt the new efficient technologies for other operations in brass unit.

Use of the modern available technologies in the brass unit will improve the knowledge and the skills of the workers. Also it contributes to the growth of the workers in terms of knowledge as well as financially also.

3.4 Environmental Benefits

3.4.1 Reduction in GHG Emission

Installation of this project for melting and reheating process results in replacement of fossil fuel by the agro based fuel. Replacement of hard coke by rice husk in the melting furnace in a common facility of a batch capacity of about 250 Kg results in reduction in about 60 TCO2 per year by replacement of about 29,952 Kg/year of hard coke in melting furnace.

4 IMPLEMENTATION OF PROPOSED EQUIPMENT

4.1 Cost of Equipment Implementation

4.1.1 Equipments Cost

Cost of the proposed project is about ₹ 32.27 Lakh which includes the design and fabrication of the Gasifier, melting and reheating furnaces along with their all other accessories like waste heat recovery system, burner, blower, insulation and refractory etc., cost of machinery includes hot rolling and cold rolling machine, spinning machine, Press etc and also includes the transportation cost and taxes as applicable.

Cost of Gasifier	₹	11,00,000
Cost of PG fired melting furnace includes the cost of Furnace structure, burner, Recuperator, Blower etc.	₹	2,60,000
Cost of PG fired reheating furnace includes the cost of Furnace structure, burner, Recuperator, Blower etc.	₹	3,60,000
Cost of the machinery includes hot rolling and cold rolling machine, spinning machine, Press etc	₹	8,00,000
Service charges	₹	2,50,000
Vat	₹	3,15,000
Transportation Cost	₹	1,41,750
Total Capital Cost	**₹(in lakh)**	**32.27**

4.1.2 Erection & Commissioning and other Miscellaneous Cost

Erection & commissioning cost is ₹ 1.26 Lakh which includes the piping, instrumentation, labour work etc and ₹ 2.52 Lakh as miscellaneous cost.

Table 4.1 Details of Proposed Equipment Installation Cost

Sr. No	*Particular*	*Unit*	*Cost*
1	Equipment Cost	₹ (in Lakh)	32.27
2	Erection & commissioning cost	₹ (in Lakh)	1.29
3	EPC cost	₹ (in Lakh)	1.68
3	Misc. Cost	₹ (in Lakh)	2.52
4	Total Cost	₹ (in Lakh)	37.76

4.2 Arrangements of Funds

4.2.1 Entrepreneur's Contribution

Entrepreneur will contribute 25 % of the total project cost which is ₹ 9.44 Lakh.

4.2.2 Loan Amount

Remaining 75 % cost of the proposed project will be funded by the bank which is ₹ 28.32 Lakh.

4.2.3 Terms & Conditions of Loan

The interest rate is considered at 10% which is SIDBI's rate of interest for energy efficient projects. The loan tenure is 5 years from the date of first disbursement of loan.

4.3 Financial Indicators

4.3.1 Cash Flow Analysis

Profitability and cash flow statements have been worked out for a period of 8 years. The financials have been worked out on the basis of certain reasonable assumptions, which are outlined below.

The project is expected to achieve monitory savings of ₹ 14.02 lakh per annum.

- The Repair and Maintenance cost is estimated at 5 % of cost of total project with 3 % increase in every year as escalations.
- Interest on term loan is estimated at 10 %.
- Depreciation is provided as per the rates provided in the companies Act.

Based on the above assumptions, profitability and cash flow statements have been prepared and calculated in Annexure-4.

4.3.2 Simple Payback Period

The total project cost of the proposed technology is ₹ 37.76 Lakh and monetary savings is ₹ 14.02 Lakh hence, the simple payback period works out to be 2.69 years.

4.3.3 Net Present Value (NPV)

The Net present value of the investment at 10 % works out to be ₹ 11.38 Lakh

4.3.4 Internal Rate of Return (IRR)

The after tax Internal Rate of Return of the project works out to be 18.70 %. Thus the project is financially viable.

4.3.5 Return on Investment (ROI)

The average return on investment of the project activity works out at 24.47 %.

Table 4.2 Financial Indicators of Proposed Technology/Equipment

S. No.	Particular	Unit	Value
1	Simple payback period	Year	2.69
2	NPV	₹ (in Lakh)	11.38
3	IRR	%	18.70
4	ROI	%	24.47

4.4 Sensitivity Analysis in Realistic, Pessimistic and Optimistic Scenarios

A sensitivity analysis has been carried out to ascertain how the project financials would behave in different situations like when there is an increase in energy cost savings or decrease in energy cost savings due to variation in the fuel consumption. For the purpose of sensitive analysis, following scenarios have been considered.

- Optimistic scenario (Increase in Coal consumption by 5%, Increase in Charcoal consumption by 5%)
- Pessimistic scenario (Decrease in Coal consumption by 5%, Decrease in Charcoal consumption by 5%)

In each scenario, other inputs are assumed as a constant. The financial indicators in each of the above situation are indicated along with standard indicators

Table 4.3 Sensitivity Analysis

Scenario	IRR (%)	NPV (₹in Lakh)	ROI (%)	DSCR
Pessimistic	16.81	8.82	24.09	1.40
Realistic	18.70	11.38	24.47	1.47
Optimistic	20.55	13.93	24.81	1.55

4.5 Procurement and Implementation Schedule

Table 4.4 Procurement and Implementation Schedule

Sr. No.	Activities	Weeks														
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	Design															
2	Civil Construction for foundation															
3	Procurement of Raw Material															
4	Fabrication of Gasifier and Furnaces															
5	Procurement of the machinery include rolling machines, Lathe and Press															
6	Installation of the machinery															
7	Refractory Lining															
8	Insulation															
9	Erection and Commissioning															
10	Testing															
11	2 days breakdown period															

