

# Energy Audit Implementation for Energy Consumption in a Foundry Unit towards Cleaner Environment

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**ABSTRACT :** The Amount of energy consumed on a daily basis in a foundry unit is tremendous, resulting in high energy consumption costs. The cost of energy represents several percentage points of the overall costs of a foundry. The electricity demand is very high, particularly for the induction melting furnaces. The required thermal energy input is obtained by combustion of coal needed for the process of formation of cast iron in the cupola furnace. Moreover, energy consumption by various machines in the foundry must be considered in the overall energy consumption of the factory. With the world facing energy crisis and the lack of attention towards efficient energy use in industrial sector poses a great concern for the energy management teams in the industries. For this purpose, this dissertation work is conducted for indentifying the opportunities and possibility of finding solutions to the energy wastage and energy conservation in one of the foundry plants located at MIDC Amravati (Maharashtra, India).

**KEYWORDS:**Energy Audit, Energy Conservation, Foundry, Shot Blast Machine, Compressors, Induction Furnace.

## I. INTRODUCTION

Foundry is an energy intensive industry and energy accounting is essential to determine the amount of actual energy use and the total energy waste. A good energy management is the key towards energy conservation and it starts with an energy audit. For a comprehensive business strategy in any industry, an effective energy audit is a very powerful tool to minimize the energy expenses. The energy audit in the foundry visited was implemented by the following actions:

1. *Analysis of the energy consumptions and costs*, by analyzing the energy bills of the last 12–24 months for each energy vector of the foundry (electricity, natural gas, coke, etc.);
2. *Survey on some general data of the industry*, such as the number of working days/weather data of the facility and its location, the facility layout, the type and operating hours of the production and services plants, the equipment list (technical characteristics and models of both process-related and general energy-consuming equipment such as heater, chillers, air compressors, etc.)
3. *Analysis of the energy consumed by the equipment*. This is an important step in any energy audit: each equipment has to be imputed by the energy consumed monthly and annually, differentiating between “process uses” (melting, moulding, etc.) and “plant services uses” (heating, compressed air, lighting, etc.). This stage can be performed by calculation (on the basis of power nominal data of the equipment, operating hours and work load factors) and/or by

measuring data (using power/energy meters and/or a data logger systems to monitor the energy consumptions or energy-related parameters during a significant interval). Such activity needs some tools to be implemented such as walk-through tours, audit interviews, gathering detailed data (on the manufacturing process, the electrical supply system, the electrical motors, the heating, ventilation and air conditioning system, the lighting system, the air compressors and the compressed air distribution system, the building envelope and windows characteristics) and measurement instruments (wattmeter, thermometer, voltmeter, combustion analyzer, etc.);

4. *Accounting of neglected energy consuming points in the industry.* This includes energy savings at water pump of sand plant Mular machine, compressor of shot blast machine, cooling water pump of induction furnace, energy use during lunch break within the office and shop floor. The study in this paper was concentrated on these areas as they were consuming much more energy as was necessary. These were duly noted, the data was collected, organized and analyzed.

## II. ENERGY SAVING OF WATER PUMP FOR SAND PLANT MULAR

**Approach to the problem:** As observed at the foundry, the sand plant mular machine's water pump was operating continuously because the machine operator(s) was/were not aware about the operating switches of the motor from the switch panel. If the switch is kept 'ON', the motor runs continuously. This aspect was ignored in the foundry resulting in high energy losses. On the other hand, if the switch is kept 'OFF' from the panel, the motor operates automatically when mular machine starts and after providing required amount of water to mular machine, the switch turns to 'OFF' automatically, thereby shutting down the pump when not required. A huge amount of electricity was saved by such a small step. Now with the proper instructions to all operators of sand plant mular machine, the switch of pump is kept on 'OFF' position from panel.

### Energy saving :-

Power rating of pump - 0.5 HP = 372.85 watts

Motor pump running time :

BEFORE	17 hours (approx.)	} 7 hours saved (approx.)
AFTER	10 hours (approx.)	

Energy consumed = Power (kW) X Number Of Working Hours x Multiplying Factor (here it is taken as 6)

Energy consumption/day:

BEFORE	$0.373 \times 17 \times 6 = 38 \text{ kWh}$
AFTER	$0.373 \times 10 \times 6 = 22.38 \text{ kWh}$

The Difference Between The Initial And The Latter Values Is The Energy Savings  
i.e.

Energy saved	$38 - 22.38 = 15.62 \text{ kWh}$
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1 unit is 1 kWh and tariff for 1 unit of electricity [3] (industrial purposes) is Rs. 6.71/unit

**Total Amount Saved On Energy Consumption Per Day:  $15.62 \times 6.71 = \text{Rs. } \underline{104.80}$**

**III. ENERGY SAVING OF COMPRESSOR (5HP) FOR SHOT BLAST MACHINE**

**Approach to the problem:**For the shot blast machine, a separate 5 HP compressor was being used. At the start of this energy audit, a trial was conducted to provide air to the shot blast machine from the 25 HP compressors in use for the sand plant in the foundry. It was observed that the air from the 25 HP compressors was sufficient to fulfill the air requirement for the shot blast machine. As a corrective measure for the energy wastage at the 5 HP compressors of the shot blast machine, it is kept 'OFF' and the required air is being supplied by the 25HP compressor in the foundry.

