# RAW MATERAIL PRE HEATING - 100 TPD

**ORISSA SPONGE IRON CLUSTER**

BEE, 2010
Detailed Project Report on Raw material Preheating - 100 TPD
Sponge Iron SME Cluster, Rourkela,Orissa (India)
New Delhi: Bureau of Energy Efficiency;
Detail Project Report No.: **SPONGE/RPS/02**

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*We sincerely appreciate the efforts of industry, energy auditors, equipment manufacturers, technology providers, consultants and other experts in the area of energy conservation for joining hands with Bureau of Energy Efficiency (BEE), Ministry of Power, and Government of India for preparing the Detailed Project Report (DPR) under BEE SME Program in SMEs clusters. We appreciate the support of suppliers/vendors for providing the adoptable energy efficient equipments/technical details to the SMEs. Therefore, it was decided to bring out the DPR for the benefits of SMEs.*

*We sincerely thank the officials of BEE, Executing Agencies and ISTSL for all the support and cooperation extended for preparation of the DPR. We gracefully acknowledge the diligent efforts and commitments of all those who have contributed in preparation of the DPR.*

*We assure you, always, of our best services.*

***[V Ramchander]***

***Managing Director***

***Contents***

**List of Table**

***List of Figure***



**Lists of Abbreviations**

| | |
|---|---|
| BEE | - Bureau of Energy Efficiency |
| DPR | - Detailed Project Report |
| DSCR | - Debt Service Coverage Ratio |
| GHG | - Green House Gases |
| HP | - Horse Power |
| IRR | - Internal Rate of Return |
| MoP | - Ministry of Power |
| MoSME | - Micro Small and Medium Enterprises |
| NPV | - Net Present Value |
| ROI | - Return On Investment |
| SIDBI | - Small Industrial Development Bank of India |
| SME | - Small and Medium Enterprises |
| ESP | -Electro Static Precipitator |

## ***EXECUTIVE SUMMARY***

APITCO Ltd. is executing the BEE-SME program in Orissa Sponge Iron Cluster, supported by Bureau of Energy Efficiency (BEE) with an overall objective of improving the energy efficiency in cluster units.

Orissa State is renowned for Sponge iron manufacturing business and is a big hub for sponge iron supply. There are about 107 sponge iron units in cluster and majority of industries located in Sundargarh District area and engaged in production of sponge iron.

The major Energy consumption in sponge Iron cluster is of thermal energy which is derived from coal and electrical energy from which is used from grid. Electricity is used for supplying energy for motor driven drives like kiln main drive, cooler main drive, crushers, bag filters, pumps, ESPs etc. and lighting purpose which are essential during the operation of sponge Iron plants. If the percentage share of the total energy consumption is considered then the electrical is not more than 2% where as the remaining 98% is the thermal energy requirement. HSD is used as fuel in DG sets for generation of electricity during the power failure from Electricity board.

In Sponge Iron plants, it is observed that a good amount of heat energy is expelled out of kiln in the form of waste gases; more over an extra amount of electrical energy is given via forced draft fan to reduce the heat content of the flue gases for the environmental concern. The flue gases exits from kiln during the operation contains good percentage of carbon monoxide, which is further burnt in the ABC i.e. to convert into CO2. The After Burning Chamber, which causes rise in outlet temperature of flue gases. The considerable heat is available in flue gas and can be used for preheating the raw material. This preheating of raw material by using flue gas results reduction of coal consumption.

Installation of preheating furnace in the sponge iron plant can save 14145 MT of coal per year.

The DPR highlights the details of study conducted for assessing the potential for reducing thermal energy consumption during operation by installing raw material preheating system in various units in the cluster, possible energy savings and its monetary benefit, availability of the technologies/design, local service providers, technical features and proposed equipment specifications, various barriers in implementation, environmental aspects, estimated GHG reductions, capital cost, financial analysis, and schedule of project Implementation.

Total investment required and financial indicators calculated such as debt equity ratio, monetary saving, IRR, NPV, DSCR and ROI etc for proposed technology is furnished in Table below:

| S. No. | Particular | Unit | Value |
|---|---|---|---|
| 1 | Project cost | (in Lakh) | 375.10 |
| 2 | Coal Savings | MT/Year | 14145 |
| 3 | Monetary benefit | (in Lakh) | 336 |
| 4 | Simple payback period | Months | 1.00 |
| 5 | NPV | (in Lakh) | 730. |
| 6 | IRR | %age | 71.69 |
| 7 | ROI | %age | 30.89 |
| 8 | Average DSCR | Ratio | 4.35 |

The projected profitability and cash flow statements indicate that the project i.e. installation of raw material preheating system will be financially viable and technically feasible solution for the cluster.

## *ABOUT BEE'S SME PROGRAM*

Bureau of Energy Efficiency (BEE) is implementing a BEE-SME Programme to improve the energy performance in 29 selected SMEs clusters. Orissa Sponge Iron 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:***

***Activity 1: 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.

***Activity 2: 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 up of energy efficiency projects in the clusters

***Activity 3: Implementation of energy efficiency measures***

To implement the technology up-gradation project in the 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.

***Activity 4: 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

Rourkela is one of a town in Sundargarh District in Orissa state, India. It is located 413 kilometers East of state capital, Bhubaneswar. Sundargarh is renowned for the Sponge Iron business. They even export the finished product to various countries throughout the world. There are about 107 sponge iron industries are established and majority of industries are located in near by area of Rourkela.

The major Energy consumption in Sponge Iron cluster is thermal energy which is from coal and electricity from State Grid. Electricity is used for driving the prime movers used in the plants i.e. Kiln main drive, Cooler Kiln main, air compressors, pumps, and other drives and even for lighting purpose. The majority of energy share is in the form of thermal energy (98%) which is burning the coal and remaining is by the electrical energy.

### 1.1.1 Production process

The process of sponge iron manufacturing involves removal of oxygen from iron ore. Sponge Iron also called as Direct-Reduced Iron (DRI) is produced from direct reduction of iron ore (in the form of lumps, pellets or fines) by a reducing gas using fuel i.e. natural gas or coal. The reducing gas is a mixture majority of Hydrogen (H2) and Carbon Monoxide (CO) which acts as reducing agent. This process of directly reducing the iron ore in solid form by reducing gases is called direct reduction. In this process coal will be used for producing reducer gas and the process will be carried out in a Horizontal Rotary Kiln. The finished product i.e. sponge Iron observed under a microscope, resembles a honeycomb structure, which looks spongy in texture. Hence the name is called sponge iron.

The reduction of Iron Ore can be achieved by using either carbon bearing material, such as non-coking coal or a suitable reducing gas in the form of reformed natural gas. The processes employing coal are known as solid-reluctant of coal-based processes while those employing reducing gases are known as gas-based processes.

**The basic reactions in this process are as follows:**

$$C + O2 = CO2$$
$$CO2 + C = 2CO$$
$$Fe2O3 + CO = Fe2O3 + CO2$$
$$Fe3O4 + CO = FeO + CO2$$
$$FeO + CO = Fe + CO2$$

**Process**

Non-coking coal and iron ore along with limestone in the required size range and quantity are continuously fed into the feed – end of the inclined rotary kiln through a feed pipe. The materials move along the length of the kiln due to its inclination and rotation. Air is blown in through required number of air tubes suitably located along the length of the kiln. At the feed-end of the kiln air is blown in through nozzles for drying and pre heating of the charge. Initial heating of the kiln is carried through a central oil burner located at the discharge feed end. As the charge moves through the kiln, it is heated by the hot gases, which flow in the opposite direction to the charge (i.e. counter current flow). The initial part of the kiln (about 30%) is called the pre heating zone, where moisture in the charge and volatiles in the coal are removed / burnt off as waste gases. The required heat in this zone is provided by the combustion of the feed coal. The remaining portion of the kiln is called as the reduction zone. In this zone, oxygen in the iron ore is removed leaving metallic iron as per the following chemical reaction.