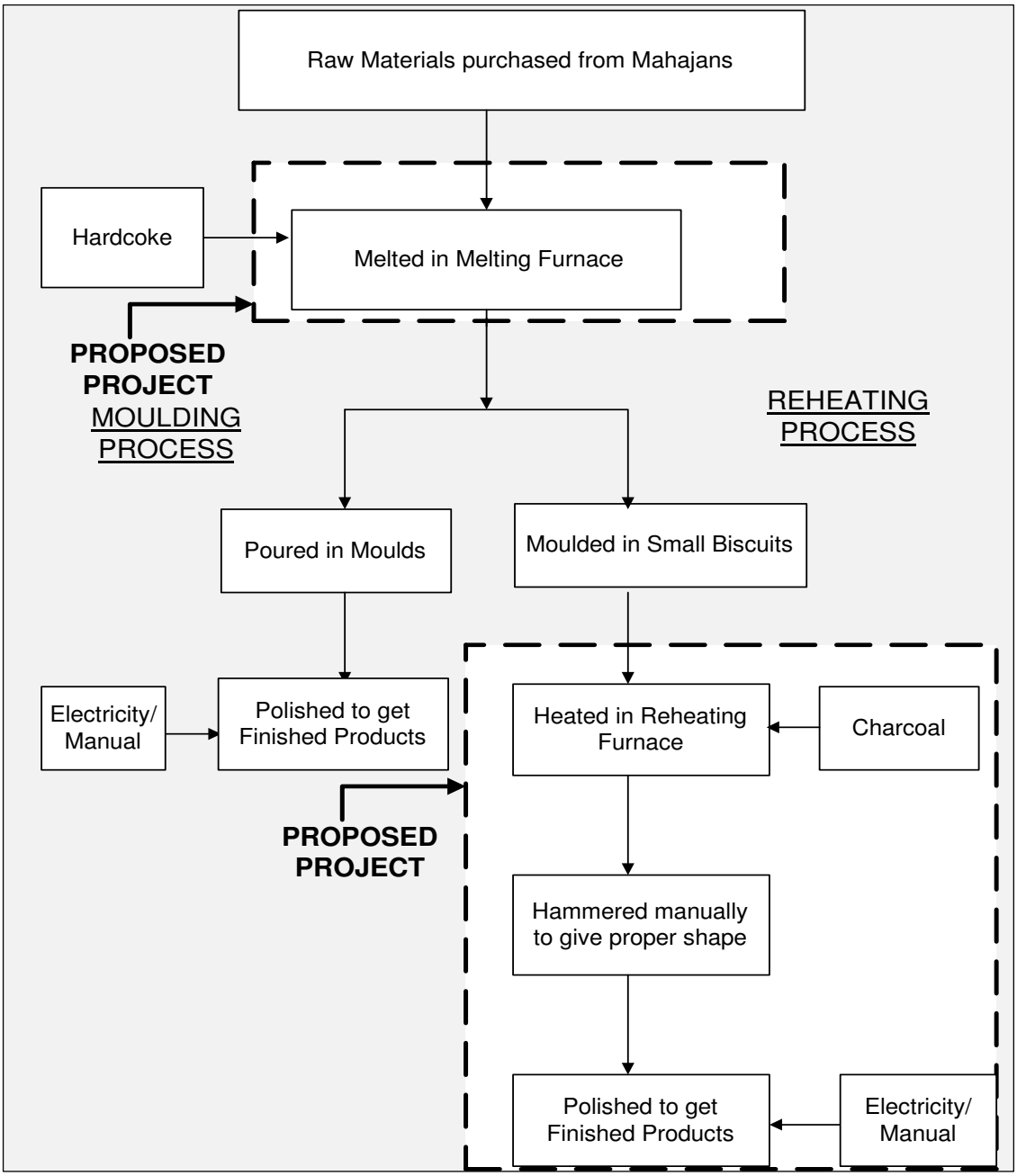
Annexure

Annexure -1: Energy Audit Data Used for Baseline Establishment under the Sub Head 1.4 in Chapter-1

Baseline for implementation of the proposed project can be considered is the specific fuel consumption and cost per unit of production in the melting and reheating furnaces which depends on the efficiency of the furnace.

Sr.	Particular	Unit	Value
1	Quantity of production per batch	Kg	250
2	Melting Furnace temperature	°C	950
3	Reheating Furnace temperature	°C	800
4	Ambient Temperature	°C	35
5	Specific heat of Brass	Kcal/Kg °C	0.112
6	Calorific value of Hard Coke	Kcal/kg	4500
7	Calorific value of Charcoal	Kcal/kg	6500
8	Quantity of Hard Coke per batch	Kg	208
9	Quantity of charcoal per batch	Kg	333
10	Efficiency of the Melting furnace	%	3.91
11	Efficiency of the Reheating furnace	%	0.99
12	Cost of Hard Coke	₹/Kg	8.5
13	Cost of Charcoal	₹/Kg	22.5
14	Specific fuel consumption in melting furnace	Kg of Hard Coke/ Kg of Production	0.83
15	Specific fuel consumption in reheating furnace	Kg of Charcoal/ Kg of Production	1.33
16	Fuel consumption cost in melting furnace	₹/ Kg of Production	7.07
17	Fuel consumption cost in reheating furnace	₹/ Kg of Production	29.97
18	Annual Production	Tonne/ Annum	36
19	Annual Consumption Hard Coke	Tonne/ Annum	29952
20	Annual Consumption Charcoal	Tonne/ Annum	47952

