

Non Implemented Case Study– Energy Conservation Measure

Measure
Air infiltration in to a large batch type furnace
Equipment
Furnace
Industry / Sector
Engineering
Year of Implementation
1996
Cost Benefit Analysis
o Type of Measure: Marginal investment
o Annual Energy Savings: 16.3 Mt LPG
o Actual cost savings: Rs. 2.20 lakh
o Actual investment : Marginal
o Payback: Immediate
Implementation Highlights
<p>The plant had implemented this measure and found that the savings were not achieved as estimated and hence implementation not continued. The main reasons for not achieving the savings are:</p> <ul style="list-style-type: none"> o The size, shape and weight of the material is not fixed and varied from load to load o Air infiltration could not be arrested permanently due to frequent deformation of the door. The furnace is rectangle type with a door in the front and the sealing at the bottom was made by sand groove. When the door is closed, the door bottom edge sits in to sand grove. Frequently the door gets deformed due to hitting of the door during material movement. This deformation caused improper sealing at the edges there by results air infiltration. o Some of the peep holes and thermocouple holes could not be closed due to complexity of the product and change in its shape o The operation of the furnace is not continuous and the energy cost component is not very significant (not even 0.3% of the product cost) o The implementation of the measure required attention for every loading to ensure that there is no air gap in sealing. In actual practice it was become more of time consuming and requiring considerable manpower

Summary

Arresting the air infiltration in the furnaces increases the rate of rise of the temperature and reduces the fuel consumption by avoiding the unnecessary heating of this unwanted air.

Background

The heavy engineering plant has one big batch type of the furnace for stress relieving application. The furnace capacity is 50 Mt. Per batch.

The furnace has 30 LPG fired burners fitted on the two sides of the furnace. Average LPG consumption in the furnace is about 329 Mt pr year.

The burners are of automatic type and the temperature is maintained automatically. The normal operating temperature of the furnace is 300°C.

The combustion efficiency of the furnace was evaluated by after measuring the CO₂ percentage and temperature. It was observed that the furnace was operating at very high excess air due to huge amount of air was infiltrated through the gaps between sand sealing, side sealing, peep holes, thermocouples, etc.

CO ₂ percentage at exit of the furnace	: 3.92%
Average LPG consumption	: 182.9 kg/h
Stoichiometric air requirement	: 15.01 kg/kg of LPG
Stoichiometric CO ₂ in exhaust gas	: 14.34 %
Air per kg of fuel	: 55.85
Total air	: 10060 kg/h
Air supplied by the blowers (measured)	: 5400 kg/h
Estimated air infiltrated	: 4660 kg/h
Exhaust gas temperature	: 390 °C
Heat loss due to infiltration	: 3.5 lakh kcal/h
Equivalent LPG consumption	: 30.0 Kg/h

It was suggested to avoid the air infiltration in to the system by closing the unused peep holes, keeping proper sealing at the bottom and sides of the door.

It was also suggested to keep the maximum excess air level not more than 30% (though the required range is 5-15%) since it was not possible to control complete air infiltration.

Techno-economics:

Reduction in heat losses	: 1 lakh kcal/h
Average LPG savings	: 9.05 kg/h
Average operating hours	: 150 per month
Annual LPG savings	: 16.3 Mt per year
Annual cost savings	: 2.20
Investment required	: marginal
Payback period	: Immediate

Principle

- ☞ The Stoichiometric air required for LPG combustion is 15.01 kg per kg. The maximum Stoichiometric carbon dioxide in the flue gas is 14%.
- ☞ LPG burners (gas burners) require about 5-10% of excess air to have optimum combustion by matching the time, temperature and turbulence.
- ☞ Excess air above 5-10% results in
 - ☹ Unnecessary heating of unwanted excess air
 - ☹ Reduction in flue gas temperature
 - ☹ Reduction of heat transfer rate from flue gases to re-circulating air which in turn results in high stack losses.
- ☞ The excess air could be due to high air flow rates blowers or air infiltration through the various openings
- ☞ The air infiltration in to the furnace will reduce the rate of rise of the temperature and also results in more fuel consumption.

Implementation issues

Initially the plant was very meticulous about the closing of the various openings during the operation of the furnace. Due to various operational problems encountered the implementation of the measure was not continued.