

ENERGY PROFILE

BHAVNAGAR (SIHOR) STEEL REROLLING MILL CLUSTER

The Energy and Resources Institute

SHAKTI
SUSTAINABLE ENERGY FOUNDATION

Promoting Energy Efficiency in SMEs
SAMEEEKSHA

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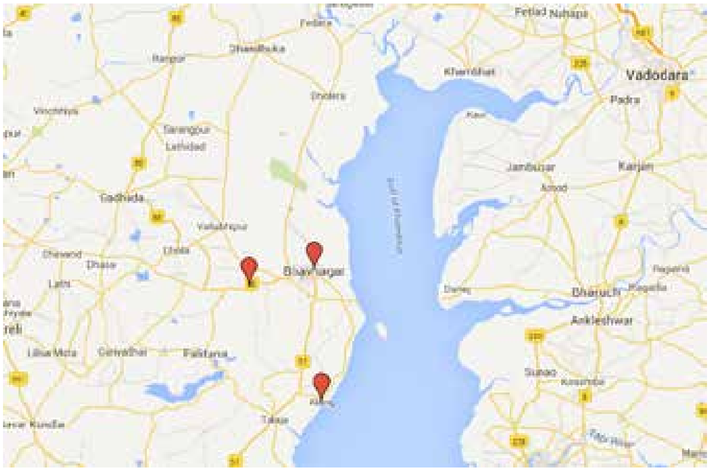
Last but not least, our sincere thanks to MSME entrepreneurs and other key stakeholders in the cluster for providing valuable data and inputs that helped in cluster analysis.

Bhavnagar (Sihor) Steel Re-rolling Mill Cluster

Overview of cluster

Bhavnagar (Sihor) steel re-rolling mills cluster is situated in Bhavnagar district, which is one of the 33 districts of Gujarat in western India. Ship breaking is the primary industrial sector in the cluster located in Alang and Sosiya. It is also the largest ship breaking yard in Asia. The ship breaking industries led to development of downstream industries such as steel re-rolling mills and steel melting industries. The raw material for steel re-rolling industries located in Bhavnagar district (mainly in Sihor *taluka*) is sourced from ship breaking industries in the form of sheets. The steel melting units also procure scrap raw material to produce billets and ingots, which is further input material for steel rolling mills. Some of the leading steel re-rolling mills in the cluster include Hi-Tech Investment Castings, Sachdeva Steel Products, Navbharat Steel Industries, Shree Ramdev Steel Industries, Arihant Industries and Chamunda Rolling Mill Pvt Ltd.



Locational Map of Bhavnagar, Sihor and Alang
(**Source**: Google Map)

Product, market, and production capacities

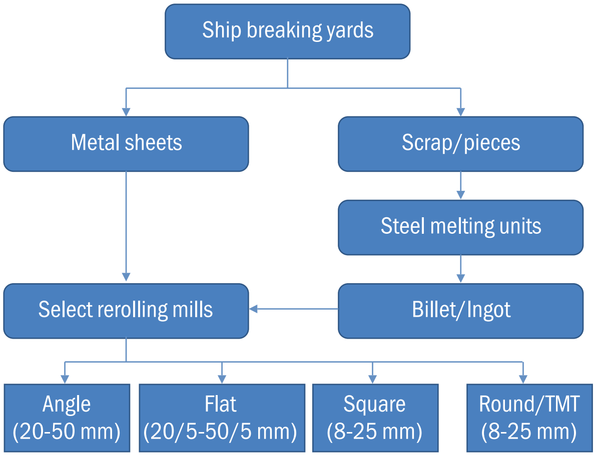
The final product from steel re-rolling industries is dependent on type of raw material available to the industry. In Bhavnagar cluster, there are two sources for raw material viz.: (i) Ship breaking industries in Alang is the primary and major source and (ii) Steel melting units located in the cluster. The end products from steel re-rolling mills include mild steel (MS) angles, flats, squares, and round bars. The re-rolling mills processing billets/ingot (i.e., final product of steel melting units) produce round bars/thermo mechanically treated (TMT) bars; mills processing sheets as raw material produce mainly angles, flats, and squares. The market for products from the cluster is mainly located within Gujarat—tower/structure-making industries, infrastructure projects, and retail market. A majority of the units sell their products through distributors or use brand name by distributors.

There are about 120 re-rolling mills in Bhavnagar district with an estimated installed capacity of 5.2 million tonne (mt) per year; of these, only 90 mills are estimated to be in operation. Most of the units are located in GIDC (Sihor). The capacities of associated reheating furnaces in the cluster vary in the range of 3.5–10 tonne per hour (tph). The total installed capacity of the operational rolling mills in the cluster is estimated to be 3.9 mt per year. The distribution of steel re-rolling mills in Bhavnagar cluster based on furnace capacities is given in the table below.

