

SWIRL BURNER FOR PULVERIZED COAL FIRED RE-HEATING FURNACE

(For Howrah Mixed Cluster)

Cluster Brief:

The Howrah mixed cluster consists of the districts of Howrah, Hooghly and Bardhaman. Howrah is hemmed in between river Hooghly on the east and river Rupnarayan on the west intersected by the Damodar. The district of Howrah came into limelight with the opening of railways in 1854, following British mercantile colonialism of India. Howrah is presently known as an industrial city, which has over 3,000 industries registered. Agro, jute and cotton, rolling, embroidery, engineering spare parts and foundry industry are prominent in the cluster. Howrah is well connected by road and railways. Two major national highways NH-2 and NH-6 are connected to Howrah.



There are about several foundries and steel re-rolling mills located in the cluster. These industries provide direct employment to over 1,00,000 people. The foundry units mostly uses cupola for melting, few foundries in past decade have started using induction furnace for producing ductile iron and steel castings. The steel re-rolling units located in and around Howrah are smaller in capacity and rolls scrap mainly from ship breaking. Rolling mills located at Hooghly and Bardhaman district are comparatively of larger capacity manufacturing TMT bars, structural and industrial products. The cluster houses over 500 foundry and steel re-rolling mill units scattered across the different industrial regions.

Table 1: MSME chemical industry details in region

Sl. No	Region	Type	Number Operational Units	of Manufacturing MSME
1	Howrah	Mix Cluster	3,000	Agro, jute and cotton, steel re-rolling, embroidery, engineering spare parts and foundry industry

*Source: Data from industry associations

Existing practice:

Pulverized coal is the most preferred fuel used in a re-heating furnace, because of its easy availability, low cost and ease of operation. Combustion depends on three “T’s” namely “Time, Temperature & Turbulence”. Efficient burning of coal depends on proper air-fuel mixture.

In most of the SRRM units, a 4-inch pipe is used as a burner for pulverized coal. This 4-inch pipe is inserted into the front and side walls of the re-heating furnace. Only primary air in ambient temperature is used for combustion in such conventional burners and the air-fuel ratio is neither monitored nor controlled. This crude practice of using 4-inch pipe as a burner leads to incomplete combustion, inefficient heat transfer to ingot/billet/scrap, and higher fuel consumption.

Proposed technology:

In order to have proper control of the air-fuel mixture in a re-heating furnace and also to ensure optimum combustion of coal, swirl burners for pulverized coal-fired re-heating furnaces can be used. The purpose of using a swirl burner is to achieve a stable flame and to ensure proper mixing of air and fuel. In a swirl burner, secondary air is supplied along with primary air in annular arrangement. Both primary air and secondary air are hot air drawn from the recuperator. The swirl burner typically has three inputs; the closest input towards the furnace is for primary air, which is directly fed from the recuperator; coal is fed from the next input on a controlled manner from the screw feeder attached to the over-head hopper. The third input is for the secondary air which pushes the coal into the burner. The hot secondary air is also utilized for complete combustion of powder coal. This burner works on the basis of three T’s of combustion:

- Time: Sufficient time for burning
- Temperature: Ignition temperature must be achieved
- Turbulence: Proper mixing of fuel and air, which is achieved by swirlers

Vanes are fabricated in between the annular pipes. The turbulence caused due to the rotation of air-fuel mixture being generated by the vane swirl generator results in proper air-fuel mixing and better combustion of fuel.

Justification of technology selection:

Use of swirl burners for pulverized coal firing in re-heating furnace will lead to optimum combustion leading to lesser fuel consumption. Some of the advantages of the system are:

- ✓ Stable flame size
- ✓ Turbulence for proper air-fuel mixture
- ✓ Provision of secondary air
- ✓ Increase in flame temperature
- ✓ Increase in furnace efficiency

Swirl burners also helps in maintaining equal pressure across all burners in the furnace leading to energy efficient and pollution free environment.

Estimated energy & monitoring saving:

The following section provides the details of the pulverized coal swirl burners in terms of energy & GHG saving potential, investment required and cost benefit analysis. The calculations have been provided considering a 15 tph SRRM plant.

Table 2: Energy & GHG emission saving and cost benefit analysis for swirl burner

SN	Parameter	Unit	Furnace with pipe burner	Furnace with swirl burner
1	Productivity	t/h	15	15
2	Operating hours per day	h/d	16	16
3	Operating days per year	d/y	300	300
4	Specific fuel consumption	kg/t	75	72.75
5	Annual fuel consumption	t/y	5400	5238
6	Saving in fuel consumption	t/y	162	
7	Annual monetary saving due to fuel savings	Rs in Lakhs	11.34	
8	Investment for say 6 nos. of swirl burners with required accessories	Rs in Lakhs	7.5	
9	Simple pay back	Y	0.66	
10	Annual energy savings	TJ/y	91	
11	Annual GHG emission reduction	tCO ₂ /y	359	

*installation of swirl burner will lead to approximate 2-5% saving

**Calorific value of coal taken as 5600 kcal/kg; cost of coal taken as Rs 7/kg; emission factor of coal taken from IPCC guideline as 94.6tCO₂/t for sub-bituminous coal.

