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ENERGY EFFICIENCY IN SMALL AND MEDIUM SCALE FOUNDRY INDUSTRY

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In this paper, the research results of surveys which were conducted in an Indian foundry cluster which are potential members of such sectors are presented. These results indicate that there is an enough potential improvement in the energy use. The use of energy efficient practices can result in their energy use effectively as well as cost reduction. The key findings about the energy pattern are a lack of energy efficient practices. The suggested recommendations can contribute to an increase in energy efficiency in such cluster.

Key words: foundry, energy, cost reduction, efficiency

INTRODUCTION

In the world the small and medium scale enterprise plays a crucial role. It manufactures vast range and energy efficiency is much more important for them [1]. The Indian foundry industry manufacturer's metal cast components for applications in auto, tractor, railways, machine tools, defense, earth moving / textile/ cement/ electrical / power machinery, pumps/ valves etc. Foundry Industry has a turnover of approx. USD 15 billion with exports approx. USD 2 billion. The Indian Metal Casting [Foundry Industry] is well established & producing estimated 9,344 Million MT of different grades of Castings as per International standards [2, 3]. The different sorts of castings which are created are ferrous, non ferrous, aluminum alloy, graded cast iron, malleable iron, Steel etc. As well as for application in automobiles, railways, pumps compressors and valves, diesel engines, cement/ electrical/ textile Machinery, aero and sanitary funnels and fittings and castings for extraordinary applications. However, gray iron castings have the significant offer that is approx 68 % of total castings created. There are approx 5000 units out of which 85 % can be named medium and small Scale units & 10 % as Medium & 5 % as Large Scale units. Ahmadabad, located in the state of Gujarat, is an important foundry cluster in Western India. There are about 500 foundry units. The cluster came-up mainly to cater to the casting requirements of the local diesel engine industry [3]. The significant issues in medium and small foundries are old technology, poor administration practices, constrained accessibility of stores, and uneducated labour. It was watched that this area remarkably expanded their utilization of power and raw materials to increase the production to adjust the market demand. The need towards cleaner creation through change in technology is must. But implementation of newer technology is not adopted due to economic justification [4]. Factor that needs to be controlled in order to save energy during induction melting is cycle time and many factors play an important role [5, 6, 7]. The estimation of the energy efficiency of a process or systems is a vital step towards the control of the energy utilization and energy costs, the energy audit may starts from a straightforward stroll through the study at different stages. It additionally gives a intend to viably impart energy data industries [5, 6, 7, 8].

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METHDOLOGY

In this paper a study on energy management in small scale industries is carried. Surveys were carried out within a selected group of small and medium companies. The survey involved 100 foundries. This gave a complete idea of the current energy utilization of the foundries, which contrasted with as well as recommendations used to implement it by economic justification. Energy consumption and process details were collected by visiting foundries for a period of two years. This study had been limited to small and medium scale sectors. The collection of data has made use of metering facilities for energy consumption in different sections / equipments.

RESULTS AND DISCUSSIONS

The real goal of the foundry case study is to show energy efficient practices in medium and small scale foundry industries contrasted with the best foundry unit in the sector. These outcomes are taking into account the energy audits completed in a company in different locations where there is a scope for improvements exist.

The data collected on energy use were used to find potential savings energy areas. Table 1 shows the present conditions of studied foundries. Also expected result based on end use consumption is shown in Table 2. Heat radiation plays a crucial role in foundry. These reading where taken while visit to different foundry industries of Gujarat State in India. Heat radiation by two different crucible body A and B are in Tables 3 and 4.

Table 1 **Present condition of studied foundries [9, 10, 11]**

Departments	Consumption of total plant energy / %	Specific energy Consumption in rupees (monthly)
Melting	72	864 000
Lightings	07	84 000
Compressors	08	96 000
Miscellaneous	13	156 000

Table 2 **Expected results based on end use consumption [10]**

Equipment as well as process	Consumption of total plant energy / %	Area savings Potential / %	Overall plant Savings / %
Melting	59	15	9
Fans and pumps	6	35	2
Lighting	6	30	2
motor	12	10	1
Air compressors	05	20	1
Miscellaneous	12	10	1
Total	97	-	16

Table 3 **Heat radiations from body A [9, 10]**

Size / m	Area / Sq. Ft.	Average Body Temperature / °C	Ambient Temperature / °C	Total Loss / Kcal/ hour	Energy loss / Kcal / hour Total Time 3 Hour
1,59 m to 2,82m height	151,5	60 – 75	25 – 50	2 840	8 515

Table 4 **Heat radiations from crucible body B [9, 10]**

Temperature in Average Degree Centigrade / °C	Energy loss KW / sq. m	Energy loss KW / hour Total Operation Time 3 Hour	Energy loss / Kcal per hour (Total Operation Time 3 Hour)
1 060	130	380	427 850

- In calculations, crucible thickness had been taken as average to 1,3 Meters and normal emissivity as 0,5.
- So in total energy loss addition of (A + B) for 3 hours process
  = 8 515 KCal/ hr + 427 850 KCal/ hr
  = 436 365 KCal/ hr
  =507 kWh

Plant operation running hours (Induction furnace) in a year will be (approx) = 900 hr.

So total consumption energy loss in normally terms of Electricity:-

= 152 100 kWh

= INR 760 500/-

[If Taking electricity at INR 5 kWh]

Investment for the lid insulation and furnace cover will be:-

= INR 600 000 (Approx.)