$3FeO_3 + CO$ --------------------→ $2\ Fe204 + CO_2$

$Fe_2O_4 + CO$ --------------------→ $3FeO + CO_2$

$FeO + CO$ --------------------→ $Fe + CO_2$

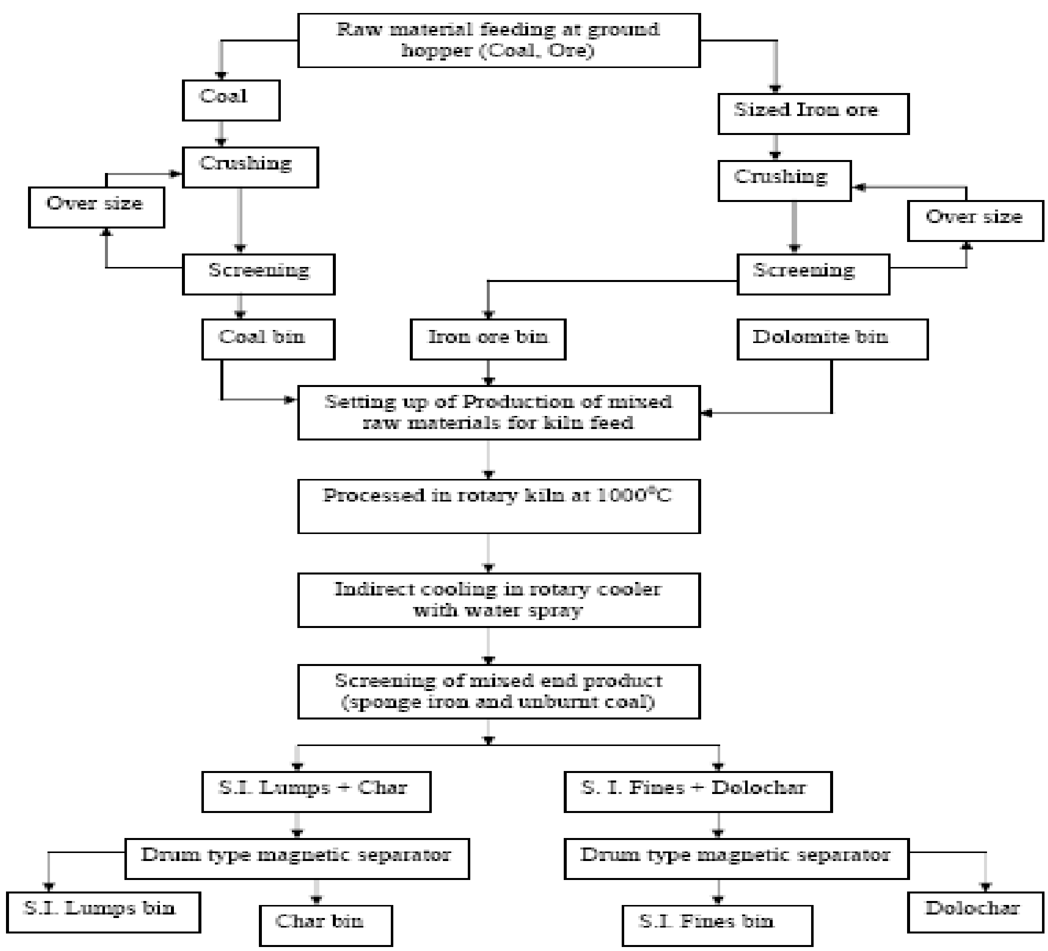
The CO is generated for the above reaction according to $CO_2 + C$ --→ $2CO$, at temperature above 900 deg. C, carbon monoxide will combine with the oxygen in the iron ore forming carbon dioxide and thus reduce the ore to metallic state.

Higher the temperature, the faster would be the oxygen removal. After the removal of oxygen and grater is the metallization of sponge iron. Metallization levels can roughly be checked by density of the sponge iron. It can also be judged by the metallic luster if a sample is rubbed against a rough surface.

After the iron ore has been metallic to the desired level, sponge iron and residual char are discharged from the kiln into a rotary drum type cooler. In the cooler sponge iron is cooled to below 250 deg. C before the material is discharged on to a belt conveyor. If the sponge iron were exposed to air at high temperatures (i.e. above 250 deg C) it would tend to re oxidize. It is therefore, necessary that the temperature of the product at the point of discharge from the cooler is as close as possible to the ambient temperature. The reduction process occurs in solid state. The crucial factor in this reduction process is the controlled combustion of coal and its conversion to carbon monoxide to remove oxygen from the iron ore.

The overall process extends to a period of 10 to 12 hours inside the kiln. During this time, iron ore is optimally reduced and the hot reduced sponge iron along with semi-burnt coal is discharged to a rotary cooler for indirect cooling to a temperature of around 120°C. Sponge iron being magnetic in nature, the discharge from cooler main drive consisting of sponge iron, chars & other contaminations are routed through electromagnetic separators, to separate other impurities from sponge iron. The product is then screened in size fractions of lump (+3mm) and fines (0-3 mm). Separate bins are installed to preserve its quality, reduce re oxidation and facilitate faster loading on to the trucks. Detailed of process flow chart are finished in Figure 1.1 below:

**Figure 1.1: General process flowchart of a typical Sponge Iron Plant**



## 1.2 Energy performance in existing situation

### 1.2.1 Fuel and electricity consumption of a typical unit in the cluster

The main energy used in a typical sponge iron industry is thermal energy derived from coal and rest is electrical energy from grid supply. Electricity is used for drive the prime movers like kiln drives, compressors, pumps, Bag filters, Crushers, FD and ID fans etc. and also for lighting. The details of different types energy consumption typical units in the cluster are presented below in Table 1.1 :

**Table 1.1: Energy consumption of typical units have 100 TPD kiln**

| S. No | Name of Industries | TPD | Annual Production | Annual Electricity consumption (millions of kWh) | Annual Coal Consumption (Tons/annum) |
|---|---|---|---|---|---|
| 1 | Bajrang Ispat Limited | 100 | 29900 | 2.89 | 40210 |
| 2 | Maa Tarani Industries Private Ltd | 100 | 27400 | 3.47 | 36848 |
| 3 | Meta Sponge Private Limited | 100 | 26400 | 3.25 | 35503 |
| 4 | Pavan jay Sponge Limited | 100 | 27200 | 3.14 | 36579 |
| 5 | Shri Balaji Metallics Pvt Ltd | 100 | 28900 | 3.48 | 38533 |
| 6 | Utkal Metallic Limited | 100 | 25689 | 3.12 | 34547 |

### 1.2.2 Average production by a typical unit in the cluster

The average production in sponge iron unit is depends on the no of kilns installed and each kiln Capacity. A single 100 TPD kiln production varies in between 29000 to25000 tons per annum depending upon the duration of campaign period per year and raw material quality.

### 1.2.3 Specific Energy Consumption

In sponge iron plants, both thermal and electrical energy are required to produce sponge iron from Iron Ore. The major share of energy is in the form of thermal energy (97%) and remaining 3% is electrical energy.

## 1.3 Existing technology/equipment

### 1.3.1 Description of existing technology

In sponge Iron Cluster in Orissa, all the units are using the coal as major energy consumption. In these sponge iron plants the flue gas generated during the process contains high temperature which is sending through chimney by cooling up to the required temperature in ESP. The heat content in flue gas is higher can be used for pre heating the raw material used in sponge iron plants.

Major units are not utilizing the same in their plant wasting the heat energy by sending out without utilizing. The Raw material i.e. Iron Ore, coal and lime stone is pre heating to the heating in kiln from 1st zone to the 6th zone where the material temperature goes from 35 C to 800 C . During the process huge amount of flue gas is generate with higher temperature and majority of flue gas contain CO and rest is Co2.

The higher temperature of flue gas i.e.CO is burned in the ABC due to CO cannot be sent out directly. During the burning process of CO, the Co is converted into CO2 and the temperature of flue gas i.e. CO2 is increased up to 1000C. The higher temperature of flue gas is then sent to the FD/GCT chambers to cool the flue gas up to the acceptable temperature to the ESP i.e.200-250C. During the cooling of the flue gas electricity /water is used.

During the process, cooling of flue gas thermal energy is simply cooling without utilizing with in process and also energy is consumed to reduce the temperature of the flue gas.

### 1.3.2 Its role in the whole process

As the proposed system is not replacing any of existing technology thus to describe the role in the whole process is not applicable.

