Successful Implementation – Energy Conservation Measure

Measure
Use of energy optimizer and application of full power during majority of heat-cycle in induction heating furnace
Equipment
Induction furnaces
Industry / Sector
Foundry
Year of Implementation
1999
Cost Benefit Analysis
• Type of Measure: Short term
• Annual Energy Savings: 2.88 lakh kWh
• Actual cost savings: Rs. 10.36 lakh
• Actual investment : Rs. 2.00 lakh
• Payback: 2 months
Implementation Highlights
• Can be implemented in all types of induction furnaces. • Very simple measure and can be implemented with out the help of the external expertise. • Maximum power operation during most of the melting time reduces total losses. • Reduction in melting time by about 7-10%. • Energy savings achieved through awareness and following the best practices during the charging and melting and sampling operations. • This measure is now being implemented by many of the foundries.

Summary

Use of energy optimizer and constant and continuous attempts to reduce the time taken for heat, sample analysis and communication enables the operating personnel to optimize the consumption. In addition operation at full power to maximum possible extent reduces the cycle time and brings down the quantum of losses.

Background

A foundry has two medium frequency induction furnaces.

The unit has fair energy metering and reporting systems. Every melting furnace is connected to an individual energy meter (average type). Every day the consumption and production of each furnace is recorded and monitored. The furnace details are as below

Furnace #	No of crucibles	Crucible capacity, kg.	Rated kW	Rated frequency, Hz	Average specific consumption, kWh/Mt.	Metals melted
# 1	2	1000 & 1000	1000	500	**674**	SG Iron
# 2	3	500, 500 & 1000	550	100	**777**	Alloy steel, SG Iron

It can be seen that the furnaces are operating at slightly high specific energy consumption as compared to the practically achievable optimum value of 625 –650 kWh/Mt.

The factors contributing for the high specific energy consumption were analyzed.

- The heat cycle (pouring to pouring) is about 25-40% of the specified standard time.
- The power to the furnace was varied very frequently due to empty space in the crucible, excess charge, sample analysis delay, poking operation & degassing operation.
- The recorded electrical parameters indicate that about 35-40% of the heat time the furnace was operated at 70-80% of rated power.
- The raw materials are charged based on past experience rather than scientific method.
- About 80% metal is charged, before taking the sample for the analysis. The remaining 20% of crucible volume is loaded after obtaining the sample analysis.
- Time taken for sample analysis is about 8-12 minutes and normally the furnace was switched off during this period, where the temperature was reduced due to losses.
- The first batch sample analysis indicates the short fall/excess of different elements, based on this the additional material is added to achieve the required composition and quantity.

The specific energy consumption in the furnaces was higher than optimum value may due to the one/all factors specified above.

Plant has taken various steps and followed to reduce the specific energy consumption.

- Meticulous weighment and charging of input material based on proposed output. This trial & error method resulted in reduction of the time taken for melting the additional charge after the sample analysis. Since in the past about 20% of the material was added during post sample analysis for makeup/compensate the composition of liquid metal. This compensating material was reduced to 10% after successful trials.
- Supply of the full power during the melting (most of the time) is being practised.
- Reduction in time taken for sample analysis & communication was significantly reduced the heat time and thereby lowered the specific energy consumption. Use of *intercoms/alarms*, pneumatic conveying and *advanced logistical preparations* helped to reduce the time for sample analysis.
- In addition to above, use of recently introduced *energy optimiser* for melting operation created a benchmark and enforced conscious practice to complete the job within the set goal. This energy optimiser senses the inverter output power and integrates into energy delivered to the furnace. It is possible to *set a predetermined energy requirement value* for melting the material to the desired temperature.

  Setting of energy parameter was be based on lowest achieved energy consumption figure during the past fortnight. Close monitoring of set goal and analysis of the reasons for not being able to comply with the benchmarking if any, shall ensure reaching the optimum level of energy consumption.

Details of techno-econmics:

Furnace		# 1 Furnace	# 2 Furnace	Total
Possible reduction in time	min	5	7	-
Reduction in energy	kW	22	21.4	54.3
Operating days	per year	330	330	-
Operating hours per day	No.	24	16	-
Energy savings	lakh kWh/year	1.75	1.13	2.88
Annual cost savings	Rs. lakh	6.30	4.06	10.36
Investment required	Rs. lakh	1	1	2.00
Payback period	Months	2	3	2

Principle

In induction furnaces the major energy losses are fixed losses such as loss due to heat to cooling water, radiation losses, etc. The component of these losses will increase with the increase in cycle time. Lesser power input to the furnace during the charging and melting period will also increase the cycle time thereby increase the specific energy consumption.

Reduction of energy consumption in any induction furnace has to start with adoption of best practices to reduce the cycle time.

Implementation issues

- Initially there was resistance from the plant personnel to change the practices followed over the years, but increased production and related financial benefit in a shift helped to overcome this
- Requires a tremendous motivation and creation of awareness among the operators
- Requires support from other departments such test labs, molding section, scrap preparation section, etc.