

Successful Implementation – Energy Conservation Measure

Measure
Optimization of primary and secondary air in a glass melting furnace
Equipment
Glass melting furnace
Industry / Sector
Glass
Year of Implementation
1998
Cost Benefit Analysis
o Type of Measure: Short term
o Annual Energy Savings: 63 kL
o Actual cost savings: Rs. 4.12 lakh
o Actual investment : Nil
o Payback: Immediate
Implementation Highlights
<ul style="list-style-type: none"> ☞ Very simple measure and can be practiced in all types of fuel-fired glass melting furnaces ☞ Also resulted in reduction of compressed air usage ☞ Reduction in exhaust gas temperature ☞ Energy savings achieved through awareness and following the best practices during the melting operations ☞ This measure is now gaining wide acceptance

Summary

Reducing the volume of primary air (cold air) (or maintaining the ratio at optimum level) and replacing with preheated secondary air will result in substantial saving of energy in glass melting furnaces.

Background

The plant has glass furnace of drawing capacity 110 Mt./day with reversible regenerator. Furnace oil is used as fuel and average consumption of oil is 585 liters per hour. The plant produces bottles of various types and capacities.

The combustion efficiency of the furnace was maintained optimally by maintaining the percentage of O₂ and CO₂, in the range of 3-4% and CO₂-12-13% respectively. The combustion process used two types of air (primary and secondary air). The secondary air is used for combustion is preheated by the regenerator. The secondary air temperature was 1270°C. The primary air is used for atomization. The optimum ratio of secondary to total air should be in the range of 0.94:1 to 0.92:1. The primary air should not exceed 8-9% total air requirement.

Measured airflows of primary air and secondary air indicated that the furnace is operating at the ratio of 0.88:1 (Secondary to total air) indicating very high quantity of primary air (12% of the total air). The compressor provides primary air while the blowers deliver secondary air.

Total air Distribution quantity

Particulars	Temperature, °C	m ³ /h	kg/h	%
Primary air	30-35	962	1164	12.14
Secondary air	1270	6960	8422	87.86
Total air		7922	9585	100.00

Flue gas exhaust temperature is about 415 °C which indicated further scope for heat recovery. More over the secondary air quantity was less.

Reducing the volume of primary air (cold air) and replacing with secondary air resulted in substantial saving of energy. By adjusting the burner air/fuel nozzles, primary air to the furnace was reduced. A simulation was worked out for different ratios of air.

Optimum operating range of primary and secondary air is as follows:

% primary air	Primary air m ³ /h	Secondary air m ³ /h	Savings kcal/h	FO savings		Cost savings Rs. lakh
				liter/h	kl/y	
7.5	594	7328	80232	8.89	71.13	4.62
8	634	7288	71586	7.93	63.46	4.12
8.5	673	7248	62941	6.97	55.80	3.62
9	713	7209	54295	6.02	48.13	3.13
9.5	753	7169	45650	5.06	40.47	2.63
10	792	7130	37004	4.10	32.81	2.13

Plant set the dampers for the ratio of primary to total air is maintained at 8%, and this resulted in annual energy saving of 63.46 kl of furnace oil (Rs.4.12 lakh).

Principle

In glass melting furnaces the primary and secondary airs are used for the combustion. The secondary air used for combustion is preheated by the heat exchanger. The primary air for spraying and air intruding from the clearance of the burner tiles enter the furnace as they are cold. Reduction in the volume of such cold air will lead to energy conservation.

If the cold air is reduced by 1% and the preheated air is increased by 1 %, it corresponds to reduction of air ratio by 1%; the fuel is saved about 0.5%.

Implementation issues

- ☰ The set point was finally achieved after repeated trials by slowly adjusting the dampers.
- ☰ For sustained savings, regular monitoring of air ratios and adjustment of dampers is required.