

Successful Implementation – Energy Conservation Measure

Measure
Use of ceramic coating in heat treatment furnaces
Equipment
Heat treatment furnaces
Industry / Sector
Engineering
Year of Implementation
1999
Cost Benefit Analysis
⌚ Type of Measure: Low investment
⌚ Annual Energy Savings: 0.35 lakh kWh
⌚ Actual cost savings: Rs. 1.75lakh
⌚ Actual investment : Rs.0.80 lakh
⌚ Payback: 6 months
Implementation Highlights
<p>Implementation of the measure has resulted in</p> <ul style="list-style-type: none"> 📦 Can be implemented in all types of heat treatment furnaces wherever the temperature of the furnace is above 700°C 📦 Increases the life of refractory 📦 Results in reduction in outer surface temperature and therefore reducing losses 📦 Installation is quick and can be done within a short span of time and doesn't require long shut downs (require 2-5 days for curing) 📦 Coatings do not call for replacement of existing refractory. It is coated over the refractory

Summary

The application of ceramic coating in furnace hot face promotes rapid and efficient heat transfer of heat by increasing the radiation component. The energy savings are achieved due to increased emissivity of the hot face and reduction in conduction losses through refractory

Background

A leading engineering company has one rectangular resistance-heating furnace used for hardening applications. The heat treatment of hardening is carried out at the temperature range of 730-855°C. The material is initially preheated to 730 °C in an hour, after that temperature is raised to 855°C and soaked at this temperature for one hour.

The type of the furnace : Batch type
 Energy Source: Electricity
 Furnace capacity: 200 kg/cycle
 Operating capacity: 160 kg/cycle

Due to very high temperature on the hot face side, the outer surface temperatures of the furnace are measured in the range of 62-106°C. The temperatures at lower half of the furnace are predominantly high (75-106°C) due to proximity of the heating elements.

Surface heat loss from lower half of the furnace : 9000 kcal/h (10.50 kW)

The radiation from the hot face (heating elements) to material was increased by applying the high emissivity ceramic coating. This measure has reduced the surface temperature there by reduced the surface heat losses can be envisaged.

Surface temperature after coating : 65 –70 °C
Surface heat losses after coating : 4700 kcal/h
Power savings achieved : 5.00 kW
Total hot face area of the furnace : 20 m²

Principle

The emissivity of refractories (fire brick, high alumina brick, ceramic fibre, etc) decrease with increase in temperature while in ceramic coating it increases (0.8 at Ambient temperature and 0.92 at 1085°C). This outstanding feature is exploited in these coatings. Salient Features of ceramic coatings are:

- ☞ These coating are suitable for service temperature up to 1350°C
- ☞ Reduces heating time
- ☞ Increases radiation heat transfer
- ☞ Increases refractory life
- ☞ Coatings are non-toxic, non-flammable and water based
- ☞ Furnace requires no modification
- ☞ Application in heat treatment furnaces, ceramic kilns, electrical heating units
- ☞ Applied at room temperature

Details of techno-economics:

Particulars	Actual energy savings
Power savings	5 kW
Annual operating hours	7000
Annual Total energy savings, lakh kWh	0.35
Annual Cost savings, Rs. lakh	1.75
Cost of Implementation, Rs. lakh	0.80
Simple payback period, Year	6 months

Implementation issues

- ☞ These coatings can not be applied in furnaces where refractory wall comes in contact with the material.
- ☞ These coatings require appropriate curing of the coating.
- ☞ The life of the coating is about 3 years, i.e. once in three years furnace requires re-coating.
- ☞ Manufacturers of ceramic coatings are willing to help in application at a cost .