## 1.4 Establishing the baseline for the equipment

### 1.4.1 Design and operating parameters

The present thermal energy consumption in 100 TPD kiln is 180 MT per day coal and operates throughout the day.

### 1.4.2 Coal consumption in existing system

The coal consumption in 100 TPD sponge Iron Rotary kiln for various units in the cluster are given in Table 1.4 :

**Table 1.4 Coal consumption in 100TPD Rotary kiln in Cluster**

| S. No | Name of Industries | TPD | Annual Product ion | Annual Electricity consumption (millions of kWh) | Annual Coal Consumption (Tons/annum) |
|---|---|---|---|---|---|
| 1 | Bajrang Ispat Limited | 100 | 29900 | 2.89 | 40210 |
| 2 | Maa Tarani Industries Private Ltd | 100 | 27400 | 3.47 | 36848 |
| 3 | Meta Sponge Private Limited | 100 | 26400 | 3.25 | 35503 |
| 4 | Pavan jay Sponge Limited | 100 | 27200 | 3.14 | 36579 |

| | | | | | |
|---|---|---|---|---|---|
| 5 | Shri Balaji Metallics Pvt Ltd | 100 | 28900 | 3.48 | 38533 |

### 1.4.3 Operating efficiency of existing kiln

The detailed energy audit studies have been undertaken in various units in the cluster to evaluate the kiln efficiency, which was found between 30 to 40%.

## 1.5 Barriers for adoption of new and energy efficient technology / equipment

### 1.5.1 Technological Barriers

The major technical barriers that prevented to implementation the Raw material pre heating system in the cluster are:

- Lack of awareness of Raw material pre heating system
- Lack of information on technology providers
- Some of the bigger plants are installed the raw material pre heating system but is not working due to technical problems. Due to this doubt on technology, many kiln operators are not installed.

### 1.5.2 Financial Barrier

Implementation of Raw material pre heating system in Sponge Iron manufacturing requires higher investment. Hence, many owners don't show interest due to high initial investment. Further, lack of awareness on successful of raw material pre heating in sponge iron plants also one of the major factors for implementing the technology.

Energy Efficiency Financing Schemes such as SIDBI's, if focused on the cluster, will play a catalytic role in implementation of identified energy conservation projects & technologies. The cluster has significant potential for implementing the raw material pre heating system.

### 1.5.3 Skilled manpower

Not applicable

### 1.5.4 Other barrier(s)

Information on energy efficient technologies is not available among cluster unit owners, though the suppliers are available in India.

## 2. TECHNOLOGY/EQUIPMENT FOR ENERGY EFFICIENCY IMPROVEMENTS

### 2.1 Detailed description of technology/equipment selected

If the sponge iron industries utilize the heat in flue gas by adopting the preheating kiln, considerable coal is saved and the coal consumption is reduced in the plant. The pre heating kiln system will improve the efficiency of existing kiln and increase the productivity. The energy consumed for cooling the flue gases are reduced by adopting the raw material pre heating system. All Sponge Iron pants more than 100 TPD can be used this technology.

The following benefits are expected by installing pre heating kiln in sponge iron plants using flue gases for pre heating of raw material. They are

- Increase the productivity
- Reduced Process time
- Reduction in Electricity cost
- Reduce the coal consumption in process
- Improved plant Efficiency
- Reduction in GHG emissions

#### 2.1.1 Description of equipment

The pre heating kiln is a equipment which is similar to the rotary existing kiln except the application. In the pre heating kiln raw material is passed in one way and flue gas from existing rotary kiln where reaction is takes place is passes in another side. The rotation of the pre heating kiln is similar/ less than the existing kiln which should match the process requirement.

**Process Description**

In the existing rotary kiln the total process i.e. heating the raw material and reduction process is completed with in the single kiln. But proposed project activity the heating of raw material is done in pre heating rotary kiln and the reaction in raw material takes place in existing rotary kiln.

In sponge Iron Industries coal is used in the kiln to heat the Iron ore and the reactant up to 700 C and reactant. So generated high temperature flue gas from the rotary kilns can used for preheating of raw material. The higher temperature flue gas is used for pre heating the raw material by installing the raw material pre heating kiln.

**Coal savings**

The flue gas generated in 100 TPD kiln during the process is around 24000 Nm3/hr and the temperature of flue gas is 900-950 C. Based on the temperature of flue gas and quantity of flue gas, the total heat available in the flue gas is 5893655 kcal /hr. The heat content can be utilized for pre heating the raw material i.e. coal and iron ore up to the required temperature before reaction takes place in existing rotary kiln. The heat content available in flue gas is utilized by adopting the pre heating kiln in existing rotary kiln , the heat required to heat the raw material will be saved i.e. at least 20% of coal is saved and productivity also increases up to 20% due to reducing the residence time existing rotary kiln.

### 2.1.2 Technology /Equipment specifications

The detailed specification of Raw material pre heating system furnished in table 2.1 below:

**Table 2.1: Raw material pre heating system Specifications**

| S. No | Parameter | Unit | Value |
|---|---|---|---|
| 1 | Type of Equipment | | Rotary kiln |
| 2 | Pre heating kiln Capacity | TPD | 100 |
| 3 | Quantity of Flue gas Flow | Nm3/hr | 24000 |
| 4 | Temperature of Flue gas (In) | C | 900-1000 |
| 5 | Temperature of Flue Gas(Out) | C | 250 |
| 6 | Raw material temperature after pre heated | C | 800—850 |
| 7 | Gas flow | | Counter flow |

### 2.1.3 Justification of the technology selected & Suitability

The flue gas coming out of the reduction kiln is having a very high thermal energy which not been used for any of the process activity. Further the high temperature content of the gas is made to cool down by the force draft fan in waste gas treatment zone which is then fed to the ESP for the waste gas cleaning due to the environment concern. This technology is very useful for exchanging the heat of the waste flue gases for preheating the iron ore and dolomite mixture in the preheating chamber and the mixture enter the kiln at a temperature of around 700$^0$C into the reduction kiln. As the temperature of the mixture has already risen, thus the mixture entering the kiln does not require any extra heat for preheating which in turns reduces the coal consumption equivalent to the energy supplied by the pre heating system.

### 2.1.4 Superiority over existing technology/equipment

In the present process condition extra amount of energy is required to reduce the waste heat of the exhaust flue gas. This is the energy required to run the FD fans for cooling the flue gas for the safety of the environment. With the installation of the pre heating system good amount of heat is absorbed for per heating ore and dolomite mixture. The on implementing this technology the process gets superior to the previous system by the following ways.

- The production increases by a minimum of 20% than the earlier.
- No changes required in the process thus with keeping the quality intact, increases the production.
- Coal consumption for the preheating of the iron ore and dolomite mixture in the preheating zone is not required after installation of the system thus reduces the coal consumption significantly resulting in cost reduction.
- Utilizes the waste energy of the flue gas which unused in the previous system.
- Reduces the environmental effect.

### 2.1.5 Availability of proposed technology/equipment

Such equipment suppliers are available and are already been installed in some of the sponge iron plants in India. The detail of the supplier is provided in Annexure-6.

### 2.1.6 Source of technology/equipment for the project

The source of the technology is indigenous and is available.

### 2.1.7 Service/technology providers

A detail of supplier has been furnished in Annexure 6.

### 2.1.8 Terms of sales

No any specific terms and conditions

### 2.1.9 Process down time during implementation

The process down time for installation of Raw material pre heating rotary kiln is one week. The pre heating kiln is installed before the existing kiln. The raw material from the pre heating kiln is entered after utilizing flue gas from the existing kiln. The flue gas is entered in the out let of the pre heating kiln and the raw material is entered in pre heating kiln in another side.

After installation of the pre heating kiln in the existing system to club the both pre heating kiln and existing kiln required at least one week time to stream line the raw material flow and the adjust the temperature to be attained during the process.

### 2.2 Life cycle assessment and risks analysis

The life of the Raw material pre heating rotary kiln system is considered for 25 years. There is no risk involved as the technology is installed in few plants and running successfully.

### 2.3 Suitable unit/plant size in terms of capacity/production

The raw material pre heating system is kiln specific. If one 100 TPD kiln required 100 TPD of raw material pre heating rotary kiln and should be installed at the out let of the flue gas path.

