Replacing downdraft kiln with chamber kiln in a refractory industry

Tags

Type: Unit case study

Sub-sector: Refractory

Location: Burnpur (West Bengal)

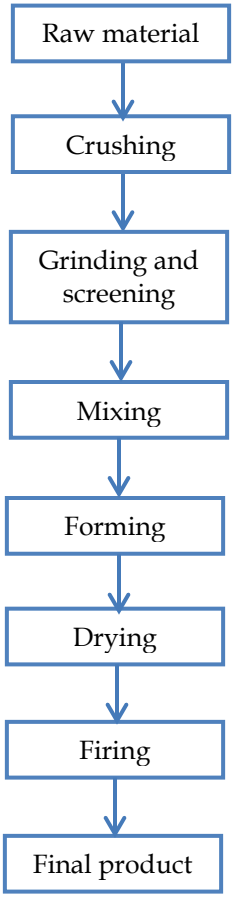
Partners: Self-effort of the unit

Cluster background

An important refractory industry cluster is located in Asansol–Burnpur (West Bengal). There are a large numbers of small-scale units engaged in manufacturing refractory products. Traditionally, these units use coal-based downdraft (DD) kilns for vitrification of green refractories. Over 200 DD kilns are used in the cluster, with an average production capacity of 100 tonnes per month. The annual production of the cluster is estimated at about 120,000 tonnes, assuming that 70% of the DD kiln units operate at 60% capacity. A few refractory units in the cluster also use tunnel kilns, which however would require substantial investments and continuous operation.

Unit profile

The unit manufactures both shaped and unshaped refractory products.
The shaped refractory products include refractory blocks, bricks, insulation bricks, bottom pouring, silica brick, etc. Unshaped products include refractory mortar, ramming mass, monolithic, etc. The installed capacity of the unit is 1200 tonnes per year (tpy). The average production is about 720 tpy, accounting for about only 60% of the installed capacity. The manufacturing process involves batch preparation, forming, drying and firing.



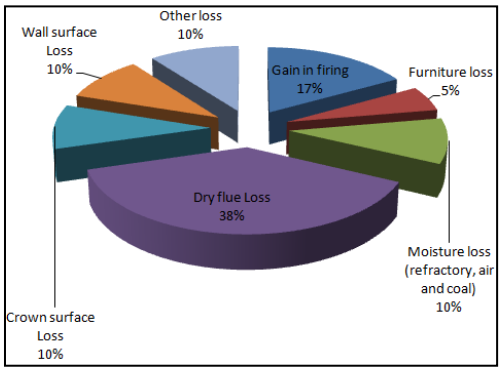
Production process

Downdraft kiln

The unit replaced inefficient downdraft kiln with a chamber kiln to utilize sensible heat in flue gases for preheating refractory products

Intervention

The unit uses both thermal energy and electrical energy in the production process. Thermal energy used in the kiln accounts for the major share of energy consumption in the unit (more than 95%). Electrical energy is mainly used in raw material preparation and shaping of green refractories. The annual energy consumption of the unit was estimated to be 252 tonnes of coal per year, equivalent to 163.8 tonnes of oil equivalent (toe) per year.



Heat balance of downdraft kiln

The unit was using DD kilns for the production of refractory products. The specific energy consumption (SEC) of the DD kiln was estimated to be 9.7 GJ per tonne of refractory produced. The SEC was significantly higher owing to the following factors:

- High temperature of flue gases due to the absence of waste heat recovery (WHR) system (dry flue losses >38%)
- Poor insulation leading to higher surface heat loss from crown(around 10%)
- Heavy structure and batch type operation resulting in significant structural losses (around 10%)

Chamber kiln

The unit switched over from the DD kiln to chamber kiln technology, which is more efficient than the DD kiln. A chamber kiln comprises a number of chambers or rooms with permanent side walls and roof and arranged in series, with provision of coal grate in each chamber. Each chamber is connected to the next chamber in series and with the central chimney in a manner that would direct flue gases from the chamber under firing operation to the next chamber before reaching central flue and chimney. This enables transfer of the sensible heat in high temperature flue gases to preheat dry refractory mass, thereby reducing the requirement of fuel for firing. With the adoption of chamber kiln, the SEC of refractory production of the unit was reduced from 9.7 GJ/tonne to 5.6 GJ/tonne of product, achieving an energy saving of about 42% as compared to DD kiln. This is equivalent to 265 tonnes of coal per year against 1800 tonnes of refractory production (172 toe per year). The estimated reductions in greenhouse gases (GHG) emissions are 695 tonnes CO_2 per year.