Distribution of steel re-rolling mills in Bhavnagar (capacity wise)

Capacity	Capacity (tph)	Number of units
Type 1: up to 30 feet furnace	3.5	26
Type 2: 30–50 feet furnace	6.0	49
Type 3: More than 50 feet furnace	10.0	15

The actual production of the cluster during 2015–16 was estimated to be 1.33 mt per year (28% of installed capacity). The estimated annual turnover of the cluster is valued to be ₹3,200 crore. The linkage between ship scrap yards, steel melting units, steel re-rolling industries, and products has been shown in the following figure.



Linkage between industries

Steel re-rolling process

Most steel products from casting operations are further processed to produce finished steel products in a series of rolling and finishing operations. There are two common shaping processes, namely (i) hot rolling and (ii) cold rolling. In general, rolling process includes application of mechanical forces to metal surfaces through a series of rolls to produce specific shapes and sizes by reducing widths and thicknesses. The ingot or continuous casting is hot rolled into blooms or slabs, which are the basic feed material for production of a wide range of steel products. Many of these products will be the starting material for subsequent manufacturing operations, such as forging, sheet metal working, wire drawing, extrusion, machining, etc.

Hot rolling involves reheating of metal sheets/slabs/ingots/billets close to soaking temperature and rolling them into thinner and longer products through successive rolling mill stands. The steel slabs/billets are heated to about 1,150°C–1,250°C depending on type of raw material in reheating furnaces. Mainly pusher hearth furnaces are used in the cluster with coal as primary fuel.

The heated sheets/billets are rolled in a roughing stand, in which the thickness is reduced in various passes, back and forth. The length of the slab increases from 2–4 metres to an intermediate slab, which is up to 20–25 metres long. This is rolled down between 50–20 mm in only one pass through a number of stands. The speed increases after every stand, which is highest at the end. A typical process flow of hot rolling is shown in the figure.

The major process steps involved in the Bhavnagar Steel Re-rolling Mill Cluster are described below.

Raw material preparation and shearing

In raw material preparation, the scrap metal sheets are segregated as per final product profiles. The main criteria for segregation of raw material include thickness and length. The sheet is cut to desired sizes in cutting processes, in which a piece of sheet metal is separated with application of force. The most common type of cutting process is shearing using shearing machines and gas cutters. The common size of metal sheet used is 5–6 feet length. The units which use billets as raw material also use gas cutting machines for cutting billets. The waste or unused sheet after cutting is sold to the steel melting units.

Raw material preparation

Charging and reheating

Reheating of steel is the first step in hot rolling that helps in achieving sound mechanical and chemical properties of products. In reheating process, the material is stacked to hearth at charging end of the furnace. A mechanical type pusher is used to push the material inside the furnace at a constant speed. Almost all the furnaces in the cluster are of continuous type with manual charging and discharging operations.

Pusher hearth reheating furnace

In reheating furnace, the temperature of soaking zone is set close to 1,250°C. The temperature requirement is dependent on sheet thickness and final finishing required. The sheets/billets are heated in the reheating furnace to prepare them for subsequent rolling. If the metal is too cold, then it will be too hard, and it will crack and lead to stresses in rolling equipment. If the metal is too hot, then cracking, surface melting, and blemishes will occur when rolled. If the metal is not heated uniformly, uneven deformation may occur, resulting in poor quality and perhaps derailment. Therefore, the retention time of the material inside furnace and corresponding temperature profile of heating and soaking zones are key parameters in rolling mills.

Material charging (pusher heart)

Rolling and finishing

In rolling, the shape of metal is changed due to plastic deformation by passing between rolls, that is, reduction of cross-sectional area or general shape of the metal. Most of the rolling mills in the cluster have employed semi-automatic reheating furnaces (14–16 inch size). Two-high and three-high mills are generally used for initial and intermediate passes for initial and intermediate passes during hot rolling, while four-high and cluster mills are used for final passes. The primary stand/roughing stand is provided with 800 hp slip ring motor (most common installation) and intermediate stands (9 inch size) is having motor capacity up to 800 hp. The capacity of electric motor installed in final stand or finishing is having 250 kW. The most common type motor in finishing section is of DC type. The rolling process in the cluster is manual. In this, the operator takes out material from soaking zone using manual toggle clamp and feed into primary roller of four rough rollers and subsequent into roughing rollers. The speed of the mill and product quality is dependent on skill of the operator. The function of finishing stands is to provide the desired shape and gauge to the product. After final section, the product goes for cooling and end cutting. The detailed process steps followed by cold storage facilities are given in the following sections.