Annexure -2: Process Flow Diagram



Annexure -3: Detailed Technology Assessment Report

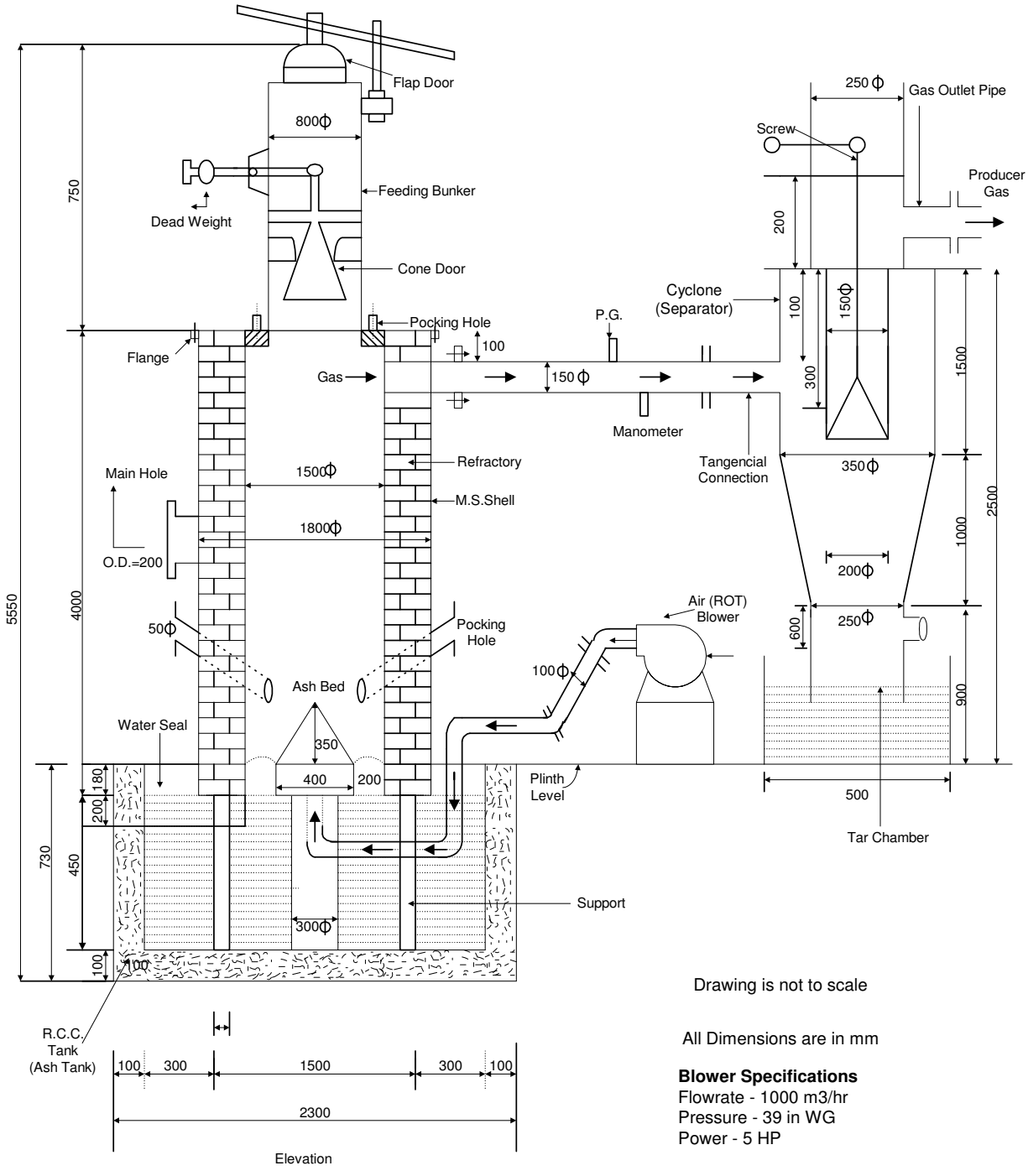
Sr.	Particular	Unit	Melting Furnace		Reheating Furnace	
			Present Situation	Proposed Situation	Present Situation	Proposed Situation
1	Type of fuel	UOA	Hard Coke	Rice Husk (By generating producer gas from Gasifier)	Charcoal	Rice Husk (By generating producer gas from Gasifier)
2	Quantity of fuel consumption	Kg/year	29,952	11,243	47,952	6583
3	Cost of fuel	₹./Kg	8.5	1.5	22.5	1.5
4	Furnace temperature	oC	950	950	800	800
5	Furnace efficiency	%	3.91%	25%	0.99%	25%
6	Gasifier Efficiency	%				75.00%
7	Annual operational hours	Hours/year	432	432	864	864
8	Cost of fuel consumption in furnaces	₹./year	2,54,592	16,864	10,78,920	9874
9	Monetary saving due to fuel change	₹./year		2,37,728		10,69,046
10	Rated Blower Power	KW		3.7		3.7
11	Rated Blower power of Gasifier	KW				3.7
12	Electricity Consumption	KWh/year				7992
13	Rated power of hot rolling machine	KW				5.5
14	Rated power of cold rolling machine	KW				7.46
15	Rated power of spinning machine	KW				3.7
16	Rated power of motorized mechanical press	KW				11
17	Working hours of each machine	Hrs/year				576

Sr.	Particular	Unit	Melting Furnace		Reheating Furnace	
			Present Situation	Proposed Situation	Present Situation	Proposed Situation
18	Total Electricity Consumption	KWh/year				23,924
19	Cost of Electricity	₹./KWh				2.3
20	Electricity cost	₹./year				55,026
21	Net annual increase in turnover due to product quality improvement	₹				1,50,000
22	Net monetary savings	₹				14,01,748

Annexure -4: Engineering drawing of the Proposed Equipment

GEN. LAYOUT FOR GASIFIER

(250 kg)

