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Case Study on Energy Consumptions and Recognition of Suitable Energy Management Techniques Foundry Industries.

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Abstract: The Indian cost-cutting measure has experienced unprecedented economic growth over the last decade. Today, India is the ninth largest economy in the world, driven by a real GDP growth of 8.7% in the last 5 years (7.5% over the last 10 years). In 2010 itself, the real GDP growth of India was the 5th highest in the world. In foundries energy accounting is necessary to determine where and how energy is being consumed and how efficient is the energy management system. There are many opportunities for improving energy efficiency in most foundries. Some of these, such as optimizing the efficiency of ancillary services can be achieved at minimal cost and make a valuable improvement to the bottom line. Reports from many foundries suggest that energy efficiency is one of the most significant cleaner production options still to be addressed in the industries. The paper outlines the improvement in energy and environmental performance possible through adoption of energy management techniques.

Keywords: Energy Management Techniques, optimizing energy, Environment

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I. INTRODUCTION:

Energy is significant, directly or indirectly, in the entire process of evolution, growth and survival of all living beings and it plays a vital role in the socio-economic development and human welfare of a country. Energy has come to be known as a `strategic commodity' and any uncertainty about its supply can threaten the functioning of the economy, particularly in developing economies. Most of these foundries are concentrated in geographical cluster. The foundry industry is characterized by its high energy consumption and particulate emissions. Melting is the most energy intensive process in foundries and also results in release of major air contaminants.

Li yuanyuan, Chen weiping et al 2010 have mentioned foundry consumes massive amount of energy, and yields tons of wastes. Foundry industry is one of major energy consumption industry and exerts noteworthy effect on environment. Energy accounting is necessary to determine where and how energy is being consumed and how efficient is the energy management system M.arasu, Rogers Jeffrey et al, 2007 have carries out research on energy conservation and emission reduction is related tightly with the survival and development of the industry, and it is also a key point of sustainable development.

Patrik Thollander, Maria Danestig et al 2007 has mentioned metal casting industry is naturally very energy intensive. Energy consumption in foundry mainly depends on electricity (Saha VJ,2010). The energy efficiency of any metal casting facility depends largely on the melting processes (Eppich R, Naranjo RD et al, 2007).Winrock International India, 2010 have done research on global warming is putting pressure on policy makers to formulate and adopt energy policies aimed at different sectors of the economy, industrial energy efficiency plays a central role in this regards There are a number of equipments in India where the flow is controlled by mechanical dampers for fans and valves for pumps. Further, majority of the doubling machines are operated at constant speed irrespective of the load on the machine. Hence, it is recommended to install Variable Frequency Drives (VFDs) for ID/FD(Induced draft/Forced draft) fans, oil circulation pumps and doubling machines. A minimum saving of 20% can be realized by installing Variable Frequency Drives (VFDs)

Energy discovery and exploitation, capacity additions, clean energy alternatives, conservation, and energy sector reforms will, therefore, be critical for energy security. Energy conservation has also emerged as one of the major issues in recent years. Conservation and efficient utilization of energy resources play a vital role in narrowing the gap between demand and supply of energy. Improving energy efficiency is one of the most desirable options for bridging the gap in the short term.

Success of Energy management depends on a team effort starting with a firm commitment from the top executive and management team. The first assignment in energy saving activity must be the initial energy audit.

It is a key step that establishes the baseline from which the future energy efficiency improvements can be measured.

This work explore first assignment in energy saving activity must be the initial energy audit. It is a key step that establishes the baseline from which the future energy efficiency improvements can be measured. One of the main results of energy audit is the possibility of determination of the energy consumption pattern. The energy pattern is the key in understanding the way energy is used in a foundry and helps to control energy cost by identifying areas where waste can occur and where scope for improvement may be possible. Safety is a critical part of any energy audit. The auditor and the audit team should have a basic knowledge of safety equipment and procedures.