# 3. ECONOMIC BENEFITS FOR THE INSTALLATION OF PRE HEATING KILN

## 3.1 Technical benefits

### 3.1.1 Fuel savings per year

The raw material preheating rotary kiln is installed at the exhaust end of the kiln after the after burning chamber where from the exhaust heat of the fuel gas is absorbed for pre heating of the iron ore and dolomite mixture and is fed at a temperature of $700^0$ C, which was previously achieved at the pre heating zone of the kiln. Thus the coal consumption for pre heating the same is not required. About 14145 tons of coal can be saved per annum by installing raw material pre heating rotary kiln in 100 TPD kiln.

### 3.1.2 Electricity savings per year

There is electrical energy savings due to avoid of FD fans and GCT system.

### 3.1.3 Improvement in product quality

There is no significant impact on the product quality.

### 3.1.4 Increase in production

There is an increase of approximately 20% in production capacity.

### 3.1.5 Reduction in raw material consumption

Not Applicable

### 3.1.6 Reduction in other losses

Not Applicable

## 3.2 Monetary benefits

The monetary benefit due to installation of raw material pre heating system kiln to the existing rotary kiln with a capacity of for 100TPD kiln is Rs. 336 lakhs per annum due to reduction of coal consumption for the pre heating of the iron ore and dolomite mixture. Details of the saving are given in Table 3.1 below:

**Table 3.1: Energy and monetary benefits**

| S. No. | Parameter | Unit | Value |
|---|---|---|---|
| 1 | Present coal consumption by a typical 100 TPD kiln | Tons/annum | 48000 |
| 2 | Total Coal savings due to Pre heating of kiln | Tones /annum | 14145 |

| | | | |
|---|---|---|---|
| 3 | Monetary Savings due to preheating kiln | Rs. annum (In lakh) | 336 |

## 3.3 Social benefits

### 3.3.1 Improvement in working environment in the plant

There is clean environment in the plant by installing the Pre heating kiln.

### 3.3.2 Improvement in skill set of workers

The technology selected for implementation is pre heating kiln will create the awareness among the workforce on advancement of the waste heat recovery system and how it will reduce the total energy consumption by existing process.

## 3.4 Environmental benefits

### 3.4.1 Reduction in effluent generation

None

### 3.4.2 Reduction in GHG emission such as $CO_2$, $NO_X$, etc

The major GHG emission reduction source is $CO_2$.The reduction coal consumption is reduce the CO2 emissions.

### 3.4.3 Reduction in other emissions like SOx

No significant impact on SOx emissions.

# 4. INSTALLATION OF PRE HEATING KILN

## 4.1 Cost of technology/equipment implementation

### 4.1.1 Cost of technology/equipments

The total cost of Pre heating kiln is estimated to be Rs. 341.00 lakhs, which includes all the required equipment. Other details are mentioned in the quotation attached in Annexure 7.

### 4.1.2 Other costs

Other charges include cabling and panel modification. Project cost details are furnished in Table 4.1 below:

**Table 4.1: Project detail cost**

| S. No. | Particular | Unit | Value |
|---|---|---|---|
| 1 | Pre heating Kiln | in lakh | 341.00 |
| 2 | Erection and Commissioning. | in lakh | 17.05 |
| 3 | Cabling , civil works and Instrumentation | In lakhs | 17.05 |
| 3 | Total Investment | in lakh | 375.10 |

## 4.2 Arrangement of funds

### 4.2.1 Entrepreneur's contribution

The entrepreneur's contribution is 25% of total project cost, which works out at Rs. 93.78 lakh.

### 4.2.2 Loan amount

The term loan is 75% of the total project, which is Rs.281.33 lakh.

### 4.2.3 Terms & conditions of loan

The interest rate is considered at 10.0% which is prevailing interest rate of SIDBI for energy efficiency related projects. The loan tenure is 5 years and the moratorium period is 6 months.

### 4.3 Financial indicators

#### 4.3.1 Cash flow analysis

Considering the above discussed assumptions, the net cash accruals starting with 283.29 lakh in the first year operation and increases to 1319 at the end of fifth year.

#### 4.3.2 Simple payback period

The total project cost of the proposed technology is Rs. 341.00 lakh and monetary savings due to reduction in electricity consumption is Rs. 336.00 lakh and the simple payback period works out to be 1.0 years.

#### 4.3.3 Net Present Value (NPV)

The Net present value of the investment at 10.0% interest rate works out to be Rs.730. lakh.

#### 4.3.4 Internal rate of return (IRR)

The after tax Internal Rate of Return of the project works out to be 71.69 %. 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 30.89%. The average DSCR is 4.35.

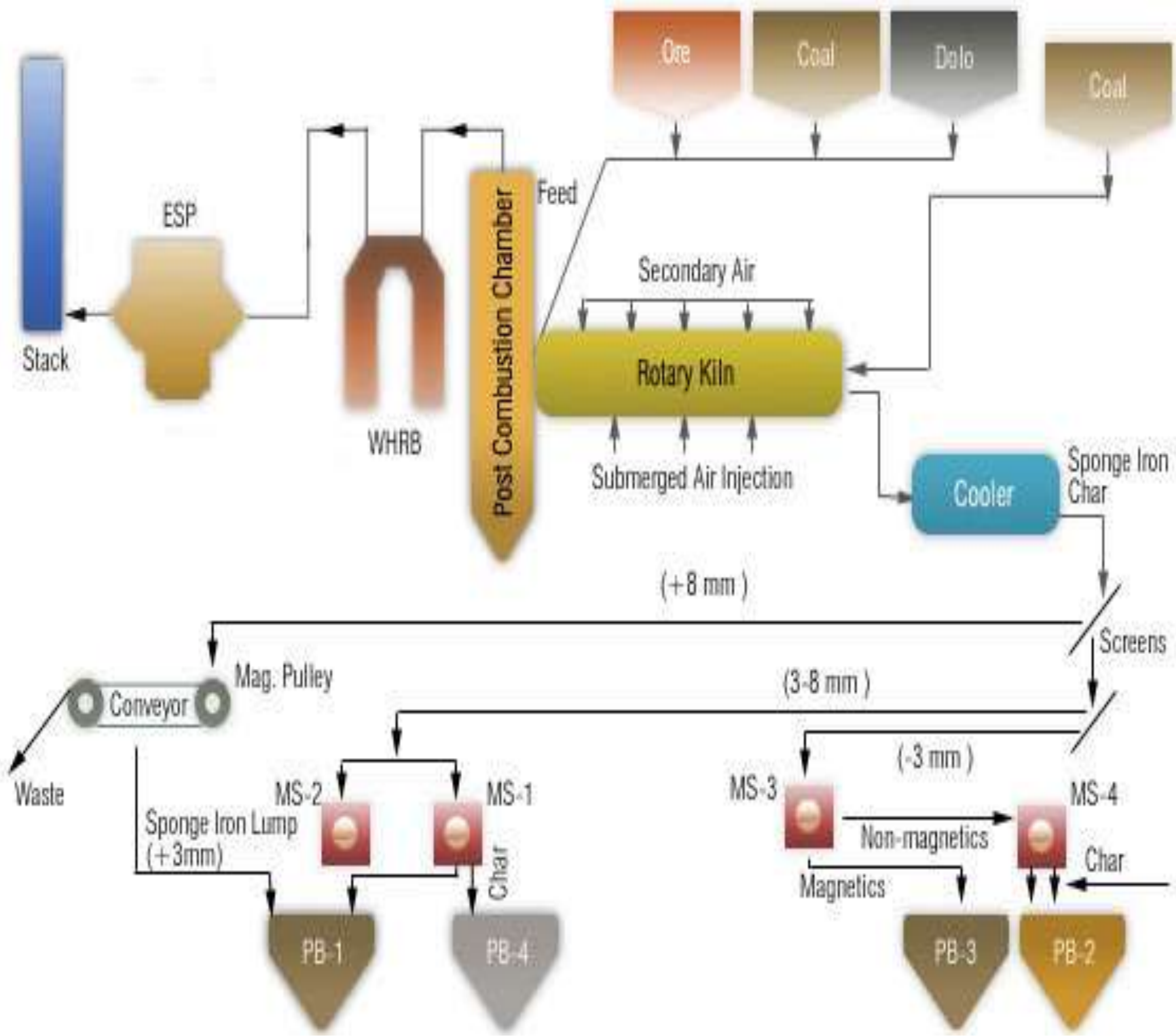
### 4.4 Procurement and implementation schedule

The project is expected to be completed in 4 weeks from the date of release of purchase order. The detailed schedule of project implementation is furnished in Annexure 5.