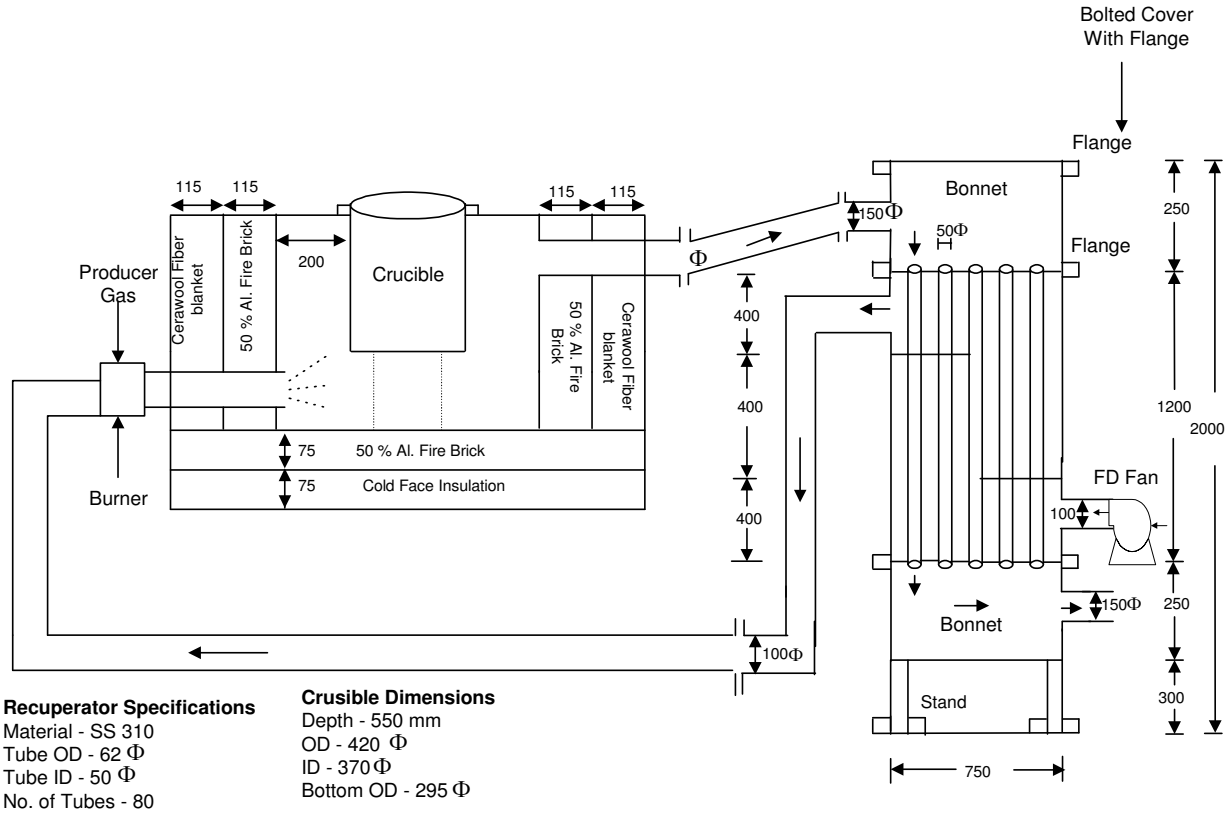


Drawing is not to scale

All Dimensions are in mm

Blower Specifications
Flowrate - 1000 m3/hr
Pressure - 39 in WG
Power - 5 HP

PG Fired Melting Furnace of Capacity of about 250 Kg



Recuperator Specifications
Material - SS 310
Tube OD - 62 Φ
Tube ID - 50 Φ
No. of Tubes - 80
Pitch - 105 mm

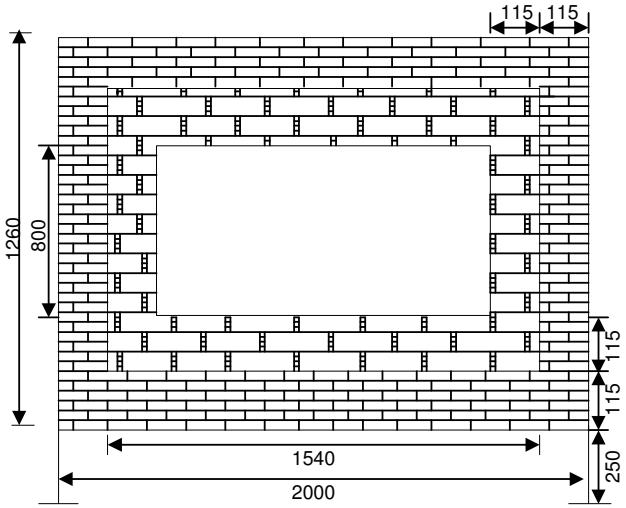
Blower Specifications
Flowrate - 1000 m3/hr
Pressure - 39 in WG
Power - 5 HP

