A SIMPLE SOLUTION FOR EFFICIENT ENERGY UTILIZATION IN AN INDUSTRY

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Abstract— a simple solution for efficient energy utilization in an industry is presented in this paper using proper energy auditing. Main objective of energy audit is to Conversation Energy in industry 1. Sincere attempt has been put to calculate Energy consumed in a day, a week and a month. energy wastage areas have been identified and conducted energy audit. The main aim is to found, quantify, describe and cost saving measures depending to energy use in varies places (workshop, canteen, plant engineering office, corporate & HR office) of the industry 1. And also detailed study of data collected has been done. Cost effective suggestions have been given to improve the efficiency of energy use. Energy estimation of monthly load has been done. And also cost calculation for workshop zones (existing) for suggested action has been made. The useful information generated by activities are documented and given to the consern authority. Energy Auditing in an intial step, which is helped reduces the situation of Energy crisis by providing appropriate energy conservation methods.

Keywords— Elektra, Lux meter,Watt meter, Voltmeter, Lamps

INTRODUCTION

The main aim of energy audit is to encourage the ideas of Energy Conversations in industry 1. The intention of the energy audit is to find, calculate, describe and cost saving measures related to energy use in varies places of the industry 1.

The process Energy Audit Study is as follows:

- Searching of places or areas of energy wastage and evaluation of energy saving potential points in varies places of the industry 1.
- Information sharing about cost effective methods to improve the efficiency of energy use.
- Study and reporting auditing results and information generated by activities.
- Calculation of costs and payback periods for suggested actions.
- Searching of possible usage of other resources such as co-generation.

Identification of utilization:

Searching areas where more energy is used, hence it is very easy to identify particular place or area where energy audit can be focused and gives importance of energy use and its cost. Audit study results can be used to make changes in management structures and process to control energy usage.

Load study and energy consumption calculation by each load can be made by manual method and sub meters installation at different places of plant. So that information about actual energy usage per specified area can be collected. The operation and maintenance details of all equipment and other electrical devices need to be collected with help of the information, a spreadsheet or charts can be made to analyze the system in better manner.

Points to be consider when collecting load data:

i. **Power consumption:** Actual power consumption is measure by wattmeter or Power analyzer.

ii. **Usage:** The usage of the equipment's in terms of hours per day and days per year can be collected form key person in plant,

departments etc. It is important to ensure the accuracy of this data because much of the potential for energy saving lies on wise allocation of the equipment operating hours.

iii. **Additional Information:** Some other additional information have to be collected, such as insulation media in case of AC's or Availability of natural light etc.

Finding the target area:

The prospects for energy saving can range from the simplest, such as lightening retrofits to the most complex such as the installation of a cogeneration plant. After the preliminary identification of prospects, more time should be spent on those which have shorter payback periods.

Analysis of cost benefits:

The identified energy saving should be studied in terms of the costs of implementing the project versus the benefits that can be gained.

Action Plan:

Based on the cost benefit test, an action plan must be developed. The opportunities identified are implemented. Action plan should include all the important steps for implementing the prospect and the responsibility. Furthermore, there should be an idea to monitor the results.

ENERGY AUDIT METHODOLOGY

The methodology adopted for this audit was a there step process comprising of:

Data collection: initially data collection phase, exhaustive data collection was performed using different tools such as observation, interviewing concern persons, and measurements.

For any corrective as per the suggestion, measures to reduce power consumption, it is first necessary to know the power consumption pattern is detail. For this, the exhaustive data collection exercise was performed at all the departments.

Below Steps have to be considered for data collection:

- The team's allotment to each department, workshop, office, plant engineering etc. to get data.
- Technical information about the general electrical appliances was collected by observation and interviewing.
- The power consumption of appliances was rated based on power used by appliances.
- The details of usage of the appliances were collected by interviewing concern persons across all departments.
- Light intensity was measured using lux meter at the places and points, where light intensity was either very low or low high.
- Generalizations and approximations and were done at places with lack of information

Analysis of Data: Detailed analysis of data collected was done. In data analysis, the data collected is processed to draw signification conclusions to pinpoint loopholes and identify the area to focus upon. Analysis of power consumptions observations obtained was used to obtain the power consumption pattern and also to get the information about the points where electric power is wasted.

Recommendation: On the basis data analysis and observations, some steps for reducing power consumption without affecting the comfort and satisfaction were recommended along with their cost analysis.

Energy as well as cost analysis of different appliances were performed and recommendations were made based on the capital cost recovery time.

The process is as follows:

- The capital cost involved in replacing an appliance and/or process has been estimated.
- The energy saving can be done by making some changes and it has been calculated in terms of price of energy per year.
- Two costs were compared to calculate the capital cost recovery time which is defined as the total time by which the saving in energy bill balances the capital cost involved.