***ANNEXURE***

**Annexure 1: Process Flow Diagram**

Process flow diagram will remain the same after implementation of proposed energy efficient motor.



**Annexure2: Detailed technology assessment report–Raw Material Preheating-100TPD**

| S.No | Particulars | Units | Existing kiln | Pre heated kiln Tech |
|---|---|---|---|---|
| 1 | Installed Capacity of kiln | TPD | 100 | 100 |
| 2 | Iron Ore Consumption | TPD | 160 | 160 |
| 3 | Coal Calorific Value | kcal/kg | 3000 | 3000 |
| 4 | Coal Consumption | TPD | 180 | 180 |
| 5 | Dolomite | TPD | 5 | 5 |
| 6 | Total Flue Gas Generated in kiln | Nm3/Hr | 24000 | 24000 |
| 7 | Density of flue gas | kg/m3 | 1.31 | 1.31 |
| 8 | Actual Gas flow | kg/hr | 31483 | 31483 |
| 9 | Flue gas Temperature at kiln out let | oC | 900 | |
| 10 | Flue gas temperature at inlet to ESP | oC | 300 | |
| 11 | Sp. heat of flue gas | kcal/kg C | 0.3 | |
| 12 | Heat available from flue gas | kcal/hr | 5893655 | |
| 13 | Equivalent Coal Savings | kg/hr | 1965 | |
| 14 | No of hours operation | hrs/day | 24 | |
| 15 | No of Days operation | Days/year | 300 | |
| 16 | Total coal savings | Tons/year | 14145 | |
| 17 | Total monetary savings | Rs.Lakhs/year | 354 | |
| 18 | Electrical energy Consumption | kWh/Day | 1800 | |
| 19 | Electrical energy cost for preheating kiln | Rs.Lakhs/year | 18 | |
| 20 | Total monetary savings | Rs.Lakhs/year | 336 | |
| 21 | Cost of preheating kiln including civil, equipment etc | Rs.Lakhs | 341 | |
| 22 | Total investment required | Rs. Lakhs | 341 | |
| 23 | Payback period | Years | 1.0 | |

**Note:**

1. The power tariff slabs from Electricity Board are Rs.3.30 to 3.75 based on the energy consumption in a month. Here Rs.3.30 per kWh is taken for small capacity plants like 50TPD Plants
2. The coal quality and quantity is depends on the mine to mine. The calorific value of coal is depends on mine and is varies from 2500 to 3000 kcal/kg.
3. The landed cost of coal is also varies depends on quality and the distance from the plant. Here the average landed cost of coal is Rs.2500 per ton of coal.
4. The proposed pre heating kiln and other equipments installed in existing rotary kiln will consume average of 180 units per day based on the capacity of equipments, capacity of motors, blowers, fans and others etc installed in the pre heating kiln.
5. The consumption coal in the 100 TPD kilns and other will depends on the plant to plant and also quality and calorific value of fuel. Here the requirement of coal for the production of 100 TPD sponge Iron is taken as 160 Tons per day

**Annexure 3: Detailed drawing for civil works**

## Annexure 4: Detailed financial calculations & analysis

### Assumptions

| Assumptions | | | | |
|---|---|---|---|---|
| | Name of the Technology | Pre Heating Kiln | | |
| | Rated Capacity | 100TPD Sponge Iron Plant | | |
| | Details | Unit | Values | Basis |
| | No of working days | Days | 300 | |
| | No of Shifts per day | Shifts | 3 | |
| | Capacity Utilisation Factor | % | 65 | |
| | Proposed Investment | | | |
| | Pre Heating Kiln | Rs. in lakhs | 341.00 | |
| | Erection and Comisioning | Rs.in Lakhs | 17.05 | |
| | Cabling, Civils and Modifications | lumpsum | 17.05 | |
| | Total Investment | Rs. in lakhs | 375.10 | |
| | Financing pattern | | | |
| | Own Funds (Internal Accruals) | Rs. in lakhs | 93.78 | Feasibility Study |
| | Loan Funds (Term Loan) | Rs. in lakhs | 281.33 | Feasibility Study |
| | Loan Tenure | Years | 5.5 | Assumed |
| | Moratorium Period | Months | 6 | Assumed |
| | Repayment Period | Months | 72 | Assumed |
| | Interest Rate | % | 10 | SIDBI Lending Rate |
| | Estimation of Costs | | | |
| | O & M Costs | % on Plant & Equip | 5 | Feasibility Study |
| | Annual Escalation | % | 5 | Feasibility Study |
| | Estimation of Revenue | | | |
| | Coal savings | Tons/Year | 14145 | |
| | Coal Saving Cost | Rs./ton | 2500 | Detailed calculations enclosed in DPR |
| | St. line Depn. | % | 5.28 | Indian Companies Act |
| | IT Depreciation | % | 80.00 | Income Tax Rules |
| | Income Tax | % | 33.99 | Income Tax |

| Estimation of Interest On Term Loan | | | | (Rs.in lakhs) |
|---|---|---|---|---|
| Years | Opening Balance | Repayment | Closing Balance | Interest |
| 1 | 281.33 | 23.44 | 257.88 | 28.13 |
| 2 | 257.88 | 46.89 | 210.99 | 25.79 |
| 3 | 210.99 | 46.89 | 164.11 | 21.10 |
| 4 | 164.11 | 46.89 | 117.22 | 16.41 |
| 5 | 117.22 | 46.89 | 70.33 | 11.72 |
| 6 | 70.33 | 46.89 | 23.44 | 7.03 |
| | 23.44 | 23.44 | 0.00 | 2.34 |
| | Total | 281.33 | | |

| WDV Depreciation | | | | | (Rs.in lakhs) | | |
|---|---|---|---|---|---|---|---|
| Particulars / years | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Plant and Machinery | | | | | | | |
| - Cost | 375.10 | 272.80 | 54.56 | 10.91 | 2.18 | 2.73 | 0.55 |
| - Depreciation | 19.81 | 19.81 | 19.81 | 19.81 | 19.81 | 19.81 | 19.81 |
| - WDV | 272.80 | 54.56 | 10.91 | 2.18 | 2.73 | 0.55 | 0.00 |

| Projected Profitability | | | | (Rs.in lakhs) | | | | |
|---|---|---|---|---|---|---|---|---|
| Particulars / Years | 1 | 2 | 3 | 4 | 5 | 6 | 7 | Total |
| Revenue through Savings | | | | | | | | |
| power savings | 353.62 | 353.62 | 353.62 | 353.62 | 353.62 | 353.62 | 353.62 | 2475.34 |
| Total Revenue(A) | 353.62 | 353.62 | 353.62 | 353.62 | 353.62 | 353.62 | 353.62 | 2475.34 |
| EXPENSES | | | | | | | | 0.00 |
| O & M Expenses | 18.76 | 18.76 | 18.76 | 18.76 | 18.76 | 18.76 | 18.76 | 131.29 |
| Total Expenses(B) | 18.76 | 18.76 | 18.76 | 18.76 | 18.76 | 18.76 | 18.76 | 131.29 |
| PBDIT(A)-(B) | 334.86 | 334.86 | 334.86 | 334.86 | 334.86 | 334.86 | 334.86 | 2344.05 |
| Interest | 28.13 | 25.79 | 21.10 | 16.41 | 11.72 | 7.03 | 2.34 | 112.53 |
| PBDT | 306.73 | 309.08 | 313.76 | 318.45 | 323.14 | 327.83 | 332.52 | 2231.52 |
| Depreciation | 19.81 | 19.81 | 19.81 | 19.81 | 19.81 | 19.81 | 19.81 | 138.64 |
| PBT | 286.93 | 289.27 | 293.96 | 298.65 | 303.34 | 308.03 | 312.71 | 2092.88 |
| Income tax | 0.00 | 86.51 | 102.94 | 107.50 | 109.84 | 111.24 | 113.02 | 631.05 |
| Profit after tax (PAT) | 286.93 | 202.76 | 191.02 | 191.15 | 193.50 | 196.78 | 199.69 | 1461.83 |