Crusible Dimensions
Depth - 550 mm
OD - 420 Φ
ID - 370 Φ
Bottom OD - 295 Φ

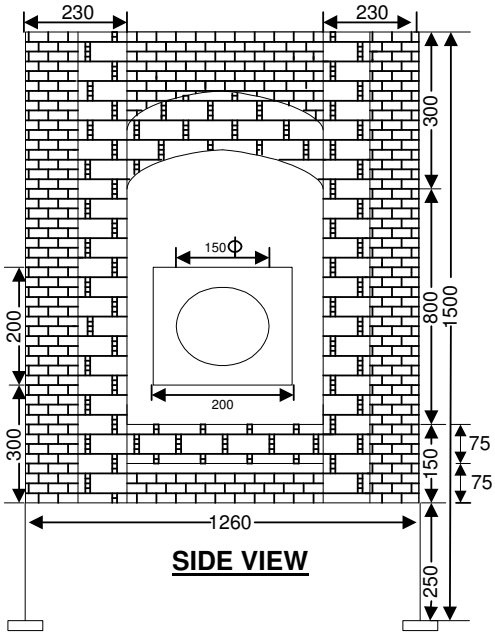
Drawing is not to Scale

All Dimentions are in mm

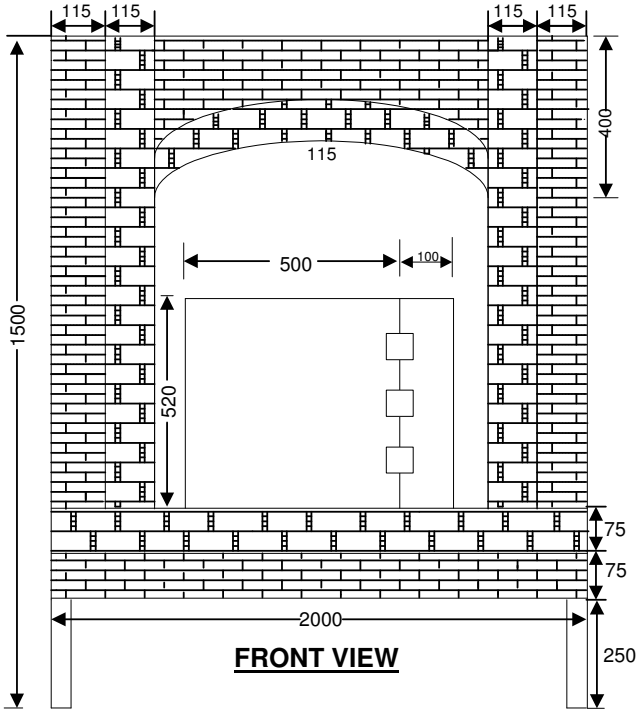
250 KG REHEATING FURNACE



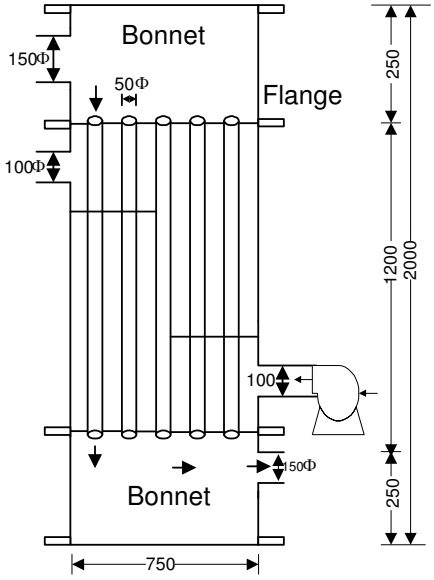
TOP VIEW



SIDE VIEW



FRONT VIEW



Blower Specifications
Flowrate-1000m3/hr
Pressure-39 in WG
Power-5 HP

Recuperator Specifications
Material-SS310
Tube OD-62Φ
Tube ID-50Φ
No. Of Tubes-80
Pitch-105mm

Drawing is not to scale,
All dimension are in mm

COLD FACE INSULATION

50% ALUMINA FIRE BRICK

Annexure -5: Detailed Financial Analysis

Name of the Technology	***Reheating & Melting Furnace***		
Rated Capacity	***250 Kg***		
Details	***Unit***	***Value***	***Basis***
Installed Capacity	kg	250	
No of Batches	Nos.	144	
No of Operating hours	Hrs.	576	(Assumed)
Proposed Investment			
Plant & Machinery	₹ (in lakh)	32.27	
Erection & Commissioning	₹ (in lakh)	1.29	
Investment without IDC	₹ (in lakh)	33.56	
EPC cost	₹ (in lakh)	1.68	
Misc. Cost	₹ (in lakh)	2.52	
Total Investment	₹ (in lakh)	37.76	
Financing pattern			
Own Funds (Equity)	₹ (in lakh)	9.44	Feasibility Study
Loan Funds (Term Loan)	₹ (in lakh)	28.32	Feasibility Study
Loan Tenure	years	5.00	Assumed
Moratorium Period	Months	6.00	Assumed
Repayment Period	Months	66.00	Assumed
Interest Rate	%age	10.00%	SIDBI Lending rate
Estimation of Costs			
O & M Costs	% on Plant & Equip	5.00	Feasibility Study
Annual Escalation	%age	3.00	Feasibility Study
Estimation of Revenue			
Fuel savings(Melting furnace)	kg/Year	29952	
Cost	₹ /kg	8.5	
Fuel savings(Re-heating furnace)	kg/Year	47952	
Cost	₹/ kg	22.5	
Quality Improvement	₹	150000	
Rice husk consumption	kg/Year	17826	
Cost	₹/ kg	1.5	
Electricity consumption	kWh/Year	23924	
Cost of electricity	₹ /kWh	2.3	
St. line Depn.	%age	5.28	Indian Companies Act
IT Depreciation	%age	80.00	Income Tax Rules
Income Tax	%age	33.99	Income Tax

Estimation of Interest on Term Loan

(₹in lakh)

Years	***Opening Balance***	***Repayment***	***Closing Balance***	***Interest***
1	28.32	2.40	25.92	3.26
2	25.92	4.80	21.12	2.37
3	21.12	5.40	15.72	1.87
4	15.72	6.00	9.72	1.30
5	9.72	6.40	3.32	0.69
6	3.32	3.32	0.00	0.10
		28.32		

WDV Depreciation

Particulars / years	*1*	*2*
Plant and Machinery		
Cost	37.76	7.55
Depreciation	30.21	6.04
WDV	7.55	1.51

Projected Profitability

Particulars / Years	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*
Revenue through Savings								
Fuel savings	14.02	14.02	14.02	14.02	14.02	14.02	14.02	14.02
Total Revenue (A)	14.02	14.02	14.02	14.02	14.02	14.02	14.02	14.02
Expenses								
O & M Expenses	1.89	1.94	2.00	2.06	2.12	2.19	2.25	2.32
Total Expenses (B)	1.89	1.94	2.00	2.06	2.12	2.19	2.25	2.32
PBDIT (A)-(B)	12.13	12.07	12.01	11.95	11.89	11.83	11.76	11.70
Interest	3.26	2.37	1.87	1.30	0.69	0.10	0.00	0.00
PBDT	8.87	9.70	10.15	10.66	11.20	11.73	11.76	11.70
Depreciation	1.99	1.99	1.99	1.99	1.99	1.99	1.99	1.99
PBT	6.87	7.71	8.15	8.66	9.21	9.74	9.77	9.70
Income tax	0.00	1.24	3.45	3.62	3.81	3.99	4.00	3.98
Profit after tax (PAT)	6.87	6.46	4.71	5.04	5.40	5.75	5.77	5.73

Computation of Tax ***₹ (In lakh)***

Particulars / Years	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*
Profit before tax	6.87	7.71	8.15	8.66	9.21	9.74	9.77	9.70
Add: Book depreciation	1.99	1.99	1.99	1.99	1.99	1.99	1.99	1.99
Less: WDV depreciation	30.21	6.04	0.00	0.00	0.00	0.00	0.00	0.00
Taxable profit	-21.34	3.66	10.15	10.66	11.20	11.73	11.76	11.70
Income Tax	0.00	1.24	3.45	3.62	3.81	3.99	4.00	3.98

Projected Balance Sheet ***₹ (In lakh)***

Particulars / Years	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*
Liabilities								
Share Capital (D)	9.44	9.44	9.44	9.44	9.44	9.44	9.44	9.44
Reserves & Surplus (E)	6.87	13.34	18.04	23.08	28.48	34.23	40.00	45.73
Term Loans (F)	25.92	21.12	15.72	9.72	3.32	0.00	0.00	0.00
Total Liabilities D)+(E)+(F)	42.23	43.89	43.20	42.24	41.24	43.67	49.44	55.17