Rolling process

Cooling and end cutting

Furnace control system

Technologies employed

Reheating furnaces are the major consumers of thermal energy. The operational characteristics of reheating furnaces play a vital role in overall milling process. The reheating furnaces consist of combustion equipment like coal pulverisers, burners, combustion air blower and waste heat recovery (WHR) systems. Other associated equipment includes charging and discharging system, such as pusher and loaders. A typical reheating furnace comprises preheating, heating, and soaking zones to gradually increase and maintain desired temperature profiles for milling process. Cutting machines, trimming machines, and tools are used in rolling mills. Most of the rolling mills are open train, 2-high or 3-high type. The description of the technologies/major equipment used in the cluster is described below.

Reheating furnace

The reheating furnaces installed in the cluster are continuous-type pusher hearth furnaces having capacities 3.5–10 tph. The charge or stock is introduced at one end (‘feeding or charging’), which moves through the furnace and is discharged at the other end (‘discharge doors’). The length of the furnace is in the range of 30–85 feet and width of the furnace is 6–7.5 feet. The primary fuel used in the furnaces is pulverized coal (size up to 250 meshes), which is charged using the combustion air (primary air). The furnace combustion system (coal charging mechanism) takes the temperature of soaking zone as reference for increasing or decreasing the charging rate of coal. However, this system is by-passed in majority of the units.

The temperature of soaking zone is observed in the range of 1,130°C–1,280°C. However, this temperature is not maintained constantly throughout the operation and may be attributed mainly to lack of automation of combustion control system. The heat losses from surfaces and preheated air pipe lines were observed to be high, mainly due to poor or no insulation.

Pulverizer: The coal pulverizer units installed in the cluster of the size of 20–45 inch having electric motor capacity of 50–100 hp. A cyclone system is associated to recover fine coal particles, which are further stored in the coal charging hopper.

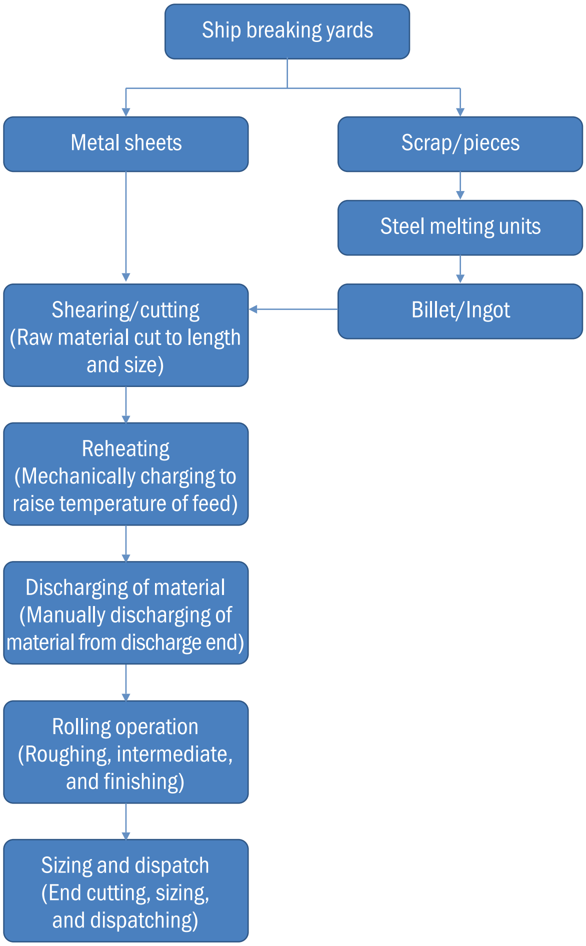
Pulverizer system

Air preheater: Waste heat recovery (WHR) systems are widely used in steel reheating furnaces to recover heat losses in flue gases and improve efficiencies. As flue gas heat losses account for a major share in overall heat inputs to furnaces, it is beneficial to use WHR systems such as air preheater. However, most of the units in Bhavnagar cluster do not have WHR systems, thereby operating the furnaces inefficiently. The flue gas temperatures of reheating furnace are observed to be quite high, in the range of 650°C–800°C in most of the units. Even in one of the units wherein WHR system has been installed, the performance of the system was not good, which may be attributed to poor designs and improper capacities.

Waste heat recovery system

Rolling mill

There are three types of rolling mills in common use, that is, 2-Hi, 3-Hi, and 4-Hi mills. This classification is based on the mode of arranging rolls in housings. Typically, one 2-Hi stand consists of two rolls, arranged one above the other. Similarly, a 3-Hi mill has 3-rolls and a 4-Hi mill has 4-rolls. For specific use, 6-Hi, 12-Hi, or 20-Hi mills are also designed. Mills having six or more rolls are generally termed as cluster mills. In the cross-country mills, the roll stands are located in a scattered manner. These mills are



Hot rolling process

based on the concept of continuous rolling, but the stands are placed so far apart that the piece must leave one set of rolls before entering the next.

