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Study and Analysis of Energy Utilization in Casting and Forging Industry

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Abstract:- Energy audit is a methodology which is used to reduce the energy consumption by the system. The foundry industries are the most energy consuming systems in India. The objective of this research is to minimize the energy utilization in the company by using energy audit technique. It was found that induction furnace is the major problem, which made the system to consume more energy. The experimental study was conducted to optimize the wall thickness of the furnace in order to increase the efficiency of the furnace using ANSYS. As the thickness increased from 0.200m to 0.300m the efficiency of the furnace also increased from 49.40% to 54.70% with energy utilization cost reduction of Rupees 1592, considering 8 hour per day operation.
Keywords:- Energy audit, Foundry industry, Induction furnace, Efficiency analysis, ANSYS software.

I. INTRODUCTION

Energy audit is the audit with respect to the energy flow of the system. It involves study and analysis of the energy utilization of the system, identification of energy conservation opportunities. It gives an opportunity analyze the pattern of energy use and suggests alternative mean of eliminating energy losses and improving the total efficiency of the system, which includes material cost and labor cost. It has 2 phase one is the preliminary energy audit is the simplest and quickest type of audit. It is carried out in a limited span of times and at a shorter time; also focuses on major energy supplies and demands. Other one is Comprehensive audit or detailed energy audit investment grader audit. This type of audit expands the general energy audit.

II. LITERATURE SURVEY

Sangmesh Bhalke, et.al[1] done energy auditing for 12 foundries. Major problem was the induction furnace, which consumes more energy on average energy consumption. They did the experimentation by closing the lid of the induction furnace and charge material was done by robust design approach and hence it was found that the lid of the furnace plays a crucial role in power consumption. By robust design approach it has been found that the contribution is 59.6% towards the power consumption.

JakobRosenqvist, et.al[2] conducted energy audit in Linköping University. They introduced the top down approach with iterative approach to analyse the system. They used the duration diagram and graphical methods to analyse the data.

ManjunathaBabu P, et.al[3] conducted energy audit in BMSIT campus. The purpose of this energy audit is to identify, quantify, describe and to identify cost saving measures relating to energy use in the Academic blocks, hostel and canteen**.** They used the power factor improvement as a technique to reduce the energy consumption in the campus.

AbhilashEdacherian, et.al[4] done energy study in two industries namely Steel complex limited and Peekaysteel casting private limited. They did the comparative analysis between them and found that the melting process has a major energy demand. They analysed using histograms and gave recommendations to optimize the process.

Dr. R.K. Jain[5] gave the overview about the scenario of Indian casting industry. He did the experimental study on rotary furnace. From this experimental work that for energy conservation in melting, optimal rotational speed of rotary furnace is given which reduces the energy consumption.

Dr.M.Arasu, et.al[6] did the benchmarking study in four Indian foundries against standard energy consumption percentage. They calculated the specific energy consumption by using regression analysis. By this study they concluded that melting is the process which has high demand for energy.

Malkiat Singh, et.al[7] gave the idea for the reduction of energy cost by reducing lighting cost by using simple techniques. The recommended few change like replacement of with electronic chokes in a phased manner etc.

Ali Hasanbeigi, et.al[8] gave the guidelines for conducting an energy audit in industrial facilities, and briefly explained about the techniques like power factor correction, scatter diagram, histogram etc.

III. PROBLEM GENESIS

In a particular foundry industry, it was observed from July to August the energy units are increased from 3, 17,250 units to 3, 75,300 units. After detail analysis of system it was found that existing furnace with the melting capacity of 1tons has the energy efficiency 49%, which can considerably increase by changing some of the parameter related to furnace. The main aim is to analyze the process and decrease power consumption which leads to increase efficiency.

IV. METHODOLOGY

The methodology of conducting energy audit is follows as, the preliminary visit to the company then it followed by data collection as per the requirements. After the data collection energy conservation opportunities are identified through data analysis. Preliminary data analysis is carried out by using Microsoft excel by plotting graphs and then efficiency of the furnace is calculated by using ANSYS software. Then the improvement recommendations were given.

Table I: Specifications of Existing Furnace at Bhuwalka Industry.

Inner Diameter	1.575m
Outer Diameter	1.775m
Length	1.250m
Refractory Material	Aluminum Ramming Mass
Thermal Conductivity	11W/m^0C
Specific Heat	950 J/Kg K
Density	3400 Kg/m^3
Temperature 1	1350^{0}C
Temperature 2	25^{0}C

V. EFFICIENCY ANALYSIS IN ANSYS SOFTWARE

The efficiency of the furnace is analyzed by using ANSYS software by determining the heat loss through the induction furnace wall. In the furnace the model is created in ANSYS by using data collected for the furnace. Heat loss is calculated using boundary conditions as Convection co- efficient at inner side of wall 200 W/m2 0c Convection co-efficient at outer side of wall 12 W/$m^2 0_{C.}$

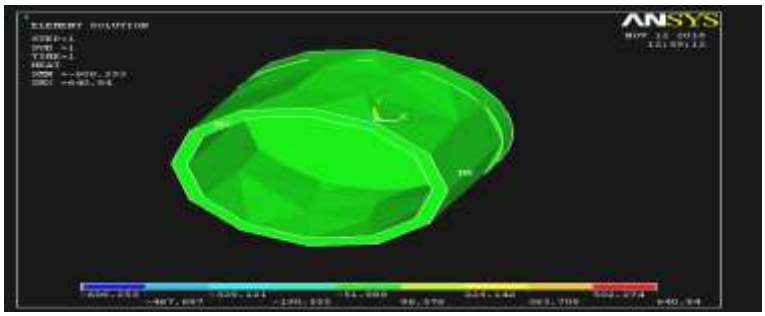

Fig. 1: Heat loss in Induction furnace (obtained through ANSYS)

VI. RESULTS

By ANSYS analysis the efficiency of the furnace and calculated the optimum dimension of furnace. Then the cost reduction is calculated based on the optimum dimension, heat loss and also using energy tariffs.

Efficiency Calculation: Efficiency of the furnace is calculated as shown below by considering one hour operation. Efficiency = $\frac{(\text{input heat} - \text{heat loss})}{\text{input heat}}$ = (76 – 38.45)/76 = .494 = 49.40%.

Estimation of cost reduction: Cost reduction due to the reduction in heat loss is calculated as shown below.
= (Heat loss at wall thickness of 0.200m - heat loss at wall thickness 0.300m)*37
= (38.45-33.07)*37 (According to Kolar electrical price per unit is Rs.35+ Tax Rs.2)
= Rs. 199.06 per hour.
The above estimation of cost is with respect to the one hour operation of Induction Furnace. If we take full day operation like 8 hour operation estimation of cost reduction becomes:
=199.06*8 = Rs.1592.48 per day.

VII. CONCLUSION

By the analysis it is observed that as the thickness value increases, the efficiency of the furnace also increases. If we increase the thickness value from 0.200m to 0.300m the efficiency of the furnace will increase from 49% to 57 If we increase thickness up to 0.300m the cost will reduce up to Rs. 1952 per day considering Kolar electricity tariff Rs. 35 per along with the tax of Rs.2.

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