Assets	1	2	3	4	5	6	7	8
Gross Fixed Assets	37.76	37.76	37.76	37.76	37.76	37.76	37.76	37.76
Less: Accm. Depreciation	1.99	3.99	5.98	7.97	9.97	11.96	13.96	15.95
Net Fixed Assets	35.77	33.77	31.78	29.78	27.79	25.80	23.80	21.81
Cash & Bank Balance	6.47	10.12	11.42	12.46	13.45	17.88	25.64	33.36
TOTAL ASSETS	42.23	43.89	43.20	42.24	41.24	43.67	49.44	55.17
Net Worth	16.31	22.77	27.48	32.52	37.92	43.67	49.44	55.17
Dept equity ratio	2.75	2.24	1.67	1.03	0.35	0.00	0.00	0.00

Projected Cash Flow:

₹ (In lakh)

Particulars / Years	***0***	***1***	***2***	***3***	***4***	***5***	***6***	***7***	***8***
Sources									
Share Capital	9.44	-	-	-	-	-	-	-	-
Term Loan	28.32								
Profit After tax		6.87	6.46	4.71	5.04	5.40	5.75	5.77	5.73
Depreciation		1.99	1.99	1.99	1.99	1.99	1.99	1.99	1.99
Total Sources	37.76	8.87	8.46	6.70	7.03	7.40	7.74	7.76	7.72
Application									
Capital Expenditure	37.76								
Repayment of Loan	-	2.40	4.80	5.40	6.00	6.40	3.32	0.00	0.00
Total Application	37.76	2.40	4.80	5.40	6.00	6.40	3.32	0.00	0.00
Net Surplus	-	6.47	3.66	1.30	1.03	1.00	4.42	7.76	7.72
Add: Opening Balance	-	-	6.47	10.12	11.42	12.46	13.45	17.88	25.64
Closing Balance	-	6.47	10.12	11.42	12.46	13.45	17.88	25.64	33.36

Calculation of Internal Rate of Return

₹ (In lakh)

Particulars / months	***0***	***1***	***2***	***3***	***4***	***5***	***6***	***7***	***8***
Profit after Tax		6.87	6.46	4.71	5.04	5.40	5.75	5.77	5.73
Depreciation		1.99	1.99	1.99	1.99	1.99	1.99	1.99	1.99
Interest on Term Loan		3.26	2.37	1.87	1.30	0.69	0.10	-	-
Salvage/Realizable value					-	-	-	-	-
Cash outflow	(37.76)	-	-	-	-	-	-	-	-
Net Cash flow	(37.76)	12.13	10.83	8.57	8.33	8.08	7.84	7.76	7.72
IRR	18.70%								

NPV	11.38

Break Even Point ***₹ (In lakh)***

Particulars / Years	***1***	***2***	***3***	***4***	***5***	***6***	***7***	***8***
Variable Expenses								
Oper. & Maintenance Exp (75%)	1.42	1.46	1.50	1.55	1.59	1.64	1.69	1.74
Sub Total (G)	1.42	1.46	1.50	1.55	1.59	1.64	1.69	1.74
Fixed Expenses								
Oper. & Maintenance Exp (25%)	0.47	0.49	0.50	0.52	0.53	0.55	0.56	0.58
Interest on Term Loan	3.26	2.37	1.87	1.30	0.69	0.10	0.00	0.00
Depreciation *(H)*	1.99	1.99	1.99	1.99	1.99	1.99	1.99	1.99
Sub Total (I)	5.73	4.85	4.36	3.81	3.21	2.64	2.56	2.57
Sales (J)	14.02	14.02	14.02	14.02	14.02	14.02	14.02	14.02
Contribution (K)	12.60	12.56	12.52	12.47	12.42	12.38	12.33	12.28
Break Even Point (L= G/I)	45.46%	38.64%	34.84%	30.54%	25.86%	21.32%	20.75%	20.97%
Cash Break Even {(I)-(H)}	29.64%	22.77%	18.91%	14.55%	9.81%	5.21%	4.57%	4.73%
BREAK EVEN SALES (J)*(L)	6.37	5.42	4.88	4.28	3.63	2.99	2.91	2.94

Return on Investment

₹ (In lakh)

Particulars / Years	***1***	***2***	***3***	***4***	***5***	***6***	***7***	***8***	***Total***
Net Profit Before Taxes	6.87	7.71	8.15	8.66	9.21	9.74	9.77	9.70	69.82
Net Worth	16.31	22.77	27.48	32.52	37.92	43.67	49.44	55.17	285.30
									24.47%

Debt Service Coverage Ratio

₹ (In lakh)

Particulars / Years	***1***	***2***	***3***	***4***	***5***	***6***	***7***	***8***	***Total***
Cash Inflow									
Profit after Tax	6.87	6.46	4.71	5.04	5.40	5.75	5.77	5.73	34.23
Depreciation	1.99	1.99	1.99	1.99	1.99	1.99	1.99	1.99	11.96
Interest on Term Loan	3.26	2.37	1.87	1.30	0.69	0.10	0.00	0.00	9.59
Total (M)	12.13	10.83	8.57	8.33	8.08	7.84	7.76	7.72	55.78

Debt

Interest on Term Loan	3.26	2.37	1.87	1.30	0.69	0.10	0.00	0.00	9.59
Repayment of Term Loan	2.40	4.80	5.40	6.00	6.40	3.32	0.00	0.00	28.32
Total (N)	5.66	7.17	7.27	7.30	7.09	3.42	0.00	0.00	37.91
	2.14	1.51	1.18	1.14	1.14	2.29	0.00	0.00	1.47
Average DSCR (M/N)	1.47								

Annexure -6: Details of Procurement and Implementation

Sr. No.	Activities	Weeks														
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	Design															
2	Civil Construction for foundation															
3	Procurement of Raw Material															
4	Fabrication of Gasifier and Furnaces															
5	Procurement of the machinery include rolling machines, Lathe and Press															
6	Installation of the machinery															
7	Refractory Lining															
8	Insulation															
9	Erection and Commissioning															
10	Testing															
11	2 days breakdown period															