1.2 Need for energy conservation in India

The increasing demand for power has led to considerable fossil fuels burning which has in turn had an adverse impact on environment. In this context, efficient use of energy and its conservation is of paramount importance. It has been estimated that nearly 25,000 MW can be saved by implementing end-use energy efficiency and demand side management measures through out India. Efficient use of energy and its conservation assumes even greater importance in view of the fact that one unit of energy saved at the consumption level reduces the need for fresh capacity creation by 2 times to 2.5 times. Further, such saving through efficient use of energy can be achieved at less than one-fifth the cost of fresh capacity creation. Energy efficiency would, therefore, significantly supplement our efforts to meet power requirement, apart from reducing fossil fuel consumption. The economic development of a country is often closely linked to its consumption of energy. Although India ranks sixth in the world as far as total energy consumption is concerned, it still needs much more energy to keep pace with its development objectives. India's projected economic growth rate is slated at 7.4per cent during the period 1997-2012. This would necessitate commensurate growth in the requirement of commercial energy, most of which is expected to be from fossil fuels and electricity. India's proven coal reserves may last for more than 200 years, but the limited known oil and natural gas reserves may last only 18 years to 26 years, which is a cause of concern. The continued trend of increasing share of petroleum fuels in the consumption of commercial energy is bound to lead to more dependence on imports and energy insecurity. India's energy intensity per unit of GDP is higher as compared to Japan, U.S.A. and Asia by 3.7 times, 1.55 times and 1.47 times respectively. This indicates inefficient use of energy but also substantial scope for energy savings. The increasing global trade liberalisation and growing global competition have made productivity improvement, including energy cost reduction, an important benchmark for economic success. Therefore, a paradigm shift in our approach to energy policy issues is needed – a shift from a supply dominated one to an integrated approach. This integrated approach would have to incorporate a judicial mix of investment in the supply side capacity, operational efficiency improvements of existing power generating stations, reduction of losses in transmission and distribution, end-use efficiency and renewable technologies. The policy goals and concepts would have to be shifted from "energy conservation" to "energy efficiency", and from "energy inputs" to the "effectiveness of energy use" and "energy services". Creation of new power generation capacity is costly and necessitates long gestation period whereas energy efficiency activities can make available additional power at comparatively low investments within a short period of time.

1.3 Need of Energy Conservation in Maharashtra:

Energy conservation avoids wasteful use of energy without much investment. It can be termed as a new source of energy, which when available, can be readily used without any further loss or gestation period. It is the cheapest source of energy. In fact, it is the easiest solution to bridge the gap between demand and supply. Some other reasons are: 1. increasing energy demand in India is a drain of the national economy. Besides, it is a major factor hindering the competitiveness of basic Indian industries in the global market. Thus, energy conservation is equally important for the nation and industrial firms. 2. Electrical power is one of the scarce resources in our country. Generation of electricity is very capital intensive. 1 MW of power generation costs approximately Rs. 4 crore because of the low plant load factor and high transmission losses prevalent in the country. The installed capacity of power station has to be therefore, 2.2 times the electrical load. Energy saving achieved through energy efficiency and conservation also avoids capital investment in fuel, mining, transport, water and land required for power plant, thereby mitigating environmental pollution. At present, there is a gap of 4000 MW between demand and supply of the electricity in the State of Maharashtra. To install 4000 MW capacity, the requirement of capital is of the order of approximately Rs.16,000 crore. Gestation period for setting up new power projects is of the order of approximately 4 years to 5 years. Hence, the energy conservation measures provide cheapest way to bridge the demand and supply gap with minimum capital investment. It also improves the plant load factor of generating stations which helps to reduce the cost of electricity. Maharashtra is one of India's leading industrial states. It has about 29,562 industries of which around 10,000 HT industries are established within it. Also, Maharashtra is the largest producer of electricity in the country.

II. INDUSTRY STATISTICS

India accounts for about 8–9% of total castings production in the world. The major casting producing regions in the world are depicted. In the year 2009, India's casting production was estimated to be nearly 7.4 million tonnes (MT). India is the second-largest producer of both grey-iron castings as well as steel castings next to China. Indian foundry industry produces various grades of value-added castings as per various international standards.

There are approximately 4,500 foundry units in India out of which 80% can be classified as small-scale units, 15% as medium-scale units, and just 5% as large-sale units. Approximately, 20% of the foundry units have ISO international quality accreditation. There are several foundry clusters in India. Some of the major clusters are Howrah, Coimbatore, Rajkot, Kolhapur, Ahmedabad, Batala, Jalandhar, Ludhiana, Belgaum, Chennai, Agra, Pune, and Vijayawada.

