Replacement of existing kiln car with low thermal mass kiln car with Silicon Carbide furniture in a ceramic unit

Tags

Type: Unit case study

Sub-sector: Ceramic

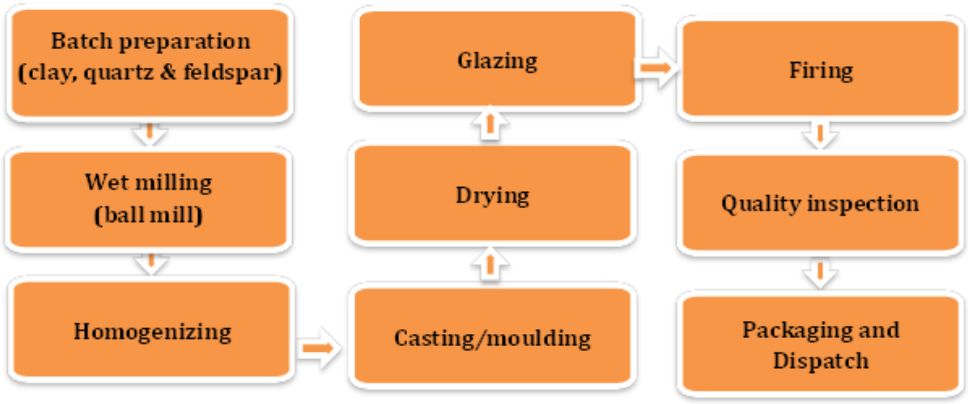
Location: Khurja

Partners: Self effort of the unit

Year: 2018

Cluster background

The Khurja ceramic cluster is one of the oldest ceramic clusters in India, located in Bulandshahr district, Uttar Pradesh. More than 200 ceramic units are engaged in manufacturing of various ceramic products such as crockery, table ware, decorative ware, porcelain insulators, special ceramics, toys and non-china crockery products. Due to environmental regulations, the units have shifted over from coal-fired downdraft (DD) kilns to mainly oil/gas-fired tunnel kilns. A number of units also operate oil-fired shuttle kilns for producing special ceramic products.



Unit profile

The unit manufactures ceramic cups of different shapes and colours using a wide range of raw material combinations. The average production of the unit is estimated to be 40,000 pieces per day. The manufacturing steps consist of mould preparation, body material preparation, shaping, drying and firing.

It requires both electrical and thermal energy at different stages of the process to operate the ball mill, casting/moulding, kilns, cutting &finishing machines and utilities such as motors, pumps, air compressors, etc. Thermal energy accounts for about 90% of the total energy consumption in the unit.

The energy consumption of the unit included 184,000 kWh of electricity, 171,000 Sm^3 natural gas (NG) and 4500 litres of HSD. The annual energy consumption of the unit was estimated to be 173 tonnes of oil equivalent (toe), equivalent to about 91 lakh rupees. The equivalent greenhouse gas (GHG) emissions from the unit were estimated to be 462 tonnes CO_2 per year.

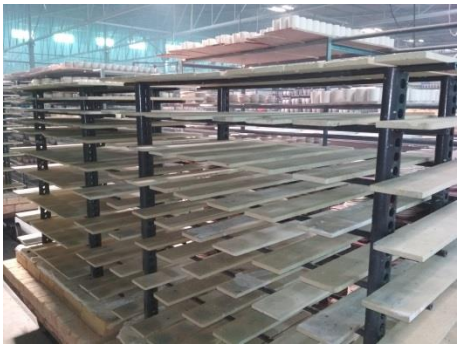
The unit replaced conventional high thermal mass kiln car by low thermal mass car with silicon carbide furniture, resulting in energy saving of 33%

Intervention

Cars are used in tunnel kilns to carry ceramic products during firing, and the kiln furniture includes all the objects and fixtures that are used to support, hold or position ceramic ware/articles in the kiln during the firing process. The dead mass of cars used in the unit was quite high; the ratio of kiln car weight to product was about 3:1. This resulted in (i) higher specific energy consumption (SEC) of about 10.4 Sm^3 per 1000 pieces, and (ii) high push time of the car, of 50–60 minutes.

Traditional kiln furniture

The unit replaced the high dead-mass refractory brick-based kiln cars by low thermal mass (LTM) cars with silicon carbide (SiC) furniture. The use of low thermal mass material in kiln cars led to a significant decrease in push time of the kiln cars, and increased production rates. However, the fired ceramic products need to adhere to a certain firing cycle in order to avoid cracks in the final products coming out of the kiln. Therefore, the unit increased the length of the kiln from 120 feet (36 metres) to 180 feet (54 metres) that covers preheating, firing and cooling zones.



Low thermal mass (silicon carbide) kiln furniture

With the modified structure, the ratio of car weight to product came down significantly from 3:1 to 1:1. This has reduced SEC level from 10.4 Sm^3 to 6.9 Sm^3 per 1000 pieces. Further, the push time for the car has been reduced from 50–60 minutes to about 20 minutes, leading to higher production rates. The unit has achieved an overall energy saving of about 33% (58,100 Sm^3 per year), and GHG reduction of 127 tonnes CO_2 per year. The estimated monetary saving is 25 lakh rupees per year. With an investment of 25 lakh rupees, the simple payback period for this improved technology is about one year.