

Non Implemented Case Study – Energy Conservation Measure

Measure
Oxy-fuel burner application in steel melting by an arc furnace
Equipment
Arc furnace
Industry / Sector
Mini steel
Year of Implementation
-
Cost Benefit Analysis
o Type of Measure: High investment measure
o Annual Energy Savings: 33.6 lakh kWh
o Total cost savings: Rs.63.00 lakh
o Investment required: Rs. 50 lakh
o Payback: 10 months
Implementation Highlights
<ul style="list-style-type: none"> ☞ Huge energy savings are achievable and the concept is well proven abroad. But in India no arc furnace has oxy fuel burners. ☞ Though management principally agreed on the concept and energy savings achievable, the plant has not implemented this measure due to various reasons <ul style="list-style-type: none"> ☞ High investment required ☞ In India the liquid fuels (HSD) has high sulfur content and this has detrimental effect on the melting and final composition of the fuel. Now in India, ULSD is available hence this draw back is avoided. ☞ Availability of oxygen nearby is required for burners operation. ☞ No case study or success story within the country. ☞ More over, the mini steel sector is doing very badly and management was facing the problem of funds raising.

Summary

Oxy-fuel burners in the arc furnaces will results in reduction of specific energy consumption by 40 kWh/Mt by achieving the uniform temperature across the bath and fast melting rate. In addition the oxy-fuel burners use of low cost fuel.

Background

Plant has two electric arc furnaces of rated holding capacity of 23 MT. The furnace transformer rating is 13.5 MVA with on load tap changer. The furnace has three electrodes for arc generation.

The annual energy consumption in electric arc furnaces is about 500 lakh kWh which accounts for 65% total plant consumption. The specific energy consumption fluctuates between 570-740 kWh per Mt. of tapped metal. The electrode consumption is about 6.25 kg/Mt. And the oxygen consumption is about 15 nm³/Mt.

Proposal: Installation of oxy fuel burners

Electric arc furnaces are characterized by the presence of cold spots depending upon the shell shape, size, capacity and operational conditions. Non optimal thermal distribution especially at the periphery of the furnace walls results in non-uniform melting due to temperature difference and sudden collapse of scrap close to the arc.

The scrap near the walls remains solid even after formation of molten bath at the center. Hence the arc becomes exposed and most of the energy radiates to the wall and roof. The energy for melting the metal sticking to the sides can come only from the bath through conduction.

Oxy fuel burner is one such innovative technology, which has been prevalent in the Iron and Steel Industry. The Idea behind the oxy fuel burner is used for efficient, rapid melting of scrap by partial substitution of electric power with directional input of heat during the melt down of scrap in the electric arc furnace. These burners supplement the electric power with liquid/gas fuels.

Oxy fuel burners should be installed in the arc furnaces to ensure quicker and more uniform melt down to reduce the power consumption by nearly 40 kWh/MT of steel produced. The reduced energy demand can be met by using liquid fuel fired oxygen burners.

The success stories else where indicated that there were many associated benefits achieved. Some of them are increased life of electrodes, reduction in refractory consumption, reduced heat time, uniform temperature across the melt bath, etc.

Techno-economics:

Energy savings	: 40 kWh/MT
Power savings per heat (20t-heat)	: 800 kWh
Cost savings	: Rs. 2800/heat
Required liquid fuel per heat	: 190 liters
Cost of liquid fuel	: Rs 1272.00/heat
Net cost savings per heat	: Rs 1500/heat
Annual cost savings	: Rs 63.00 lakh
(@ 14 heats/day for 300 days for both furnaces)	
Initial cost for installing oxy fuel burners	: Rs 50.00 lakh
Simple pay back period	: 10 months

Principle

Electric arc furnaces are major energy guzzlers in the secondary Iron & Steel Industry. The furnaces are used for melting scrap and the recent trend is included for melting of sponge iron.

The specific energy consumption for electric arc furnaces in India is around 650-700 kWh/MT of steel melted. This is because these furnaces have not adopted the recent technological up-gradations like **Oxyfuel burners**, ultra high power, eccentric bottom tapping, computerized melt controls, foamy slag practice, waste heat recovery, etc.

Technologies such as the above have enabled the world's leading companies to operate their furnaces at a specific consumption of 380-400 kWh/t.

Among all up-gradations Oxy-fuel burner application finds the first place in terms of energy savings and other associated benefits.