Annexure -7: Details of Technology Service Providers

S. No.	*Technology*	*Name of Service Provider*	*Address*	*Contact Person and No.*
1	Technical Expert	Yajna Fuel Services	B – 15, Dattaviahar Co – OperativeHousing Society, Ground Floor, Shivaji Nagar, B – Cabin,Thane (W) – 400602	Mr. Mukund Gharpure - 09969410594, 022 - 25424983
2	Fabricator	Standard Engineering Works	474/475, Palasuni, Rasulgarh , Bhubaneshwar – 751010	Harhpal Rajput - 093382224660
3	Fabricator	Biraja Steel Industries	Plot. No. 172, Sector A Zone A, Mancheswar Industrial Estate	Gaurang Mahalik - 09938677782
4	Technical Expert and Fabricator	Shri Sadguru Dev Engg. Services	A/4, New Veena Vihar, Datta Mandir Road, Dhanukar Wadi, Kandivali, Mumbai - 67	Mr. Ravi Patel - 09969378982
5	Machinery	Sai Marketing Corporation	Ramayan, Rajnagar, Katol Road, Nagpur - 440013	Mr. Ariz Malvia

Annexure -8: Quotations for Proposed Technology

Yajna
FUEL SERVICES

Work Centre.: B-15, Dattavihar co-op Hsg.So., Gr. Floor, Shivaji Nagar, B- Cabin,
Thane (W) 400602. Tel.: 022- 2538 4681, Tel/Fax.: 2542 4983
e-mail.: yajnafuel@vsnl.net web site.: www.yajnafuelindia.com

To,
M/s.See-Tech Solution Pvt Ltd.
11/5, MIDC, Info Tech Park,
Near VRCE Telephone Exchange,
South Ambazari Road,
Nagpur – 440 022

Kind Attention: - Mr. Milind Chittawar

Subject: Budgetary offer for Gasifiers and PG fired Melting and Reheating Furnaces for different capacities

Dear Sir,

We thank you for your enquiry. Based on the discussions & data furnished by you, we are pleased to submit offer for the mentioned subject, as follows: -

1) Annexure I: Scope of Supply.
2) Annexure II: Quotation, Payment Terms & Exclusions

We hope you will find the details & information submitted in order and in line with your requirement. However if you have any quarries (Technical/Commercial), kindly feel free to call on us.

We assure you of our best services & hope to hear a favorable reply soon.

Thanking you,
Yours Faithfully,

For YAJNA FUEL SERVICES.

(Dr. M.G. Gharpure)

ANNEXURE I

Scope of work:

1. Preparation of site plan for furnace and Gasifier installation, estimation of Storage space, Chimney connection, firing orientation, Ducting to Chimney
2. Fabrication of furnace and Gasifier, Refractory lining, Insulation lining, etc
4. Commissioning.
5. Performance testing and Economic Evaluation.

ANNEXURE II

PROJECT ESTIMATION FOR GASIFIER OF DIFFERENT CAPACITIES

Sr. No.	Description	Total cost (Rs.)
1	Rice husk fired Gasifier of Capacity of about 30 Kg • Gasifier main reactor with water jacket, provisions for air entry & gas outlet, etc. • Blower for delivering gasification air • Cyclone separator for separation of course particles from gas • Gas flaring arrangement to be used during start-up of the gasifier • Calorific value of gas – 1100 to 1200 Kcal/Nm3 • Gas Composition – CO: 10 - 20 %, H2:10 – 20%, CH4: 3 – 8 %, CO2: 7 -12 %, N2: 40 – 50 %	Rs. 2,45,000/-
2	Rice husk fired Gasifier of Capacity of about 60 Kg • Gasifier main reactor with water jacket, provisions for air entry & gas outlet, etc. • Blower for delivering gasification air • Cyclone separator for separation of course particles from gas • Gas flaring arrangement to be used during start-up of the gasifier • Calorific value of gas – 1100 to 1200 Kcal/Nm3 • Gas Composition – CO: 10 - 20 %, H2:10 – 20%, CH4: 3 – 8 %, CO2: 7 -12 %, N2: 40 – 50 %	Rs. 3,60,000/-
3	Rice husk fired Gasifier of Capacity of about 100 Kg • Gasifier main reactor with water jacket, provisions for air entry & gas outlet, etc. • Blower for delivering gasification air • Cyclone separator for separation of course particles from gas • Gas flaring arrangement to be used during start-up of the gasifier • Calorific value of gas – 1100 to 1200 Kcal/Nm3 • Gas Composition – CO: 10 - 20 %, H2:10 – 20%, CH4: 3 – 8 %, CO2: 7 -12 %, N2: 40 – 50 %	Rs. 5,80,000/-

Sr. No.	Description	Total cost (Rs.)
4	Rice husk fired Gasifier of Capacity of about 250 Kg • Gasifier main reactor with water jacket, provisions for air entry & gas outlet, etc. • Blower for delivering gasification air • Cyclone separator for separation of course particles from gas • Gas flaring arrangement to be used during start-up of the gasifier • Calorific value of gas – 1100 to 1200 Kcal/Nm3 • Gas Composition – CO: 10 - 20 %, H2:10 – 20%, CH4: 3 – 8 %, CO2: 7 -12 %, N2: 40 – 50 %	Rs. 11,00,000/-
5	Rice husk fired Gasifier of Capacity of about 500 Kg • Gasifier main reactor with water jacket, provisions for air entry & gas outlet, etc. • Blower for delivering gasification air • Cyclone separator for separation of course particles from gas • Gas flaring arrangement to be used during start-up of the gasifier • Calorific value of gas – 1100 to 1200 Kcal/Nm3 • Gas Composition – CO: 10 - 20 %, H2:10 – 20%, CH4: 3 – 8 %, CO2: 7 -12 %, N2: 40 – 50 %	Rs. 15,00,000/-

