

Successful Implementation – Energy Conservation Measure

Measure
Replacement of Refractory with Ceramic Fiber to reduce the surface heat losses in electrically resistance heated furnaces
Equipment
Light weight low conductive Ceramic Fiber
Industry / Sector
Foundry - Automobile
Year of Implementation
1996
Cost Benefit Analysis
o Type of Measure: Medium
o Actual cost : Rs. 4.0 lakh
o Energy Savings: 0.97 lakh kWh
o Payback: 14 months
Implementation Highlights
<p>Implementation of the measure has resulted in</p> <ul style="list-style-type: none"> ☞ Reduction in surface heat losses by 60%. ☞ Reduction in surface temperature up to 40° C. ☞ Reduction in cycle time by 40%. ☞ Increased productivity by 33%. ☞ Reduction in ambient temperature of furnace surroundings by 5-10°C. ☞ Improvement in working conditions. ☞ Reduction in heat-up time and fast raises of temperature. ☞ Reduction in thermal inertia of the furnace.

Summary

The refractory of these heat treatment furnaces was replaced with ceramic fiber to reduce the surface heat losses, reduce the thermal inertia and increase the loading space.

Background

One of the leading foundries has three electrical (resistance) heat treatment furnaces (A, B and C) for annealing application of automobile components. These furnaces of batch type and were provided with heavy weight refractory bricks.

The measured surface temperatures were in the range of 75-120°C resulting in very high surface heat losses due to high thermal conductivity of the heavy refractory. The high thermal inertia was time after loading to reach the required annealing temperatures. To reduce the surface losses the audit team had suggested to replace the insulation with ceramic fibre supported by refractory bricks.

Refractory insulation of three furnaces was replaced with combination of ceramic fiber and refractory while one furnace was completely revamped. During the replacement, resistance-heating elements were also replaced. A local contractor who also supplied the material carried out the implementation work.

Principle

Ceramic fiber has very low thermal conductivity (0.06-0.125 kcal/mh°C) and less weight when compared (96-132 kg/m³) with heavy weight refractory bricks having thermal conductivity of 0.18-0.35 kcal/mh°C)

Details of techno-economics:

Particulars	Units	A	B	C	Total
Surface heat losses before insulation	kCal/h	4504	6600	6600	17704
Surface heat losses after insulation	kCal/h	2462	2589	2235	7286
Reduction in surface heat losses	kCal/h	2042	4011	4365	10418
Percentage reduction in losses	%	45	61	66	59
Savings in power	kW	2.4	4.7	5.1	12.1
Cycle time before replacing of insulation	h	16.0	17.5	17.5	17.0
Cycle time after insulation	h	9	11	11	10.3
Reduction in cycle time	h	7	6.5	6.5	6.7
Savings due to reduction in surface losses	kWh/year	11397	24485	26647	62530
Savings due to reduction in cycle time	kWh/year	7479	13642	13461	34582
Total energy savings	kWh/year	18877	38127	40108	97112
Annual cost savings	Rs	67767	137258	144389	349414
Investment Required	Rs	200000	100000	100000	400000
Payback period	years	2.95	0.73	0.69	1.14

**Implementa
tion issues**

The plant was not aware of ceramic fiber and its related advantages. Initially the plant personnel were hesitant to revamp the furnaces. More over in house capability to evaluate the losses and take up the project was limited. A local contractor, who also supplied the material, carried out the implementation work.

The actual implementation was carried out by planning the furnace outages in order to keep the production going. The furnaces have to completely cool down before they can be stripped of their earlier insulation. Resistance-heating elements were also replaced in order to get uniform heating in the furnace.

Refractory insulation of these furnaces was replaced with combination of ceramic fibre and refractory while one furnace was completely revamped. The time needed for insulation change is approximately 2 weeks per furnace.