Mill housings: Mill housings are one of the most important structures of rolling mills since they hold mill assembly in position. Housings are elements in a rolling mill that hold chock assemblies, adjusting and other mechanisms, and retain proper positions. Thus, their construction and dimensions have to take into account sizes of related elements. The forces that act on the rolls during rolling are completely transferred on to them through the nuts of the adjusting mechanism. The housing of the rolling stand requires high rigidity, sufficient strength for taking the loads, simplicity of design, and minimum cost of production. One-piece cast housings of simple form (rectangular section) are used for heavy roughing mills, for example, blooming, slabbing, billet, and plate mills.

Rolls: Rolls are the most vital component of a rolling mill. The deformation of metal work piece is directly accomplished by rolls. The rolling stresses are first applied on rolls and then transmitted to other sections of a mill. Consequently, the rolls had to be harder and more resistive to deformation than the metal under processing.

Power supply, distribution, instrumentation, and control system

» The electrical power supply and distribution system in mils mainly include transformer, circuit breakers, and control panels.
» DC drive or Variable Voltage Variable Frequency (VVVF) drives for regulating speed of AC motors particularly in finishing mills is the latest trend.
» PC–PLC instrumentation and control system for automation of front and end cropping shears, furnace control system, flying shear, etc. with valve actuators.

Lighting system

The lighting provided in different plant areas is mainly mercury vapour lamps (250–500 watt). In office areas, mainly compact fluorescent lamps (CFL) and fluorescent tube lights (T-8/T-12) are used.

Energy scenario in the cluster

Coal is the major source of energy and is procured from local distributors. Electricity is supplied by Paschim Gujarat Vij Company Limited (PGVCL). The power outage is very minimal in the cluster, and hence diesel consumption is negligible. The details of major energy sources and tariffs are given in the table below.

Prices of major energy sources

Source	Remarks	Price
Electricity	High Tension connection (HT)	₹8.50 per kWh (inclusive of energy, demand charges, other penalty/ rebate, and electricity duty)
	Low Tension connection (LT)	₹9.00 per kWh (inclusive of energy, demand charges, and electricity duty)
Coal	From local market	₹6,000 per tonne (price subjected to market fluctuations)

Source: http://www.pgvcl.com

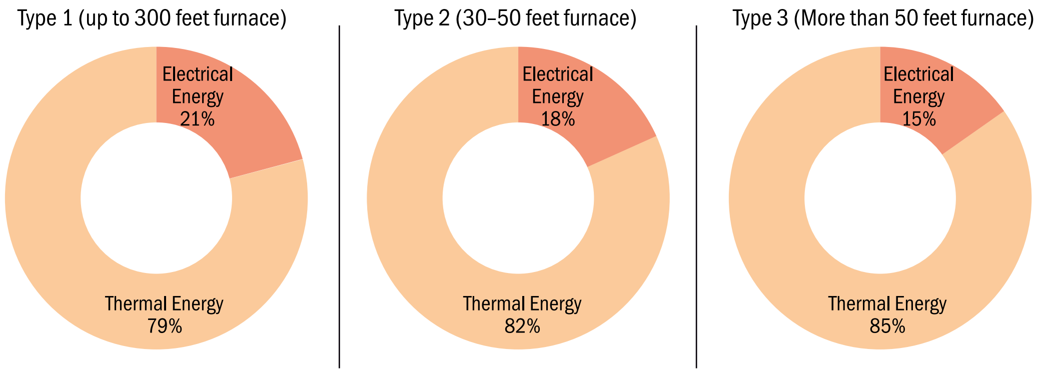
Energy consumption

Unit level consumption

The primary energy sources used in hot rolling mills may be categorized into two parts, the first part includes the energy used for raising the temperature of the feed to desired value (generally 1130°C–1280 °C) i.e. reheating furnace and the other part is the energy required for formation and shaping of hot product. Most of the reheating furnaces in the cluster operate on coal, whereas electricity is the primary energy source for milling and auxiliary operations. The major energy consuming area is reheating furnace that consumes about 80–85% of total energy input to the facility. The electricity share in total consumption varies in the range of 15%–20%. The average unit capacities and their energy consumption in the cluster are given in the table below.