PROJECT ESTIMATION FOR PG FIRED MELTING FURNACES OF DIFFERENT CAPACITIES

Sr. No.	Description	Total cost (Rs.)
1	Melting furnace with crucible type Producer Gas fired of capacity of about 30 Kg • Melting Furnace Fabrication plus refractory works • Recuperator, Burner • FD fan • Piping + ducts + insulation with aluminum cladding	Rs. 90,000/-
2	Melting furnace with crucible type Producer Gas fired of capacity of about 60 Kg • Melting Furnace Fabrication plus refractory works • Recuperator, Burner • FD fan • Piping + ducts + insulation with aluminum cladding	Rs. 1,30,000/-
3	Melting furnace with crucible type Producer Gas fired of capacity of about 100 Kg • Melting Furnace Fabrication plus refractory works • Recuperator, Burner • FD fan • Piping + ducts + insulation with aluminum cladding	Rs. 1,50,000/-
4	Melting furnace with crucible type Producer Gas fired of capacity of about 250 Kg • Melting Furnace Fabrication plus refractory works • Recuperator, Burner • FD fan • Piping + ducts + insulation with aluminum cladding	Rs. 2,60,000/-
5	Melting furnace with crucible type Producer Gas fired of capacity of about 500 Kg • Melting Furnace Fabrication plus refractory works • Recuperator, Burner • FD fan • Piping + ducts + insulation with aluminum cladding	Rs. 5,50,000/-

PROJECT ESTIMATION FOR PG FIRED REHEATING FURNACES OF DIFFERENT CAPACITIES

Sr. No.	Description	Total cost (Rs.)
1	Reheating furnace Producer Gas fired of capacity of about 30 Kg • Reheating Furnace Fabrication plus refractory works • Recuperator, Burner • FD fan • Piping + ducts + insulation with aluminum cladding	Rs. 1,20,000/-
2	Reheating furnace Producer Gas fired of capacity of about 60 Kg • Reheating Furnace Fabrication plus refractory works • Recuperator, Burner • FD fan • Piping + ducts + insulation with aluminum cladding	Rs. 1,55,000/-
3	Reheating furnace Producer Gas fired of capacity of about 100 Kg • Reheating Furnace Fabrication plus refractory works • Recuperator, Burner • FD fan • Piping + ducts + insulation with aluminum cladding	Rs. 2,00,000/-
4	Reheating furnace Producer Gas fired of capacity of about 250 Kg • Reheating Furnace Fabrication plus refractory works • Recuperator, Burner • FD fan • Piping + ducts + insulation with aluminum cladding	Rs. 3,60,000/-
5	Reheating furnace Producer Gas fired of capacity of about 500 Kg • Reheating Furnace Fabrication plus refractory works • Recuperator, Burner • FD fan • Piping + ducts + insulation with aluminum cladding	Rs. 6,45,000/-

PROJECT ESTIMATION FOR SOLID FUEL FIRED MELTING AND REHEATING FURNACES

Sr. No.	Description	Total cost (Rs.)
1	Reheating furnace Charcoal fired of capacity of about 500 Kg • Reheating Furnace Fabrication plus refractory works • Recuperator, Burner • FD fan • Piping + ducts + insulation with aluminum cladding	Rs. 6,40,000/-
2	Melting furnace with crucible type Hard Coke fired of capacity of about 500 Kg • Melting Furnace Fabrication plus refractory works • Recuperator • FD fan • Piping + ducts + insulation with aluminum cladding	Rs. 5,40,000/-

Payment Terms

20 % advance along with work order
30 % after providing the layout for furnace installation and start for fabrication
30 % after completion of fabrication
20 % after erection and commissioning

Exclusion: (Buyer's Scope)

1. Any damage to living or nonliving object.
2. Welding facility at site
3. Water required for castable.
4. Transportation/Freight.
5. Any instrumentation and control other than supplied with the furnace.
6. Start up fuel expense.
7. Expenses required for aesthetic.
8. Civil work & Electrical connections to all motors.
9. Any other item not included in scope of work.
10. Unloading/shifting of equipment at site.
11. Responsibility of any theft of material at site.

SAI MARKETING CORPORATION

"RAMAYAN", RAJNAGAR, KATOL ROAD, NAGPUR - 440 013. PH: 2592078, 2591666, FAX : 2537221

To,
SEE – Tech Solutions Pvt. Ltd.
11/5, MIDC, Infotech Park,
Near VRCE Telephone Exchange,
South Ambazari Road,
Nagpur - 440022

Subject: Quotation

Dear Sir,

With reference of discussion with you, following is the quotation for the required machineries.

Basic Costs:

Sr.	Machinery	Basic Value (Ex – works)
1	Hot Rolling Machine (15 inch)	Rs. 1,35,000/-
2	Cold Rolling Machine (15 inch)	Rs. 1,70,000/-
3	Spinning Machine	Rs. 65,000/-
4	Motor Operated Press (10 T Capacity)	Rs. 1,50,000/-
5	Hand Operated Press	Rs. 60,000/-
6	Lathe Machine (3 ft bed length)	Rs. 95,000/-

Other Costs:

Taxes: 5 % VAT or 12.5 % CST whichever is applicable
Packing and forwarding – 5 %
Installation cost is to be paid extra – 5 %
Transportation cost to be paid by the client as actual
Octroi extra as applicable if any

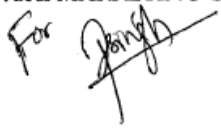
Other Terms

Warranty for 1 year against the manufacturing defect

Delivery time – 60 days

Payment – 25 % advance along with order and balance payment against the proforma invoice before delivery

FOR SAI MARKETING CORPORATION



Annexure -9: Photographs of Brass Unit using Modern Machineries

Various Equipments proposed in the modern brass unit at Bhubaneshwar Brass Cluster
(These Equipments are in use and successfully running in the other brass Clusters in India)

Moulds for Ingot Formation

Reheating Furnace

Cold Rolling Machine

Motor Operated Press

	
Lathe Machine	Lathe Machine

Bureau of Energy Efficiency (BEE)
(Ministry of Power, Government of India)
4th Floor, Sewa Bhawan, R. K. Puram, New Delhi – 110066
Ph.: +91 – 11 – 26179699 (5 Lines), Fax: +91 – 11 – 26178352
Websites: www.bee-india.nic.in, www.energymanagertraining.com

SEE-Tech Solutions Pvt. Ltd
11/5, MIDC, Infotech Park,
Near VRCE Telephone Exchange,
South Ambazari Road,
Nagpur – 440022
Website: www.letsconserve.org

India SME Technology Services Ltd
DFC Building, Plot No.37-38,
D-Block, Pankha Road,
Institutional Area, Janakpuri, New Delhi-110058
Tel: +91-11-28525534, Fax: +91-11-28525535
Website: www.techsmall.com