**Energy savings:**

Due to shutting down of the 5HP compressor of the shot blast machine, the following data was observed:-

1. Running time of the compressor per day is roughly about 6 hours.
2. Energy of the compressor (5hp) = 3728.5 watt.
3. Electricity units consumed = Power(kW) x Number of working hours.
4. Power (kW) = 3.728 kW i.e., unit consumed = 3.728 x 6 hrs. = 22.69 kWh (approx)
5. 22.69 kWh x 6 (multiplying factor) = 136.1 units/ day.
6. **Total Amount saved on the 5 HP compressor per day = 136.1 kWh x ₹6.71/unit = Rs. 913**

**IV. ENERGY SAVINGS IN COOLING WATER PUMP IN USE FOR INDUCTION FURNACE**

**Approach to the problem:**The pumps required for cooling the induction furnace were running continuously before this energy audit was to begin. A little inspection shows that when the furnace is not running, it takes 4 - 4:30 hrs for its cool down. This energy audit was useful to give instructions to the operators to keep a logbook and note down time when the furnace is turned "OFF", and after 4 hours the maintenance personnel or security switches "OFF" the motors and also record is being maintained for that purpose.

**Energy savings:**

About 3 hours were saved as found by this energy audit by properly maintaining the running of water pump for the cooling of the induction furnace. For this purpose 3 pumps are provided which feed cooling water to furnace.

The pumps are:

PUMP 1	3 HP	
PUMP 2	5 HP	
PUMP3	5 HP	
<b>TOTAL</b>	<b>13 HP</b>	<b>9694.1 W</b>

Electricity units consumed = Power (kW) x number of working hours

Electricity consumed = 9.694 kW x 3 Hours = 29 kWh

29 kWh x 6 (multiplying factor) = 174 units/day.

**Total amount saved on the cooling water pump for induction furnace per day = 174 x Rs.6.71 = Rs.1168**

**V. ENERGY SAVING IN LUNCH BREAK PERIOD**

Every energy audit aims at reducing energy consumption to the minimum as much as possible. Energy consumed for lighting purposes i.e. within the shop floor, office use, lighting of lamps, fans, computers, machines, and other such miscellaneous things consummates an appreciably large amount of electricity resulting into high energy expenses of the factory. Energy

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savings during the break period is a very good approach towards energy conservation. This 1 hour period is a non-productive period, and hence running of machines, lights, appliances etc on the shop floor is a waste of energy and should be shut-down for an effective energy conservation implementation plan.

**Approach to the problem:** During the lunch break, maximum number of machines is in non-productive state and hence they were shut down. The electric load due to lighting and illumination purposes, fan and all the aircompressors as well as all the pumps were turned 'OFF' in the lunch break. The energy units consumed before and after this energy audit were noted, compared and the amount of energy saved by this step was determined.

**Energy savings:**

A few energy readings at the main energy meter of the foundry at the start and end of lunch break was noted:

Lunch starts 12:30 PM (kWh)	Lunch ends 1:00 PM (kWh)	Energy units consumed (kWh)	Remarks
471199	471222	23	Induction furnace was ON
472081	472106	25	Induction furnace and core shooter machine was ON
473017	473039	22	Induction furnace and core shooter machine was ON
473777	473801	24	Induction furnace and core shooter machine was ON
474728	474747	19	Induction furnace and core shooter machine was ON
475423	475447	24	Induction furnace and core shooter machine was ON
476514	476538	24	Induction furnace and core shooter machine was ON
477213	477233	20	Induction furnace and core shooter machine was ON
478032	478056	24	Induction furnace and core shooter machine was ON
478818	478836	18	Induction furnace and core shooter machine was ON
Average energy consumption		22.3 kWh	

The core shooter machine as well as the induction furnace (if the furnace is turned on) together consume about 13 kWh of energy during the lunch period.

A little observation is sufficient to note the following points:

Average energy consumed in the lunch period before the energy audit	22.3 kWh
Amount of energy consumed by core shooter and furnace (which are kept running)	13 kWh
Amount of energy saved by turning off the lighting load and other miscellaneous loads in the lunch break	22.3 - 13 = 9.3 kWh (approx.)

Total energy saved = 9.3 x 6 (multiplying factor) = 55.8 kWh per day i.e. 56 units/day

**Total amount saved on energy savings during the lunch period per day = 56KWh x Rs.6.71/kWh = Rs.375.00**

**VI. TOTAL ENERGY SAVINGS IN THE FOUNDRY**

From the obtained data, the following implications were imminent:

SN	Energy savings at :	Energy saved per day (kWh)	Amount of energy costs saved per day (Rs.)
1.	Water Pump for Sand Plant Mular Machine	15.62	104.8
2.	5 HP compressor for Shot Blast machine	136.1	913
3.	Pump for cooling water for induction furnace	174	1168
4.	Savings during lunch break	56	375
<b>5.</b>	<b>Total</b>	<b>381.72 kWh</b>	<b>Rs. 2560.8</b>

*For a 26 days working month, above energy savings amount to up to Rs.2560 x 30days = Rs. 66,560/-*

**VII. RESULTS AND CONCLUSIONS**

Even a small reduction in the energy consumption of an energy intensive industry such as a foundry is highly appreciable. A proper energy audit was able to save about 382 kWh of electricity amounting to about Rs.67000/- per month. This was equivalent to about another month's energy consumption value of the foundry. As the data in this audit varies with the energy requirements of the foundry every month, the results depend on the energy consumption. Another proposal to further increase the energy conservation in the foundry, measures to utilize the solar power for lighting purposes in the office area can further significantly bring down the energy requirements of the foundry.

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