INSTALLATION OF HIGH EFFICIENCY METALLIC RECUPERATOR

(*For Howrah Mixed Cluster*)

Cluster Brief:

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 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.

The emergence of foundry industry in Bengal started in mid-19th century, based on necessity of spares for jute and cotton industries. By the end of First World War, Bengal foundries took shape into what is known presently as Howrah cluster. After independence, the small and medium sized industries owned by the British were sold to the new entrepreneurial community of Marwaris. These firms continue to remain with the second/third generation of Bengali entrepreneurs. In its peak, the cluster had over 500 foundries as well as rolling mills largely due to availability of cheap pig iron and coke and a large pool of skilled/semi-skilled labour. But over past decade, many non-Bengali industrialists moved out of state and a large number of Bengali owned small foundries were closed down. Inadequate availability of quality raw material, shortage of power, poor infrastructure and active trade unionism are some of the main reasons for the decline of the cluster. The existing industries are also 3-4 decades old and very little investment towards modernization of plant and machinery is done after initial commissioning.

There are about several foundries and rolling mills located in Howrah cluster. These industries provide direct employment to about 15,000 people. All foundry units uses cupola for melting, few foundries in past decade have started using induction furnace for producing ductile iron and steel castings. Foundry and rolling mill units are located around city, mainly at: Liluah, Salkia, Benaras road, Belgachia, Dasnagarn, Balitikuri, Jangalpur and Santragachi. Total annual turnover of foundries and rolling mills is above Rs 1,350 crores, out of which 60% is from exports. The cluster is known for exporting sanitary castings to several countries in five continents. Over 90% of casting produced in the cluster is cast iron, under 10% of total production is ductile iron and steel castings.

Existing practice:

At Present, rolling units in Howrah use top-fired pusher type re-heating furnaces with pulverized coal as fuel. The capacity of re-heating furnaces in Howrah was ranging from 2 tph to 20 tph. In re-heating furnace, only 20-30% of the total heat input is converted to useful heat. Rest of the energy is lost through different areas and forms.

The waste flue gas loss forms the major loss in a re-heating furnace which accounts for 30-35% of the total heat input. Exhaust flue gas from the furnace at a temperature of 400-700 ^{0}C has a potential to be re-used in the furnace. Presently, flue gases from the re-heating furnace were exhausted out into the atmosphere through the chimney. Thus significant heat of flue gas was wasted.

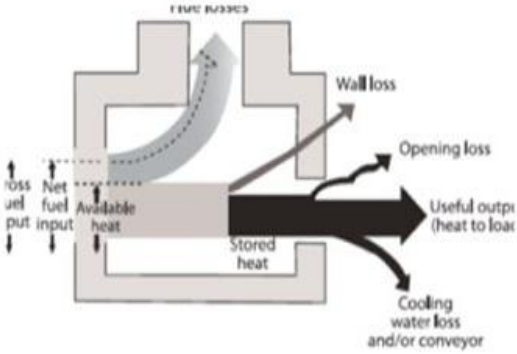


Figure 1: Sankey diagram – Re-heating furnace

Proposed technology:

As an alternative to the existing practice, a high efficiency metallic recuperator i.e. a heat exchanger can be installed in the flue duct and used to recover the waste heat from the flue gases.

In a recuperator, heat exchange takes place between the flue gases and the inlet combustion air through metallic walls. Ducts or tubes carry the combustion air to be pre-heated; the other side consists of the waste heat stream. The system works based on the basic principle of Physics which says energy moves from a hot body to a cold. Thus, in the process inlet combustion air from atmosphere is pre-heated using the waste gas. The pre-heated combustion air is fed directly into the burner. The result is saving in terms of fuels, increase in flame temperature and improvement in furnace efficiency.

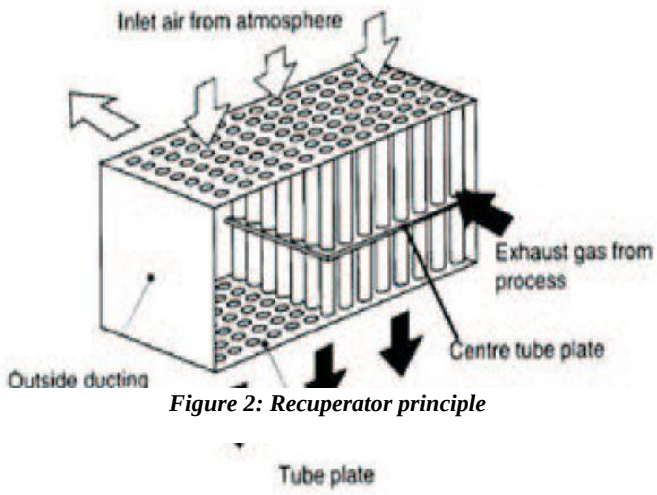


Figure 2: Recuperator principle

The recuperator efficiency depends upon two important parameters - Surface area available for heat exchange and time Recuperator material.