Production category	Electricity (kWh/yr)	Coal (tpy)	Total energy (toe/yr)	Total CO_2 emissions (tpy)	Annual energy bill (million ₹)
Type 1: (up to 30 feet furnace)	1,268,750	744	526	2,917	13.5
Type 2: (30–50 feet furnace)	1,875,000	1,288	883	4,736	21.2
Type 3: (more than 50 feet furnace)	2,500,000	2,125	1,405	7,231	30.9

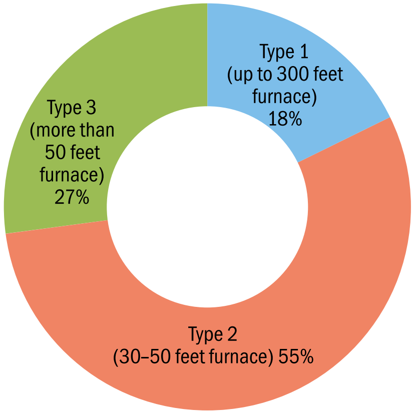
The average share of thermal and electrical energy consumption at cluster level is estimated to be 83% and 17%, respectively. The thermal and electrical energy consumption of different capacities of mills is shown in the pie chart given below.



Share of thermal and electrical energy consumption by various capacities of mills

Cluster level consumption

The annual electricity and coal consumption of the Bhavnagar (Sihor) re-rolling cluster is estimated to be 162 million kWh and 114,304 tonnes, respectively, which is equivalent to 77,974 tonne of oil equivalent (toe) per annum. The total carbon emission of the cluster is about 416,304 tonne of CO_2. The overall energy bill of cluster is estimated to be ₹1,855 million. The type 2 (30–50 feet furnace) re-rolling mills accounts for about 55% of total energy consumption in the cluster (Figure).



Share of energy consumption in re-rolling mill

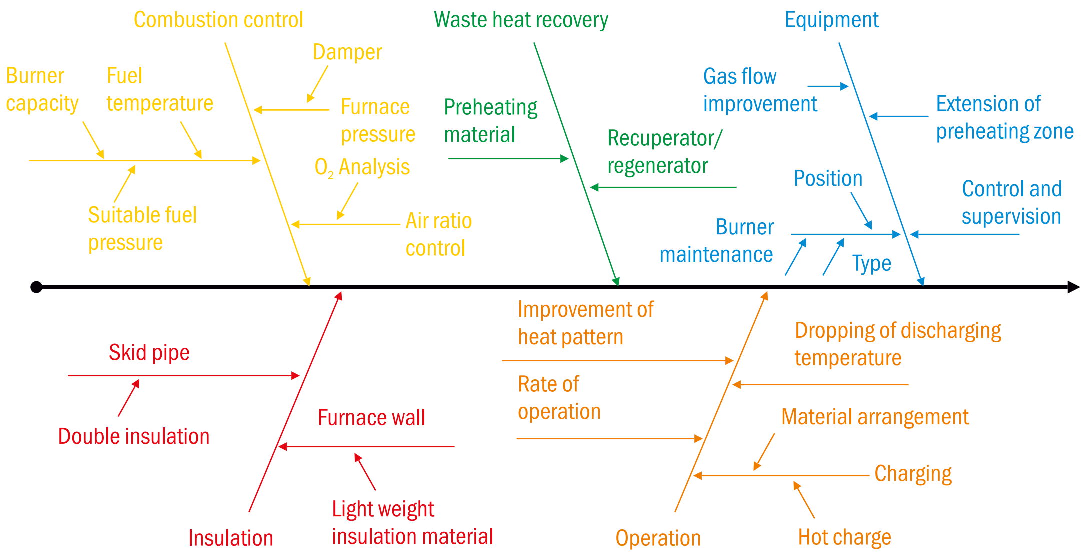
Energy consumption of the Bhavnagar (Sihor) re-rolling mill cluster

Production category	Electricity (million kWh/yr)	Coal (tpy)	Total energy (toe/yr)	Total CO_2 emissions (tpy)	Annual energy bill (million INR)
Type 1 (up to 30 feet furnace)	33	19,561	13,824	76,712	355.7
Type 2 (30–50 feet furnace)	92	62,868	43,075	231,123	1,035.4
Type 3 (more than 50 feet furnace)	38	31,875	21,075	108,469	464.1
Total	162	114,304	77,974	416,304	1,855

Source: Field survey and interaction with unit entrepreneurs

Potential energy efficient technologies

The basic concepts of energy conservation in reheating furnaces include optimization of combustion, rationalization of heating and cooling, minimization of structural heat losses, recovery of waste heat in flue gases, and recovery of waste heat in flue gases. The potential energy-efficient technologies that can help in improving the performance of Bhavnagar steel rolling mills are given below.