- If capital cost recovery time is less than the product life, the move can be supported.

Some other recommendations were also made which are based on lighting intensity, AC insulation etc.

Specific Energy Consumption (SEC):

The specific energy consumption (SEC) is defined as the energy consumption per unit of product output.

IMPLEMENTATION OF ELECTRICAL AUDITING SYSTEM AT INDUSTRY 1:

Area Covered By Industry:

- Workshop: 49mx72m= 3528m^2
- Corporate and HR Office: 7.25mx21.5m=155m^2
- Plant engineering office: 22.60mx4m= 90m^2
- Canteen: 9.25mx18.5m= 172m

Monthly Load & Cost Calculation for Workshop Zones (Existing):

ZONE 1

Table.1: Consummation of Electrical Equipments in 24 Hours in Zone 1

SL. No	Name of the Light fitting	Rating of the Light fitting (W)	No. of the Light fitting	Connected load in watts	Total running hours in month	Energy consumption per month (kWh)	Per unit cost (7.8₹)
1	Tube light	50	46	2300	720	1656	12917
2	Mercury Lamp	250	3	750	720	540	4212
Total						**2196**	**17129 ₹**

As per routine of workshop zone 1 is running 24 hours per day. So Total hours per month are 720 hour.

ZONE 2

Table.2: Consummation of Electrical Equipments in 24 Hours in Zone 2

SL. No	Name of the Light fitting	Rating of the Light fitting (W)	No. of the Light fitting	Connected load in watts	Total running hours in month	Energy consumption per month (kWh)	Per unit cost (7.8₹)
1	Tube light	50	49	2450	720	1764	13759
2	Mercury Lamp	250	9	2250	720	1620	12636
Total						**3384**	**26395 ₹**

As per routine of workshop zone 2 is running 24 hours per day. So Total hours per month are 720 hours

ZONE 3

Table.3: Consummation of Electrical Equipments in 24 Hours in Zone 3

SL. No	Name of the Light fitting	Rating of the Light fitting (W)	No. of the Light fitting	Connected load in watts	Total running hours in month	Energy consumption per month (kWh)	Per unit cost (7.8₹)
1	Tube light	50	54	2700	720	1944	15163
2	Mercury Lamp	250	3	750	720	540	4212
Total						**2484**	**19375₹**

As per routine of workshop zone 3 is running 24 hours per day. So Total hours per month are 720 hour

ZONE 4

Table.4: Consummation of Electrical Equipments in 24 Hours in Zone 4

SL. No	Name of the Light fitting	Rating of the Light fitting (W)	No. of the Light fitting	Connected load in watts	Total running hours in month	Energy consumption per month (kWh)	Per unit cost (7.8₹)
1	Tube light	50	80	4000	360	1440	11232
2	Mercury Lamp	250	5	1250	360	450	3510
Total						**1890**	**14742 ₹**

As per routine of workshop zone 4 is running 12 hours per day. So Total hours per month are 360 hour

ZONE 5

Table.5: Consummation of Electrical Equipments in 24 Hours in Zone 5

SL. No	Name of the Light fitting	Rating of the Light fitting (W)	No. of the Light fitting	Connected load in watts	Total running hours in month	Energy consumption per month (kWh)	Per unit cost (7.8₹)
1	Tube light	50	109	5450	360	1962	15304
2	Mercury Lamp	250	2	500	360	180	1404
Total						**2142**	**16708 ₹**

As per routine of workshop zone 5 is running 12 hours per day. So Total hours per month are 360 hour

Table.6: Result comparison of Illumination System at Industry 1:

Source / Meters	*Tube Light*	*Mercury Lamp*	*LED's*
Watts	50 * 2 = 100 W	250 W	100 W
Lumens	4900 lumen (2450 * 2)	12500 lumen	11500 lumen
Rate	700 (1 set = 350)	1500	7330

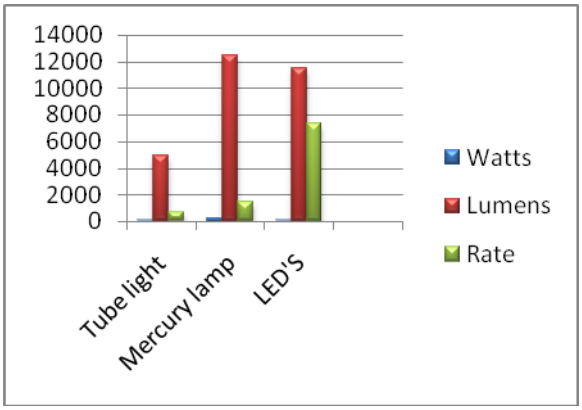

Fig.1: Comparison of different type of lamps

MONTHLY LOAD & COST CALCULATION FOR WORKSHOPE ZONES (RECOMMENDED)