| Computation of Tax | | | | | (Rs.in lakhs) | | |
|---|---|---|---|---|---|---|---|
| Particulars / Years | 1 | 2 | 3 | 4 | 5 | 6 | 6 |
| Profit before tax | 286.93 | 289.27 | 293.96 | 298.65 | 303.34 | 308.03 | 312.71 |
| Add: Book depreciation | 19.81 | 19.81 | 19.81 | 19.81 | 19.81 | 19.81 | 19.81 |
| Less: WDV depreciation | 272.80 | 54.56 | 10.91 | 2.18 | 0.00 | 0.55 | 0.00 |
| Taxable profit | 33.93 | 254.52 | 302.85 | 316.27 | 323.14 | 327.29 | 332.52 |
| Income Tax | 0.00 | 86.51 | 102.94 | 107.50 | 109.84 | 111.24 | 113.02 |

| Projected Balance Sheet | | | | | | | |
|---|---|---|---|---|---|---|---|
| Particulars / Years | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| LIABILITIES | | | | | | | |
| Share Capital | 93.78 | 93.78 | 93.78 | 93.78 | 93.78 | 93.78 | 93.78 |
| Reserves & Surplus | 286.93 | 489.69 | 680.71 | 871.86 | 1065.36 | 1262.14 | 1461.83 |
| Term Loans | 257.88 | 210.99 | 164.11 | 117.22 | 70.33 | 23.44 | 0.00 |
| **TOTAL LIABILITIES** | **638.58** | **794.46** | **938.59** | **1082.85** | **1229.46** | **1379.36** | **1555.60** |
| ASSETS | | | | | | | |
| Gross Fixed Assets | 375.10 | 375.10 | 375.10 | 375.10 | 375.10 | 375.10 | 375.10 |
| Less : Accm.depreciation | 19.81 | 39.61 | 59.42 | 79.22 | 99.03 | 118.83 | 138.64 |
| Net Fixed Assets | 355.29 | 335.49 | 315.68 | 295.88 | 276.07 | 256.27 | 236.46 |
| Cash & Bank Balance | 283.29 | 458.97 | 622.90 | 786.97 | 953.39 | 1123.09 | 1319.14 |
| **TOTAL ASSETS** | **638.58** | **794.46** | **938.59** | **1082.85** | **1229.46** | **1379.36** | **1555.60** |
| Net Worth | 380.70 | 583.46 | 774.48 | 965.63 | 1159.13 | 1355.91 | 1555.60 |
| Debt Equity Ratio | 2.75 | 2.25 | 1.75 | 1.25 | 0.75 | 0.25 | 0.00 |

| Projected Cash Flow: | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Particulars / Years | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Sources | | | | | | | | |
| Share Capital | 93.78 | - | - | - | | | | |
| Term Loan | 281.33 | | | | | | | |
| Profit After tax | | 286.93 | 202.76 | 191.02 | 191.15 | 193.50 | 196.78 | 199.69 |
| Depreciation | | 19.81 | 19.81 | 19.81 | 19.81 | 19.81 | 19.81 | 19.81 |
| **Total Sources** | **375.10** | **306.73** | **222.57** | **210.83** | **210.95** | **213.31** | **216.59** | **219.50** |
| Application | | | | | | | | |
| Capital Expenditure | 375.10 | | | | | | | |
| Repayment Of Loan | - | 23.44 | 46.89 | 46.89 | 46.89 | 46.89 | 46.89 | 23.44 |
| **Total Application** | **375.10** | **23.44** | **46.89** | **46.89** | **46.89** | **46.89** | **46.89** | **23.44** |
| Net Surplus | - | 283.29 | 175.68 | 163.94 | 164.07 | 166.42 | 169.70 | 196.05 |
| Add: Opening Balance | **-** | **-** | **283.29** | **458.97** | **622.90** | **786.97** | **953.39** | **1,123.09** |
| Closing Balance | **-** | 283.29 | 458.97 | 622.90 | 786.97 | 953.39 | 1123.09 | 1319.14 |

| Calculation of Internal Rate of Return | | | | | (Rs.in lakhs) | | | |
|---|---|---|---|---|---|---|---|---|
| Particulars / months | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Profit after Tax | | 286.93 | 202.76 | 191.02 | 191.15 | 193.50 | 196.78 | 199.69 |
| Depreciation | | 19.81 | 19.81 | 19.81 | 19.81 | 19.81 | 19.81 | 19.81 |
| Interest on Term Loan | | 28.13 | 25.79 | 21.10 | 16.41 | 11.72 | 7.03 | 2.34 |
| Cash outflow | (375.10) | - | - | - | - | - | - | - |
| Net Cash flow | (375.10) | 334.86 | 248.35 | 231.92 | 227.36 | 225.03 | 223.62 | 221.84 |
| IRR | 71.69% | | | | | | | |
| NPV | 730.07 | | | | | | | |

| Break Even Point | | | | | | | |
|---|---|---|---|---|---|---|---|
| Particulars / Years | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| A. Variable Expenses | | | | | | | |
| Oper. & Maintenance Exp (75%) | 14.07 | 14.07 | 14.07 | 14.07 | 14.07 | 14.07 | 14.07 |
| Sub Total | **14.07** | **14.07** | **14.07** | **14.07** | **14.07** | **14.07** | **14.07** |
| B.Fixed Expenses | | | | | | | |
| Oper.& Maintenance Exp (25%) | 4.69 | 4.69 | 4.69 | 4.69 | 4.69 | 4.69 | 4.69 |
| Interest on Term Loan | 28.13 | 25.79 | 21.10 | 16.41 | 11.72 | 7.03 | 2.34 |
| Depreciation | 19.81 | 19.81 | 19.81 | 19.81 | 19.81 | 19.81 | 19.81 |
| Sub Total | **52.63** | **50.28** | **45.59** | **40.90** | **36.22** | **31.53** | **26.84** |
| C.Sales | 353.62 | 353.62 | 353.62 | 353.62 | 353.62 | 353.62 | 353.62 |
| D.Contribution | 339.55 | 339.55 | 339.55 | 339.55 | 339.55 | 339.55 | 339.55 |
| E.Break Even Point (B/D) | 15.50% | 14.81% | 13.43% | 12.05% | 10.67% | 9.28% | 7.90% |
| F.Cash Break Even | 9.67% | 8.98% | 7.59% | 6.21% | 4.83% | 3.45% | 2.07% |
| G.BREAK EVEN SALES | 54.81 | 52.37 | 47.48 | 42.60 | 37.72 | 32.83 | 27.95 |

| Return on Investment | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Particulars / Years | 1 | 2 | 3 | 4 | 5 | 6 | 7 | Total |
| A.Net Profit Before Taxes | 286.93 | 289.27 | 293.96 | 298.65 | 303.34 | 308.03 | 312.71 | 2092.88 |
| B.Net Worth | 380.70 | 583.46 | 774.48 | 965.63 | 1159.13 | 1355.91 | 1555.60 | 6774.92 |
| | | | | | | | | 30.89% |

| Debt Service Coverage Ratio | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Particulars / Years | 1 | 2 | 3 | 4 | 5 | 6 | 7 | Total |
| CASH INFLOW | | | | | | | | |
| Profit after Tax | 286.93 | 202.76 | 191.02 | 191.15 | 193.50 | 196.78 | 199.69 | 1461.83 |
| Depreciation | 19.81 | 19.81 | 19.81 | 19.81 | 19.81 | 19.81 | 19.81 | 138.64 |
| Interest on Term Loan | 28.13 | 25.79 | 21.10 | 16.41 | 11.72 | 7.03 | 2.34 | 112.53 |
| TOTAL | **334.86** | **248.35** | **231.92** | **227.36** | **225.03** | **223.62** | **221.84** | 1713.00 |
| DEBT | | | | | | | | 0.00 |
| Interest on Term Loan | 28.13 | 25.79 | 21.10 | 16.41 | 11.72 | 7.03 | 2.34 | 112.53 |
| Repayment of Term Loan | 23.44 | 46.89 | 46.89 | 46.89 | 46.89 | 46.89 | 23.44 | 281.33 |
| TOTAL | **51.58** | **72.68** | **67.99** | **63.30** | **58.61** | **53.92** | **25.79** | 393.86 |
| Average DSCR | **4.35** | | | | | | | |