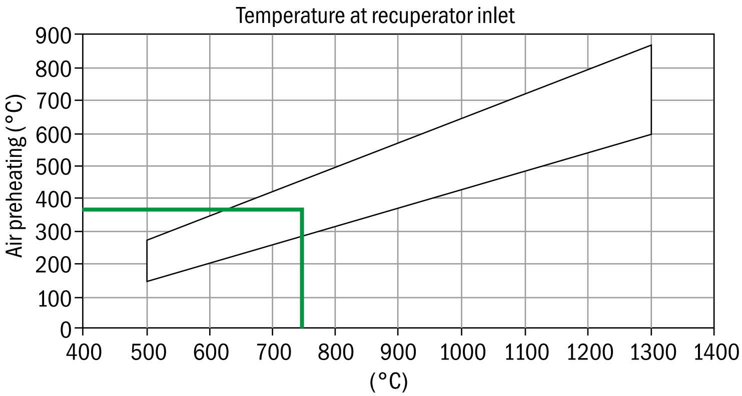


Energy optimization, maintenance practices, and control system in reheating furnace

Centralized and high efficiency recuperator

The quantity of heat taken away from a reheating furnace by high temperature flue gases (650°C–800°C) is quite large. This can be reduced by recovering waste heat available in outgoing flue gas. One of the conventional, economical, and convenient methods is use of centralized recuperator system for preheating of combustion air. Recuperator is a mechanical device in which heat exchange takes place between the flue gases and the combustion air through metallic or ceramic walls. Ducts or tubes carry the air for combustion for preheating whereas the other side contains the waste heat (flue gas) stream.

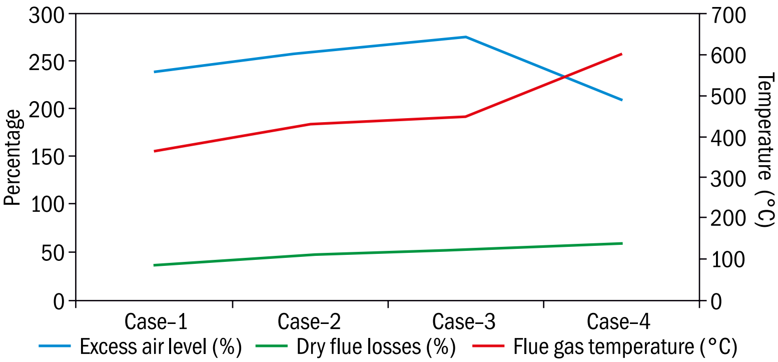
There are many types of the waste heat recovery recuperator depending on the application. The most common types of recuperator include metallic radiation, convection, hybrid and ceramic recuperators. The most commonly used recuperator in reheating furnace is convection type. Convection recuperator (also referred to as 'flue' or 'canal' recuperator) is tubular heat exchanger that utilizes convection heat transfer to



Air preheat temperature vs.. flue gas temperature preheat combustion air for the purpose of saving fuel. By recovering heat from hot flue gas and transferring it to combustion air, fuel consumption can be reduced up to 25%. The average temperature of the flue gas in the reheating furnace of the cluster is about 750°C, and installation of recuperator may increase the temperature of the combustion air to about 350°C–365°C. The energy-saving potential with high-efficiency recuperator is about 20%–27% with a simple payback period of 12–16 months.

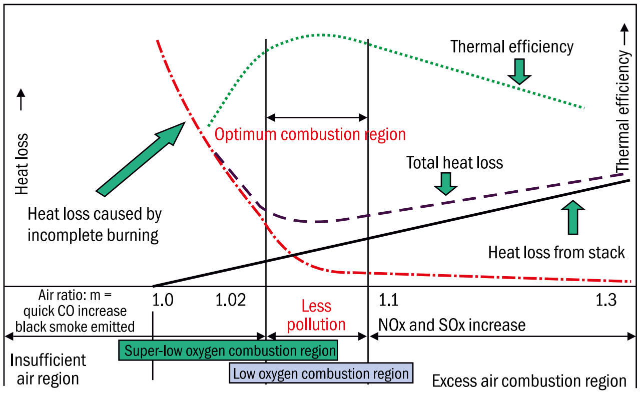
Excess air optimization and VSDs on combustion fans

The quantum of waste heat generation is directly proportional to the quantity of air used for combustion of fuel. Air, slightly in excess of ideal stoichiometric (or theoretical) fuel to air ratio is required for complete combustion. It is dependent on type of fuel used. However, excess air beyond optimum range may substantially decrease combustion efficiency as it leads to generation of excessive hot waste gases. The effect of excess air level and flue gas temperature on dry flue gas losses is shown in the figure below.