After replacing mercury and tube lights by LED HI-BAY 100W

ZONE 1

Table.7: As per routine of workshop zone 1 is running 24 hours per day. So Total hours per month are 720 hours

SL. No	Name of the Light fitting	Rating of the Light fitting (W)	No. of the Light fitting	Connected load in watts	Total running hours in month	Energy consumption per month (kWh)	Per unit cost (7.8₹)
1	LED	100	14	1400	720	1008	7862
Total						**1008**	**7862₹**

ZONE 2

Table.8: As per routine of workshop zone 2 is running 24 hours per day. So Total hours per month are 720 hours

SL. No	Name of the Light fitting	Rating of the Light fitting (W)	No. of the Light fitting	Connected load in watts	Total running hours in month	Energy consumption per month (kWh)	Per unit cost (7.8₹)
1	LED	100	21	2100	720	1512	11794
Total						**1512**	**11794 ₹**

ZONE 3

Table.9: As per routine of workshop zone 3 is running 24 hours per day. So Total hours per month are 720 hours

SL.No	Name of the Light fitting	Rating of the Light fitting (W)	No. of the Light fitting	Connected load in watts	Total running hours in month	Energy consumption per month (kWh)	Per unit cost (7.8₹)
1	LED	100	15	1500	720	1080	8424
Total						**1080**	**8424 ₹**

ZONE 4

Table.10: As per routine of workshop zone 4 is running 12 hours per day. So Total hours per month are 360 hour

SL.No	Name of the Light fitting	Rating of the Light fitting (W)	No. of the Light fitting	Connected load in watts	Total running hours in month	Energy consumption per month (kWh)	Per unit cost (7.8₹)
1	LED	100	23	2300	360	828	6458
Total						**828**	**6458 ₹**

ZONE 5

Table.11: As per routine of workshop zone 5 is running 12 hours per day. So Total hours per month are 360 hour

SL.No	Name of the Light fitting	Rating of the Light fitting (W)	No. of the Light fitting	Connected load in watts	Total running hours in month	Energy consumption per month (kWh)	Per unit cost (7.8₹)
1	LED	100	26	2600	360	936	7301
Total						**936**	**7301 ₹**

GRAPHICAL REPRESENTATION

Existing Load Fittings for workshop:

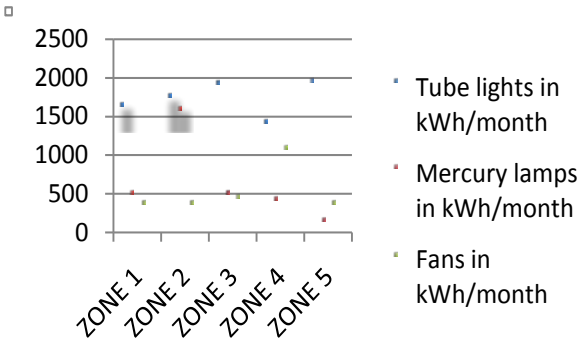

Fig.2: Zone wise existing load fittings.

Replacing Load Fittings for workshop with LED's:

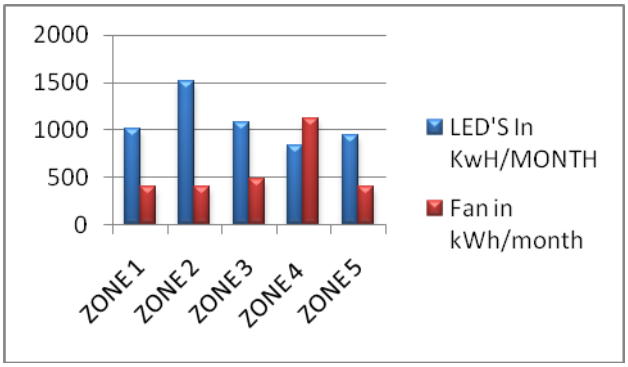

Fig.3: Zone wise load fittings after replacing with LED

CONCLUSION

This work examined the energy consumption of workshop by the present light fittings. We are recommending that to save the energy consumption by replacing the tube lights and mercury vapour lamps by LED's.

A conventional tube light has a luminous efficiency of about 40-50 lumens/watts and mercury vapour lamps has a luminous efficiency of about 45-55 lumens/watts. Light emitting diode (LED's) has luminous efficiency of 115 lumens/watts.

Light emitting diode (LED's) is more energy efficient. LED's have longer life and is environment friendly. LED's offer 60% - 70% increase in efficiency as compared to conventional tube light and mercury vapour lamp and provide a good colour. Moreover the replacement of 250w mercury vapours lamps

by 100w LED'S leads to 60% energy saving for the same illumination level. A conventional choke consume about 10-15w and operate and very poor power factor.

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