**Annexure 5: Details of procurement and implementation plan**

**Project Implementation schedule**

| S. No | Activity | Weeks | | | |
|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 |
| 1 | Placement of Orders for Equipment | | | | |
| 2 | Supply of Pre heating Kiln | | | | |
| 3 | Installation of the Pre heating Kiln | | | | |
| 4 | Trial runs | | | | |

**Annexure 6: Details of technology/equipment and service providers**

| Equipment details | Source of technology | Service/technology providers |
|---|---|---|
| Raw Material Pre heating System | Indian | Sree **Satya Sai Technical Services**<br>**John Reddy**<br>Mob. 08805751113 |

## Annexure 7: Quotation or techno-commercial bid

**Date: 17-04-2011**

**To,**
**APITCO Limited,**
**Hyderabad**

**Kind Attn. : Mr. Vamshee Krishna .**

Dear Sir,
'Greetings'

at the very outset, we would like to thank you for your enquiry regarding projects.

We have a project for converting the conventional Sponge Iron units into pre heating system. With a small investment of 3.5 Crores, sponge iron specific coal consumption can be reduced to 20 – 25 % in pre -heating kiln system.

Present 10 to 15 Pre Heating Kiln units are in operation and showing the result in saving the coal. But due to the basic design problem, all the units are facing the operational problems like lower campaign life and process and instability.

Starting unit's operational problems demoralized the sponge iron managements in investing for pre heating system. But basically Iron ore pre heating system in sponge iron process is reducing the specific coal consumption of 20 – 25 %.

Even some units already tried for converting the conventional kiln into pre heating system looking into increased coal prices. But the same design problem and operating team capabilities made failure of that project.

After studying all the units' data we prepared a project for converting the conventional kiln into pre heating system in a different way. Here the operational problems of process instability and lower campaign life will be eliminated.

Recently we prepared two parties for implementing the same by explaining the running pre heating unit's problems and remedies available in our system. Within a short period we are going to start the works.

We have solution for recovery of CD material sensible heat in Sponge Iron units but, it is very small quantity 2 to 3 % of total energy input. Nearly 12 Gcal/day in a 100 TPD unit.

Here we are attaching the presentation for pre heating system including the heat analysis and comparative heat recovery system analysis.

Hope the same will be inline with your requirements.

Looking forward your comments / clarifications for the same.

Thanks & Regards

**For Shree Satya Sai Technical Services**

**John Reddy**
Mob. 08805751113

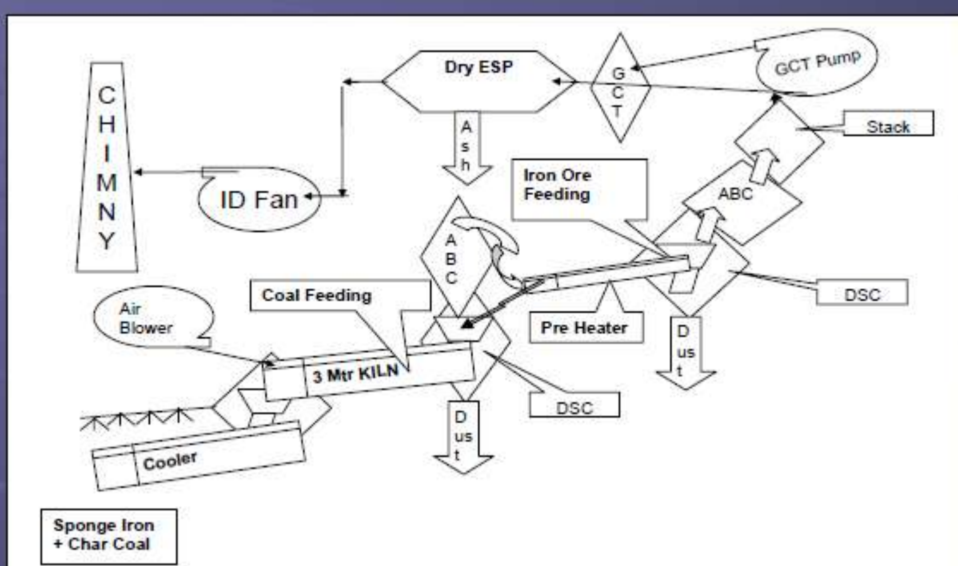
# Project Report for Pre Heating Kiln Arrangement in the existing system

## TABLE OF CONTENT

## INTRODUCTION

- India has been the largest producer of Sponge Iron in the world since last few years.
- Local conditions here favored coal based rotary kiln units, but rotary kiln sponge iron has low energy efficiency.
- In present units 6 Gcal energy is spending to produce one MT of Sponge Iron.
- Where as 1.7 Gcal is utilized in sponge iron process.
- About 2 to 2.5 Gcal per metric ton of sponge iron is going in waste gasses.
- Most of the units cooling these gasses by spraying water in GCT.
- To recover this waste gas energy even through power generation is one of feasible option.
- **It is always preferable to plough as much of this energy back in to the process as possible.**
- Heating of iron ore in another rotary kiln without coal burning and by using only waste gas heat is an attractive possibility.
- This is called **Pre Heating Kiln System.**

**Flow Diagram for Iron Ore Pre Heating with Kiln Exit Gasses**



**Pre Heating Kiln Working Principle**

- In the pre heater system sized iron ore is continuously fed into the pre heater and where as coal fed into the main kiln.
- The waste gas librated through reduction process is passes through the pre heater kiln.
- The pre heating kiln is so designed as to heat the iron ore to about 800 to 850 $^0$C by utilizing the waste heat from main kiln exit gasses.
- The discharge end of the pre heating kiln is connected to the main kiln ABC top end by the ducting to draw the waste gasses into the pre heating kiln.
- Where the waste gasses enter in counter current fashion and the combustibles are burn with pre heated air and Iron Ore get Pre Heated.
- The rest of the pre heating kiln effectively act as a cooler for gasses and the temperature will come down to 500 $^0$C.
- By which we can reduce water consumption in GCT.

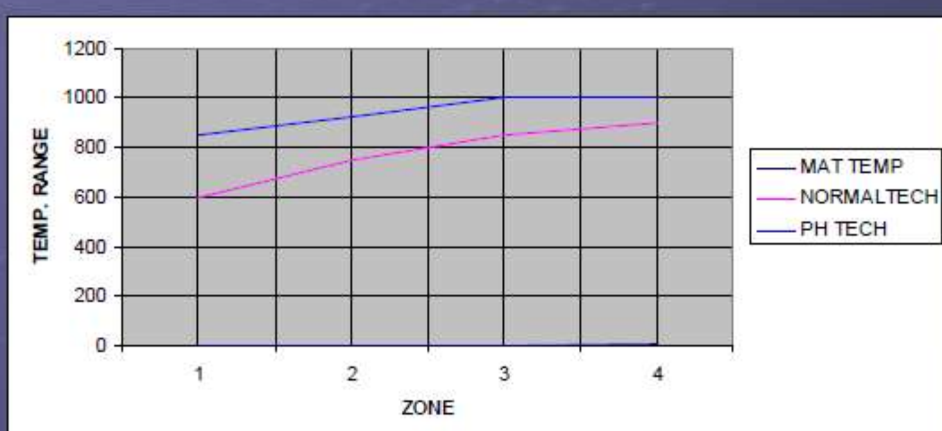
## SILENT FEATURE OF THE TECHNOLOGY

- **Usage of waste heat with lower project cost**
- **The cost of production reduces.**
- **Reduction in coal consumption by 20-25%**
- **Total coal burning per day is reduced 20 to 25% compare to the present consumption.**
- **Total coal handling in the unit is reduces to 25%.**
- **This is directly reducing the pollution level in the unit.**
- **Lower solid waste generation due to reduced coal consumption**
- **As the solid waste qty reduces cooling water consumption also reduces.**
- **Environment Friendly :** The carbon particles, volatile dust, and left over CO is being fully burnt in the kiln by proving excess air.
- **Safer Technology :** The burning of carbon particles and lowering the temp. at after burning chamber is being done in pre heater so the risk of high temp. handling is reduce.