Excess air versus dry flue gas loss

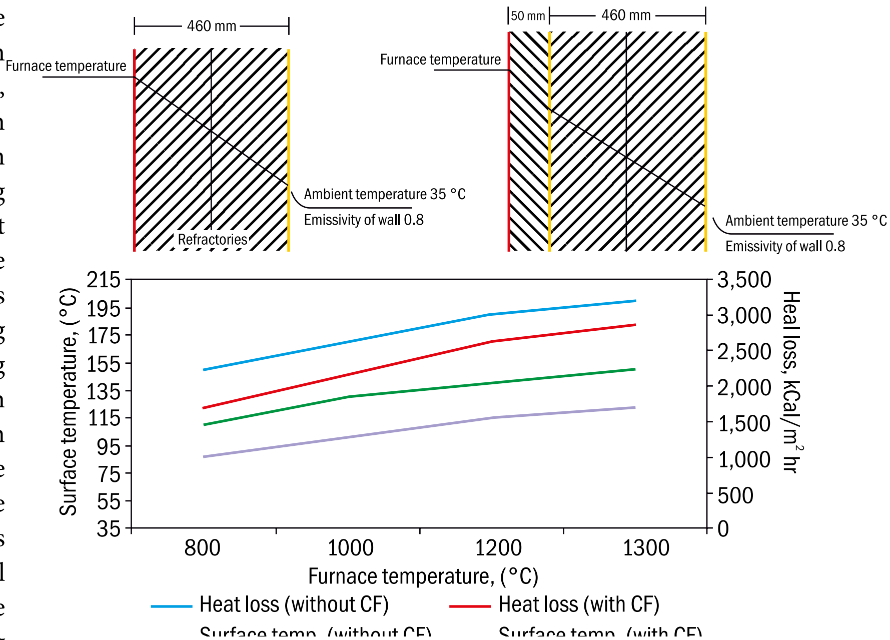
Controlling oxygen levels and using Variable Speed Drives (VSDs) on combustion air fans associated with reheating furnaces help in optimizing combustion in the furnace. The use of VSDs on combustion air fans in reheating furnace also helps to control oxygen levels, especially during variation in furnace production rate. The fuel and electricity savings in reheating furnace through optimization of excess air level depend on load factor of the furnace and the control strategies applied. The estimated energy saving is 4%–9% of thermal energy. With an estimated investment of ₹5.5–₹7.5 lakh for complete system, the simple payback period is about 18 months.



Effect of air to fuel ratio on thermal efficiency
Source: Detailed field assessment studies in reheating furnaces in Indonesia, UNEP 2014

Improved insulation and refractories of reheating furnace

The efficiency of a furnace is directly dependent of the method of combustion and heat stored within the furnace structure. The heat loss from furnace walls and material discharge doors is about 3–5%, which is significant.



Effect of insulation in a furnace: Heat loss vs. surface temperature

These heat losses include (i) Radiation loss through openings and furnace surface, and (ii) Heat accumulation loss to internal insulation and supports composing the furnace body. The heat accumulation loss can be ignored for a continuous operation furnace having minimal change in operating temperature. Reduction in radiation heat loss from furnace surfaces can be achieved by enhancing the insulation. This includes (i) Covering of internal wall surface with ceramic fibre insulation, and (ii) Covering external wall surface with ceramic fibre or rock wool insulation. The potential energy savings for insulating a continuous furnace were estimated to range from 2%–5%. However, the capital investment required for reinforcement of insulation may be higher indicating long payback period.

Energy efficiency drives for rolling mills

Motor systems, which include motor driven units, such as rolling mills, combustion air blowers, sharing machine, and material handling equipment consume substantial amount of energy used in steel rolling mills. About 70% of the energy input to motor-driven systems is lost due to system inefficiencies. Rolling mill applications demand high precision and high overload ability. They are characterized by quickly changing loads, rapid alternation between driving and braking actions, constant torque in a wide speed range, and large torque steps. High-efficiency drives are the most suitable solutions in metal industries. With the use of accurate controlling and energy efficient drives, the industry can optimize production cost, minimize maintenance, enhance reliability, and ensure quality of end product. Energy-efficient motors reduce energy losses through improved design, better materials, tighter tolerances, and improved manufacturing techniques. With proper installation, energy-efficient motors can also stay cooler, may help reduce facility heating loads, and have higher service factors, longer bearing life, longer insulation life, and less vibration.

The use of energy-efficient motors such as IE2 and IE3 motors in milling auxiliaries can improve efficiency up to 5%–6%. The initial investment for high-efficiency motors is about 15–20% more than the standard efficiency class motor. The simple payback period will be up to 30 months.

Computerized roll pass design

Shape rolling is widely used in material processing of structural and mechanical parts as it possesses good mechanical properties and high productivity. However, due to involvement of complicated mechanics in shape rolling, it has made the process design an art of experience. Therefore, it is very common to trust expert decision in process design, particularly for complicated shapes. In general, for simple shapes, empirical relationships using computerized numerical controls (CNC) can considerably reduce experience-oriented design procedure. The primary objectives and advantages of the roll pass design are:

» Production of correct profile within tolerance limits with good surface finish (free from surface defects)
» Maximum productivity at lowest cost and optimum energy utilization
» Minimum roll wear and easy working.