Justification of technology selection:

Use of high efficiency metallic recuperator is best suited for rolling units, where the exhaust temperature of flue gas temperature is very high. Some of advantages of the system are:

- ✓ Reduced fuel consumption
- ✓ Increase in combustion air temperature
- ✓ Increase in flame temperature
- ✓ Increase in furnace efficiency

Estimated energy & monitoring saving:

As mentioned in the earlier segments, re-heating furnace capacity at Howrah rolling units vary from 2 tph to 20 tph. For calculating the energy and monetary benefits, a typical case of a re-heating furnace of 10 tph capacity having exhaust flue gas temperature of 670 ^{o}C is considered:

Table 1: Cost benefit analysis for high efficiency metallic recuperator

Parameters	UOM	Present	Proposed
Flue gas temperature before recuperator	^{o}C	670	670
Flue gas temperature after recuperator	^{o}C	670	160
Ambient air temperature	^{o}C	35	35
Quantity of flue Gas	kg/h	4,722	4,722
Specific heat of air	kcal/kg ^{o}C	0.24	0.24
Total Heat content in Flue Gas	kcal/h		577,920
Effectiveness of recuperator	%		70
Heat Content in inlet air to the furnace	kcal/h		404,544
Preheated temperature to the furnace		35.0	392.0
Fuel savings per hour	kg/h		72.24
Annual operating hours	h/y	2,640	2,640
Annual Fuel savings	kg/y	190, 714	

Parameters	UOM	Present	Proposed
Cost of fuel	Rs/kg	7.62	
Annual monetary savings	Lakh Rs/y	14.54	
Estimated investment	Lakh Rs	15	
Simple payback period	Months	12.39	

The benefits can be summarized as:

- ✓ Increased combustion air temperature
- ✓ 95.3 tonnes of fuel can be saved annually
- ✓ Payback less than 1.5 years

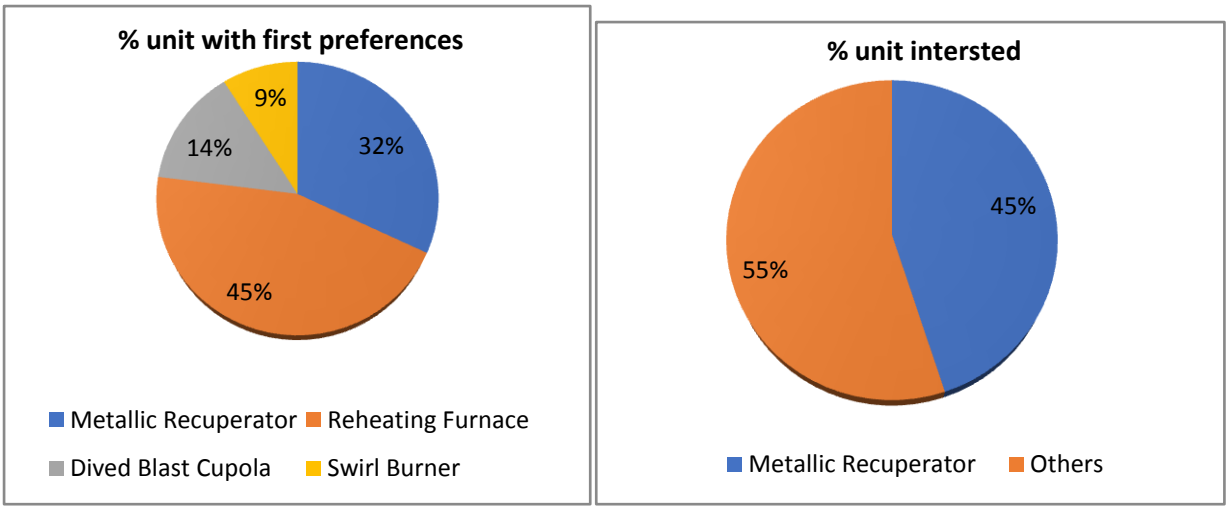
Replication Potential:

Howrah has a large number of rolling mill units. The steel Rolling Mills Association (SRMA) is the biggest association for rolling mills and some local associations like Howrah chambers of commerce and Industries (HCCI) and Durgapur rolling mill association are 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)

The technology of high efficiency metallic recuperator has a significant demand, with 20 out of 60 surveyed units so far, showing interest for the technology. However, while analyzing the preference of the units on the list of technologies, the technology of re-heating furnace is second in the list after 'reheat furnace automation '.

Figure 3: Summary of survey results



As seen from the above, 45 % of the units out of 60 surveyed units till date, has opted for "reheat furnace automation " for excess air control as the first preference for implementation.

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 20% in the cluster, i.e. 20 units. Based on 20% replication, the overall project benefits will be as follows:

Table 2: Impact of replication of technology

Parameter	UOM	Value
Annual thermal energy saving (one unit)	t/y	191
Annual thermal energy saving (one unit)	MJ/y	4,470,641
Annual coal saving (considering 20% replication)	t/y	3,814
Annual CO_2 emission saving (one unit)	tCO_2/y	404
Annual CO_2 emission saving (considering 20% replication)	tCO_2/y	8,071
Estimated investment in technology (one unit)	Lakh Rs	15
Estimated investment in technology considering 20% replication	Lakh Rs	300
Total energy savings (in 10 years)	MJ	894,128,260
Annual CO_2 emission saving (in 10 years)	tCO_2/y	80,710

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 high efficiency metallic recuperator is well established. A large number of reputed technology suppliers are available for the technology. However, a local service office for the technology supplier needs to be established. Some of the established technology suppliers who have presence in the cluster are:

- ✓ Eastern Equipment Engineers and Pvt Limited, Kolkata.
- ✓ Fuel Save Systems & Devices Pvt. Ltd, Faridabad.
- ✓ Thermo process Engineering Pvt. Limited, Mulund, Mumbai.
- ✓ R K Industrial Process, Faridabad
- ✓ Awasthi Industries Limited, Mumbai
- ✓ Technotherma Furnaces, Mumbai
- ✓ Refined Furnace, Jaipur