III. METHODOLOGY ADOPTED FOR ENERGY USE & TECHNOLOGY AUDIT STUDIES

A well planned methodology was adopted to execute the energy use and technology audit studies and to achieve the desired project objectives. Major steps which were followed during the energy use & technology studies of the project are mentioned below:

- Data Collection
- Measurements
- Analysis
- Technical discussion
- Conclusion

The primary objective of the energy audits is to quantify the existing electricity consumption pattern and to determine the operating efficiencies of existing systems. The key points targeted through energy audits were determination of specific fuel consumption, various losses, operating practices. Pre-planned methodology was followed to conduct the energy audits. Energy audit team has collected all relevant information related to energy with respect to production. Measurements were taken with involvement of plant people. Analyses of all the data captured have been done and then on basis of measurement discussions were held with the plant team.

3.1 Pre energy audit activities

Energy audit team have assessed the energy productivity of unit through a study and discussed the various energy issues. At first energy audit team have taken plant round to have feel of plant and to understand plant team's expectation through energy audit. Plant management assigned one technical person as coordinator, who has given all kind of details of energy and in his presence data measurement were taken. Finally at the end of audit, there was discussion with all plant team regarding findings of energy saving in plant.

3.2 Type of Energy Audit

The type of Energy Audit to be performed depends on: - Function and type of industry - Depth to which final audit is needed, and - Potential and magnitude of cost reduction desired Thus Energy Audit can be classified into the following two types. i) Preliminary Audit ii) Detailed Audit

3.3 Preliminary Energy Audit

Methodology Preliminary energy audit is a relatively quick exercise to: • Establish energy consumption in the organization • Estimate the scope for saving • Identify the most likely (and the easiest areas for attention • Identify immediate (especially no-/low-cost) improvements/ savings • Set a 'reference point' • Identify areas for more detailed study/measurement • Preliminary energy audit uses existing, or easily obtained data

3.4 Detailed Energy Audit Methodology

A comprehensive audit provides a detailed energy project implementation plan for a facility, since it evaluates all major energy using systems. This type of audit offers the most accurate estimate of energy savings and cost. It considers the interactive effects of all projects, accounts for the energy use of all major equipment, and includes detailed energy cost saving calculations and project cost. In a comprehensive audit, one of the key elements is the energy balance. This is based on an inventory of energy using systems, assumptions of current operating conditions and calculations of energy use. This estimated use is then compared to utility bill charges. Detailed energy auditing is carried out in three phases: Phase I, II and III. Phase I - Pre Audit Phase Phase II - Audit Phase Phase III - Post Audit Phase

II. Major Energy Consumption Areas of Foundry

Energy management in foundry (A Case Study)

Table1: Specific Energy consumption

Type of Furnace	Type of Fuel	Running hr/Day	Production capacity	Fuel Consumption /Day	Specific Energy Consumption/Ton of Molten metal	Specific Energy consumption in Rupees
Induction	Electricity	8	8	4900	900	3500

Energy consumption in Melting section: Foundry B

Table 2: Furnace Detail

Furnace	No. of crucibles	Crucibles Capacity ,KG	Rated Kw	Rated Frequency, Hz	Average Specific Consumption,KWh/Mt	Metal Melted
1	2	1000	950	500	690	SG IRON

Table 3: Details of techno-economics

Furnace	Plant A(Furnace)	Plant B (Furnace)	Total
Possible reduction in time (min)	8	10	-
Reduction in energy (kW)	22	24	46
Operating days per year	330	330	-
Operating hours per day	22	16	-
Energy savings (Lakh kWh/year)	1.85	1.46	3.31
Annual cost savings (Rs. Lakh)	5.90	3.95	9.85
Investment required (Rs. Lakh)	1.2	1.3	2
Payback period (Months)	2	3	2

Table 4: Benefits of load staggering

Load to be shifted to night shift (10 PM - 6 AM)	14KW
Assumed working hours per shift	8 HOURS
Monthly power consumption (30 days/month)	3400
Electrical cost for night shift operations (assuming Rs 3.5/kWh during 10 PM - 6 AM)	RS. 11900
Electrical cost for general shift operations (assuming Rs. 5/kWh)	17000
Savings per month	5100
Annual savings	61200

Table 5: Cost benefit analysis of power factor improvement

Existing load of the unit (KW)	110KW
Existing power factor	0.92
Desired power factor	0.99
Existing demand (kVA)	120
Capacitor required (kVAr)	45 APPROX.
New demand (kVA)	115
Reduction in maximum demand (kVA)	5
Monthly savings in demand charges @ Rs 300/kVA	1500
Cost of capacitors @ Rs 250/kVAr	11250
Simple payback period	8

Justification for Selection of Technology in current situation

Table 6: Energy Management proposals in foundry cluster

Foundry [A,B]	**Present System**	**Proposed System**	**Justification for Selection of Technology**
FOUNDRY A	Conventional 40 W Tube Light	Replace LED	It is highly efficient and very environment friendly. It also operates on high PF and it has instant start up also.