Simple Payback = Cost of Energy Efficient Product

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Annual Electricity Savings

= 600 000 ÷ 760 500 × 12 months

- Pay Back period = 9,46 Months.

Establishment of T5 lights set up of 40 w light.

Life cycle examination for T5 lights set up of 40 W Light. Power comparison for T5 light & 40 W lights is demonstrated in underneath Table 5. Also energy saving for the 28W light shows in Table 6.

Table 5 **Comparison of energy Consumption between T5 and 40W lights [10]**

Category	Power Consumption with ballast
Conventional fluorescent light (40 W)	55 W / Tube
Energy efficient T5 lamp (28 W)	30 W / Tube

Table 6 **Energy saving for 28W light [10]**

Saving	25 W / lamp
Running Hours	5 000 hrs/year
Energy Saving	= 0,025 kW/lamp × 5 000 hrs/ year × INR, 4,8 / kWh = INR, 600 / year / lamp

Ordinarily a fluorescent light will last between 10 to 20 times the lengths of a proportionate brilliant light when worked a few hours on end. The higher introductory expense of a fluorescent light is normally more than adjusted for by lower vitality utilization over its life. The more drawn out life might likewise diminish light substitution expenses, giving extra sparing particularly. Substitution of T5 lights could be possible on disappointment and trade premise for any light [10]. Flue gas examination was done amid the energy review. Just damper is obliged to be introduced to control air flow. By controlling excessive air quantity, coal usage would be reduced. It will bring about higher furnace temperature, subsequently high melting temperature.

Fuel Saving = 30 ÷ 15 = 2 %

Aggregate Fuel utilization = 95 ton / year

Savings = 0,02 × 96 ton / year = 1,94 ton / year

Expense of coal = 1 920 kg / year × INR 20 / kg =INR 38 400 / year

Investment needed for Damper Controlling = INR 10 000

Pay back = 10 000 × 12 ÷ 38 000 = 3,2 months.

Alternative of Re-Winded Motors by more Energy Efficient Motors (EEM)

Cupola furnace motor and others were considered in the visit, its passing power is the measurement being taken at site to break down the motor. In the midst of the survey it was viewed that the best of motors are re-winded had consumes more than 5 times which prompts approximately 2,50 times more power use and lower working capability. These motors can be replaced by the Energy Efficient Motors which prompts higher working capability up to 4,0 % for the similar working condition Energy-Efficient Motors (EEM) is exactly in which, design improvement especially to facilitate more productivity with standard working conditions [10, 11]. The power comparisons in rewind and EE motor with energy saving in electrical motor is shown in Tables 7 and 8.

Table 7 **Power Comparison in Re-wind & EE Motor [9, 11]**

Equipment (20 hp)	Power utilization
Specified motor	15 kW
Energy motor	14 KW
Saving capability	2 KW

Table 8 **Energy saving in Electrical motor [11]**

Economy	1 kW/motor
The continue Running Hours	10 hours /day 2 000 hours/year
Energy Saving	= 1 kW per Motor × 2 000 hours per year × INR, 5,0 per kWh = INR, 0,10 Lakhs/ year/motor

Install New Screw Compressor with Variable Frequency Drive (VFD)

During the energy audit, Air compressor was studied in detail to identify energy conservation in compressed air system. It was observed that the compressor is fully loaded and set pressure for loading is 5,5 Kg/cm^2 and for unloading are 6,5 Kg/cm^2.It is recommended that by installing new screw compressor with additional 375 to 400 CFM capacity. This compressor by design with installed with VFD (Variable Frequency Drive). The receiver pressure would be given as feed back to the VFD and this way compressor would never go to unload mode of operation. The annual energy saving potential is INR, 10,20 Lakhs. This requires investment of Rs. 8,00 Lakhs, which gets paid back in 10 month [10, 11]. The energy saving proposals with literature data and author’s own research yield energy saving proposal for foundry industry is presented in Table 9.

CONCLUSIONS

Small and medium scale foundry industry is a vital part in the Indian industries and would keep on playing an important part in the Indian economy later on. It has been watched that a many of the Small scale industry in this area today, are not intrigued with innovative upgrades and their quality, effectiveness and because of this benefit have really declined throughout the years. Globally, numerous new organizations are coming into the field and the competition is currently expanding rivalry from bigger units. To stay in the market the units thus, need to embrace more up to date and innovative ways to deal with update their technological capacities and hence stay focused. The small scale units, in any case, have constrained limit and assets to put resources into the innovative capacity improvement. The contextual analyses in the small scale areas easily demonstrate the advantages of vitality effective process. Subsequently it can be said that energy efficient methodology is one of best approach for showing the advantages of energy and productivity improvement in medium and small scale industry.

Table 9 **Energy savings proposals in studied Foundry [9, 10, 11]**

Sr. No.	Present System	Proposed System
1	No protection above the furnaces	Provides surface protection by applying insulation paint so to cover of Copula furnace to lessen heat losses.
2	No proper Damper Control so to controlling abundance air	Advances Combustion capacity of Furnace By dropping Excess Air
3	Out dated T/8 40 W CFL	Replace 40 W Light by T5, 30 W Light
4	100 W CFL	20 W LED
5	An Out dated re-winded for blower	Gives Energy Efficient motors
6	The unlock Lid	lid cover up & protection for prompting furnace
7	Screw Compressor	Variable Frequency Drive (VFD) Screw Compressor

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Note: The translator responsible for English language is Bernard Albert George, Anand, Gujarat, India