## COMPARISION OF THE CONVETIONAL KILN AND PRE HEATER SYSTEM

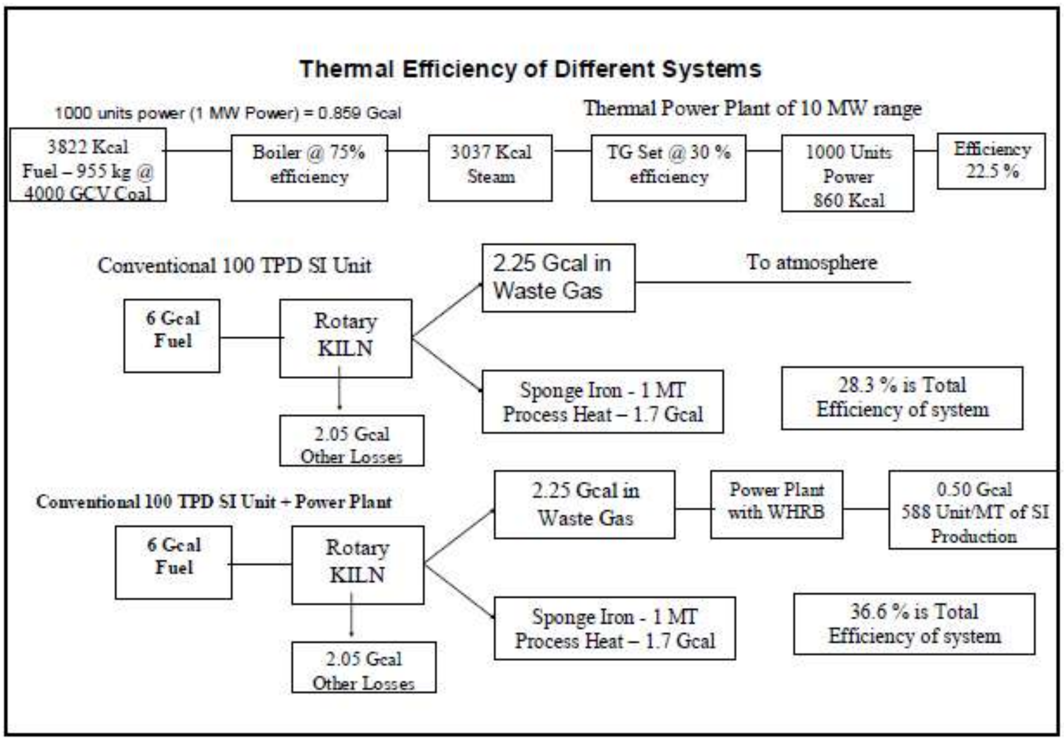
| Process Parameters | Conventional Kiln | Pre Heater System |
|---|---|---|
| Energy Consumption | 5.5 to 6.0 Gcal/MT-DRI | 4.1 to 4.5 Gcal/MT-DRI |
| Coal Consumption [Coal of 10% Moisture, 25 % Ash; Wet basis] | 1100 – 1200 Kg/MT-DRI | 825 – 900 Kg/MT-DRI |
| Loss of energy in waste gasses | 2.0 to 2.5 Gcal/MT-DRI | 1.8 to 1.9 Gcal/MT-DRI |
| Sensible energy loss in solid product | 0.28 to 0.32 Gcal/MT-DRI | 0.2 to 0.22 Gcal/MT-DRI |
| $CO_2$ emission | 2.1 to 2.3 MT/MT-DRI | 1.05 to 1.15 MT/MT-DRI |

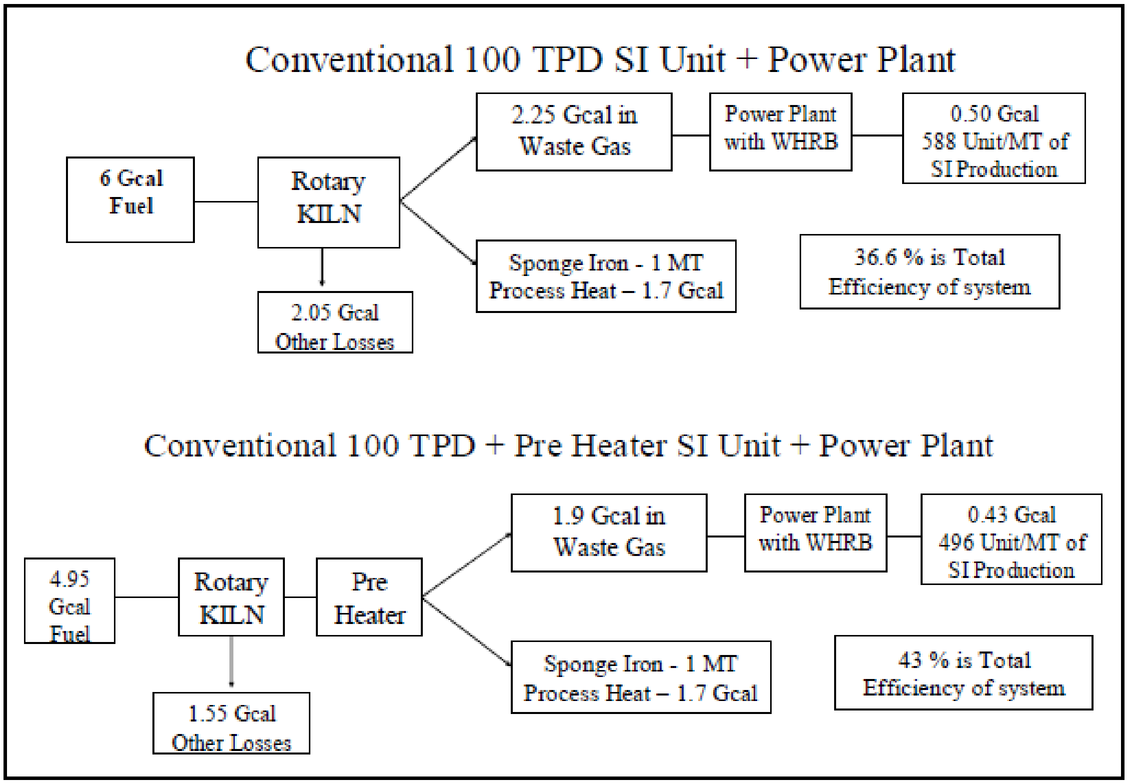
## MATERIAL TEMP COMPARISON IN CONVENTIONAL KILN & PRE HEATER SYSTEM



**ESTIMATION FOR THE MODIFICATION OF SPONGE IRON KILN WITH NEW PRE-HEATING TECHNOLOGY**

| SR. No. | DESCRIPTION | VALUE IN LACS 50TPD | VALUE IN LACS 100 TPD | VALUE IN LACS 200TPD |
|---|---|---|---|---|
| 1 | CIVIL AND STRUCTURAL | 60.00 | 124.29 | 200.00 |
| 2 | PLANT AND MACHINERY | 90.00 | 186.15 | 360.00 |
| 3 | ELECTRICAL INSTALLATION | 10.00 | 20.57 | 35.00 |
| 4 | CONSULTANCY CHARGES | 5.00 | 10.00 | 15.00 |
| | **TOTAL** | **165.00** | **341.01** | **610.00** |




Conventional 100 TPD SI Unit + Power Plant
6 Gcal Fuel
Rotary KILN
2.25 Gcal in Waste Gas
Power Plant with WHRB
0.50 Gcal 588 Unit/MT of SI Production
Sponge Iron - 1 MT Process Heat – 1.7 Gcal
36.6 % is Total Efficiency of system
2.05 Gcal Other Losses
Conventional 100 TPD + Pre Heater SI Unit + Power Plant
4.95 Gcal Fuel
Rotary KILN
Pre Heater
1.9 Gcal in Waste Gas
Power Plant with WHRB
0.43 Gcal 496 Unit/MT of SI Production
Sponge Iron - 1 MT Process Heat – 1.7 Gcal
43 % is Total Efficiency of system
1.55 Gcal Other Losses