FOUNDRY B	Old re-winded motors	Energy Efficient Motors	Energy efficient motors are highly efficient and it has less power consumption. It also has less starting torque. There is good opportunity to replace old motors in Furnace blowers with Energy efficient motors**.**
FOUNDRY A	Open Lid	Lid cover & insulation for induction furnace	The basic requirement for thermal insulation is to provide a significant resistance path to the flow of heat through the insulation material. To accomplish this, the insulation material must reduce the rate of heat transfer by conduction, convection, radiation, or any combination of these mechanisms.
FOUNDRY A	No APFC for maintaining higher power factor	Installation of APFC with some extra capacitor to maintain unity power factor	This is the simplest and widely accepted measure for energy cost reduction in all the industries. Installation of the capacitors may lead to energy efficient system.

IV. TECHNOLOGY GAP ANALYSIS

Foundry units in unorganized sector has these characteristics; low engineering, limited technology innovation, poor R&D base, low level of human resource on knowledge of technology and operational skill etc. This sector also faces deficiencies such as the lack of access to technology, technology sharing, lack of strong organizational structure; professional attitude etc Majority of Foundry units in BJL Foundry Cluster are using low end technologies in their processes and utilities. The performance of those processes/equipments is poor as compared to the technologies available in the market. There are various technological gaps which were identified in units as under: • Lack awareness on the technologies available • Lack of awareness on quantum of energy loss and its monetary benefit • Lack of awareness among the workforce etc. There is a tremendous need for this industry to modernize/upgrade its technology and adopt energy efficient technologies in some of the areas. Further, as per the discussions made with the some of the progressive managements, they are interested in improving the energy efficiency of their units by adopting energy efficient technologies in market. From technology audit studies conducted in Foundry Cluster, below mentioned areas were identified for technology up gradations; • Copula Furnace • Induction Furnace • Rotary Furnace • Surface Insulation for reducing heat loss of furnace • Plant Lightning System • Electrical Motors.

V. SWOT ANALYSIS

Strengths:
The cluster is renowned for producing high quality castings, Foundries are shifting towards induction furnace melting, Good availability of alloys, Regular supply of electricity, Strong industrial base, Proximity to Mumbai and Pune

Weaknesses: Low degree of mechanization and automation, Use of inefficient manufacturing practices, High energy consumption and increasing input prices, Declining sand availability and growing sand disposal issues, Labour shortages, Slowdown in market

Opportunities: Increased EE in melting furnace technologies, Potential to reduce energy cost through implementation of energy audit, recommendations Increased use of robotic operations and simulation technologies, Easier availability of bank loans, Lean manufacturing practices, Common sand reclamation facility, Status of a regional export centre

Threats: Technological obsolescence, especially in the smaller foundries, Lower manufacturing costs in countries such as China, Global rise in price of raw material and fuels, Non-proven technology for green sand reclamation, Continued recession.

VI. CONCLUSION

There is a large scope of energy management in foundry industry sector in Indian small and medium scale foundry industries considering the fact that the large amount of power is being wasted by many ways. As majority of these foundries are not aware of these facts.

As of above case study we conclude that the better energy management program may save not only in terms of energy but also it may save money. Savings of at least 8% and up to 30 % may be realized by implementing some useful energy management techniques. The key to achieving savings is to take a strategic approach to managing energy use and giving importance to energy management techniques. While energy efficient technologies have a significant role to play in reducing energy use in foundry industry.

Most of the small-scale foundry units are family owned and managed. The general level of awareness among them about energy conservation and new technologies is low. Even if some of the entrepreneurs are interested in energy efficiency and technological improvements they are constrained by lack of technical know-how and finances. Looking into today's scenario, it becomes very essential for Foundry men to look for means which can bring down the energy consumption in melting operation significantly by efficient methods and techniques.

The strengths of the Indian foundry industry lie in the fact that it has a large base which is spread all over the country. India has a traditional legacy of metal casting and manpower is available at a reasonable cost. But the ferrous foundry industry is highly energy intensive. Energy cost is almost 10-15 percent of the manufacturing cost and cost of energy in India is very high in comparison to other countries

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