The benefits can be summarized as:

- ✓ Reduction of specific fuel consumption by 2-5%.
- ✓ Increase in flame temperature
- ✓ Increased furnace productivity

Replication Potential:

Howrah has a large number of rolling mill units. The Steel Re-rolling Mill's Association (SRMA) is the biggest association operational in the cluster. To establish the replication potential of the technology in the sector, the following were considered:

- ✓ Technology feasibility and adaptability through energy audits in 8 units.
- ✓ Survey of 100 units (under process)
- ✓ Meetings held with associations / stakeholders (including technology suppliers)

During the survey, it was observed that units located in Howrah & neighbouring clusters has very limited penetration to energy efficient technologies. Also, there is significant knowledge barrier in the cluster. The Technology of recuperator has very limited implementation in the cluster although the same has been widely accepted and implemented across industrial clusters around the country.

Table 2: Replication potential for swirl burner

No. of units surveyed	Replication Potential (based on applicability of the technology in surveyed unit)	Replication potential in surveyed unit (%)	Replication potential in cluster (extrapolated based on 400 units)
100	10	10	40

It can be observed that out of the 100 units surveyed, 10 numbers of units has the potential to change over to energy efficient swirl burner .Considering the survey results and based on further discussion with associations, units, stakeholders and outcome of the energy audits, it is estimated that the technology has a replication potential of 10 % in the cluster. Considering a total number of 400 units in the cluster, the replication potential is 40 units.

Based on the initial survey and discussion with units/association it is estimated that the technology has replication potential in at least 40 units in the cluster. Based on the estimated replication, overall project benefits will be as follows

Table 3: Impact of replication of technology (25 units)

Parameter	UOM	Value
Annual thermal energy saving (one unit)	t/y	162
Annual thermal energy saving (one unit)	MJ/y	3,795,725
Annual coal saving (considering replication in 25 units)	t/y	4,050
Annual CO ₂ emission saving (one unit)	tCO ₂ /y	359
Annual CO ₂ emission saving (considering replication in 25 units)	tCO ₂ /y	8,977
Estimated investment in technology (one unit)	Lakh Rs	7.5
Estimated investment in technology considering replication in 25 units	Lakh Rs	187.5
Total energy savings (in 10 years)	MJ	37,957,248
Annual CO ₂ emission saving (in 10 years)	tCO ₂ /y	89,769

Barrier for implementation:

Although the technology has been successfully proven in few units; there has been limited replication of the technology in the cluster. The barriers identified for limited penetration of the technology in the cluster are as follows:

- ✓ **Knowledge barrier:** Based on discussion with units, it has been found that knowledge dissemination related to the technology has been limited.
- ✓ **Non-availability of demonstration unit:** The technology of withering automation does not have any demonstration. There is a lack of confidence among units for adoption of the technology.
- ✓ **Unavailability of technology suppliers:** Although few of the technologies in the cluster are known to the units, the implementation has been hindered by the lack of technology supplier in the cluster.
- ✓ **Risk related to implementation:** The units lacks confidence related to performance of the technology. The risk of performance has been covered under the project.

Availability of technology supplier:

The technology of swirl burners is well established. A large number of reputed technology suppliers are available for the technology. Some of the established technology suppliers are:

Table 4: Technology Supplier

S. No	Vendor's name	Refined Furnaces, Faridabad	Encon Thermal Engineers Private Limited	Fuel Save Systems & Devices (P) Ltd
1	Experience/Year of establishment	Establish in 1984 , More than 20 years expertise in manufacturing of furnace and furnace related equipments for industries	ENCON Thermal Engineers was established in 1978, more the 30 years of exp. In the field of EE technology for furnace	Established in 1993 is a manufacturer, exporter and supplier of Industrial Furnace, , Blower,Burner, Heating &PumpingUnit, Industrial Recuperator, Industrial Pusher, Biomass Gasifier, Coal Pulverizer
2	Presence in India	Dealing in all over India.	Dealing in all over India.	Dealing in all over India.
3	Presence in Howrah cluster	Yes	Yes	Yes
4	Contact details	rishi@furnaceindia.org	vadodara@encon.co.in	fuelsavesystems@yahoo.com; enquiry@fuelsave.net

Technology Summary:

The benefits of the technology of swirl burner for reheat furnace in Howrah Mix Cluster are summarized below:

Table 5: Technology summary: EE Swirl Burner

Sl. No.	Category	Sub-Category	Value
1	Energy Efficiency	% improvement from baseline	2-5% saving in specific energy consumption can be achieved
2	Financial Feasibility	Payback period	The simple pay-back period for the technology is around 1 years
3	Replicability	No. of MSMEs to accept	The technology has a replicability potential in 25 units
4	Availability	Local Availability	The technology is locally available at Howrah
		Technology provider	There are 3-4 technology provider
5	Ease of Implementation		Medium: The design needs to be customized based on the plants requirement