Successful Implementation – Energy Conservation Measure

Measure
Periodic monitoring and control of air fuel ratio in indirect heating paint baking ovens
Equipment
Ovens
Industry / Sector
Automobile
Year of Implementation
Continuously followed from 1996
Cost Benefit Analysis
‹› Type of Measure: Marginal investment
‹› Annual Energy Savings: 27.44 Mt, of LPG
‹› Actual cost savings: Rs. 3.35 lakh
‹› Actual investment : Marginal
‹› Payback: Immediate
Implementation Highlights
Implementation of the measure has resulted in: ⇨ Annual energy savings of 27.44 Mt, of LPG with marginal investment. ⇨ The measure was implemented in many other applications such as hot water generators, thermic fluid heaters. ⇨ Increased awareness among the plant operating personnel. ⇨ Reduction in heating time during cold start. ⇨ Reduction in band-width of oven operating temperature. ⇨ This measure can be implemented in all types of combustion units such as boilers, boilers, ovens, dryers, etc. whether those are batch type or continuous. ⇨ This measure is applicable to all type of fuels such as solid fuels, liquid fuels and gaseous fuels provided the optimum excess air is maintained. The excess air quantity is dependent of type of fuel and type of the burner as well as combustion chamber.

Summary

Excess control in indirect firing ovens resulted in LPG savings and reduction if cold start time of the oven

Background

A leading automobile unit, which produces two wheelers, has two indirect heating paint baking ovens. The ovens use LPG as fuel.

In indirect heating ovens, the recirculating air is heated by passing over the coils of LPG combustion gases. LPG is burned in a combustion chamber and the combustion gases are passed in tubes while the air is passed over these tubes.

The hot air is re-circulated through ovens where the painted components are baked at required temperature.

The ovens consumed about 55 kg of LPG per hour. The temperature maintained in the ovens was in the range of 135-150^{o}C.

The combustion efficiency of the burners was evaluated after measuring the flue gas composition (for $CO_{2)}$ and temperature.

The measured CO_2 level in Oven # 1 and Oven # 2 was 6.8% and 7% respectively. The corresponding excess air is 105 and 110% respectively, which indicates the burners of the ovens are operating at very high excess air when compared to optimum excess air level of 10% in case of gaseous fuels.

After computing the LPG losses due to excess air, the plant started meticulously monitoring the flue gas composition (for CO_2 and O_2) and controlling the excess air and resetting the modulating regulator of the air/gas and/or by adjusting the damper.

Principle

- The stochiometric air required for LPG combustion is 15.5 kg per kg of LPG. The maximum stochiometric 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 10% results in unnecessary heating of unwanted excess air, reduction in flue gas temperature and thereby reduction of heat transfer rate from flue gases to re-circulating air which in turn results in high stack losses.

Details of techno-econmics:

Particulars	Actual energy savings
Annual Total energy savings, Mt. of LPG	**27.5**
Annual Cost savings, Rs. lakh	**3.35**
Cost of Implementation, Rs. lakh	**Marginal**
Simple payback period, Year	**Continuous**

Implementation issues

Plant operating personnel were given a portable combustion analyzer (Fyrite kit – simple version of orsat operatus). The operators once in a week monitor the CO_2 and thereby adjust the damper for optimum CO_2 (i.e, of 13-13.15%). Initially the operators were reluctant to shoulder responsibility for the additional task of monitoring and controlling of excess air in the indirect heating baking ovens. After the individual unit was declared as a profit center, various avenues for cost reduction were explored.

Reduction in excess air and thereby, reduction in LPG consumption was a cost-effective measure. It also increased the awareness and motivation level of the operating personnel.