Lighting system

The lamps/lighting system provided in the cluster is mercury vapour lamp of (250–500 watt) and fluorescent tube lights (T-12/T-8). Replacement of existing lighting with most advanced light sources and fixtures may save up to 50% on lighting energy use, while benefiting from the best in lighting quality. Energy-efficient lighting offers additional benefits, such as reduced load on air conditioning and ventilation system, better life, and is compatible with advance control and automation. The existing mercury vapour lamps may be replaced by induction lamps or LED lamps (saving up to 65%) and fluorescent tube lights (T-12/T-8) may be replaced by either LED tube light or fluorescent tube light (t-5) type. The estimated saving by replacement of existing tube lights will be up to 35%. The overall project payback period will be about 12 months.

Major cluster actors and cluster development activities

Sihor Steel Re-Rolling Mills Association

Sihor Steel Re-Rolling Mills Association has about 76 steel re-rolling units as members and plays an active role to sustainability of steel re-rolling units in term of raw material availability, product development, technology upgradation, and exposure to energy efficiency and cost-effective practices.

District Industries Centre

The District Industries Centre (DIC) undertakes various programmes for investment promotion at the grass root level, such as organizing seminars workshops, extending support for trade fairs and exhibitions organized by various Industries associations. All the services and support required by for MSME units under the single roof of the DIC.

Gujarat Energy Development Agency

The Gujarat Energy Development Agency (GEDA) is working in the field of renewable energy development and energy conservation in Gujarat. It is the state nodal agency (SNA) for the Ministry of New and Renewable

(MNRE) and the state designated agency (SDA) for Bureau of Energy Efficiency (BEE). As an important part of the Annual Action Plan submitted for energy conservation activities, GEDA organizes awareness workshops for industrial consumers all over the state. The main objective of such workshop is to generate awareness among MSMEs on energy conservation and motivate them to carry out energy audits in their existing scheme. The workshops are conducted by GEDA authorized energy auditors having relevant expertise and experience.

Abbreviations

Abbreviation	Full form
BEE	Bureau of Energy Efficiency
CFL	Compact Fluorescent Lamps
CNC	Computerized Numerical Controls
DIC	District Industries Centre
GEDA	Gujarat Energy Development Agency
HT	High Tension connection
kL	Kilolitre
kWh	kilowatt-hour
Lit	Litre
LT	Low Tension
MNRE	Ministry of New and Renewable Energy
mt	million tonne
PGVCL	Paschim Gujarat Vij Company Limited
SDA	State Designated Agency
SEC	Specific Energy Consumption
SNA	State Nodal Agency
SPC	Specific Power Consumption
SSRRMA	Sihor Steel Re-Rolling Mills Association
t	tonne
TMT	Thermo Mechanically Treated
toe	tonne of oil equivalent
tph	tonne per hour
VSDs	Variable Speed Drives
VVVF	Variable Voltage Variable Frequency
WHR	Waste Heat Recovery

Note

About TERI

A dynamic and flexible not-for-profit organization with a global vision and a local focus, TERI (The Energy and Resources Institute) is deeply committed to every aspect of sustainable development. From providing environment-friendly solutions to rural energy problems to tackling issues of global climate change across many continents and advancing solutions to growing urban transport and air pollution problems, TERI's activities range from formulating local-and-national level strategies to suggesting global solutions to critical energy and environmental issues.

The Industrial Energy Efficiency Division of TERI works closely with both large industries and energy-intensive micro, small, and medium enterprises (MSMEs) to improve their energy and environmental performance.

About SSEF

Shakti Sustainable Energy Foundation (SSEF), established in 2009, is a Section-25 not-for-profit company, which aids design and implementation of clean energy policies that support promotion of air quality, energy efficiency, energy access, renewable energy, and sustainable transportation solutions. The energy choices that India makes in the coming years will be of profound importance. Meaningful policy action on India's energy challenges will strengthen national security, stimulate economic and social development, and keep the environment clean.

Apart from this, SSEF actively partners with industry and key industry associations on sub-sector-specific interventions towards energy conservation and improvements in industrial energy efficiency.

About SAMEEEKSHA

SAMEEEKSHA (Small and Medium Enterprises: Energy Efficiency Knowledge Sharing) is a collaborative platform set up with the aim of pooling knowledge and synergizing the efforts of various organizations and institutions — Indian and international, public and private — that are working towards the development of the MSME sector in India through promotion and adoption of clean, energy-efficient technologies and practices. The key partners of SAMEEEKSHA platform are: (i) Swiss Agency for Development and Cooperation; (ii) Bureau of Energy Efficiency; (iii) Ministry of MSME, Government of India, and; (iv) The Energy and Resources Institute.

As part of its activities, SAMEEEKSHA collates energy consumption and related information from various energy intensive MSME sub-sectors in India. For further details about SAMEEEKSHA, visit **http://www.sameeeksha.org**

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Promoting Energy Efficiency in SMEs
SAMEEEKSHA