Energy Audit & Energy Conservation Opportunities in Barrel Division Plant

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Abstract—**This paper present Energy Audit method & finding Energy Conservation Opportunities in Barrel Division plant located in Dadra & Nagar Haveli, Silvassa. It is one of the largest manufacturers of drum & barrel used for keeping heavy oils, grease & crude oil. Energy Audit was done in steps first being the walk through in which broad view of the plant & its machinery were seen & then in next phase various data is being collected from management like electricity bills of last 24 months, production data. After careful analyzing various recommendation along with payback period were given to top management.**

Keywords-Energy Audit, Energy Conservation

I. INTRODUCTION

The main focus of an energy audit for the industrial is to find out energy savings opportunities that would reduce their early operating costs Savings such as energy cost and power factor incentives may be identified during the audit process. Critics of energy audit recommendations often say that auditors overestimate the savings potential available to the customer[1]. This possibility of overestimation concerns utilities who do not want to pay incentives for demand-side management programs if the facilities will not realize the expected results in energy or demand savings.

Audit activities in general order include:

i. Identification of all energy systems
ii. Evaluation of conditions of the systems
iii. Analysis of impact of improvement to those systems.
iv. Preparation of energy audit report

The analysis which includes the economic analysis is done after the audit work using all the data gathered. Studies and researchers have shown that energy auditing and conservation can save India Rs.1800 crore per year as there is a big potential for saving energy in industrial sector. In terms of electricity, these saving are equivalent to installation of 5250MW[2].

II. TYPES OF ENERGY AUDITS

The energy audit orientation would provide positive results in reduction energy billing for which suitable preventive and cost effective maintenance and quality control programmes are essential leading to enhanced production and economic utility activities. The type of energy audit to be performed depends upon the function or type of industry. There can be three types of energy audit.

a) Preliminary energy audit
b) General energy audit
c) Detailed energy audit [3]

A. 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

Industry-to-industry, the methodology of Energy audits needs to be flexible. Following steps are adopted methodology for detailed energy audit[4].

Step 1 : In this step study of process and energy uses are taken from employees, this understanding helps in planning the resources available and time required for conducting energy audit.
Step 2 : In this step importance of energy uses are discussed with the section officers so that awareness could be build this will also help in future cooperation. (Kick off meeting)
Step 3 : In this step collect the plant data and electric bill find out the more energy uses of area, which are using and work properly for different process and collect name plate review and some data use with the help of measurement device.
Step 4 : In this step measurement are taken with the help of portable instrument such as lux meter, techo meter, power analyzer etc. The energy is mainly being use in pumping and other process for purification of water. This data is compare with operating design data and baseline energy use is determined.
Step 5 : In this step calculation of all performance data (standard parameters) involve in the process is prepared and present performance data is compared with baseline data (design). Based on technology availability and compression, recommendations are proposed to save /conserve energy. These recommendations are as investment grade (payback period). Reduction in energy consumption will take place after implement of recommendations.
Step 6 : In this step flow up the methodology & technical advice on the plant than rapid will be concur best result.

Table 1 Represent walk-through and detailed process audit

Required Parameters	Walk-thought audit	Detailed Energy audit	Comments
Purpose	Awake for audit process	Save energy	Bes t result perform
Conduct kick -off meeting	May be done	must	
Collect plant data	Salient features	Detailed observations is required	Design summary, drawings, utility bills , plant flow and performance information.
Explain electric bill and schedules	May be review	must	Explain the importance of demand and energy and how changes are ma de.
Conduct field investigation	No	Highly essential	Limited investigation for walk-through audit; comprehensive investigation for detailed process audit.
Create equipment inventory and distribution of demand, energy	No	Desirable	Desirable for walk -through audit but usually not performed. Detailed inventory prepared for processes.
Develop ECMs and implementation strategies	No	yes	Walk-through audit identifies some EC M s but detailed analysis is usually not performed. Detailed process audit develops EC M stand determines which one s will be implemented
Follow -up	No	yes	

III. METHODOLOGY

We used appropriate instrumentation for quantifying the energy loads and consumption patterns of major energy consumers. Based on the measurements and study, We evolved various energy saving proposals. These proposals were discussed and evaluated techno-commercially to identify the most feasible ones. Some of the typical measurements and analysis conducted are as follows

Electrical System:

The existing the electrical distribution system right from the incomer transformer, PCC, MCC, actual loads, ELDB, and up to the last consumer was reviewed. WE carried out measurements using sophisticated microprocessor controlled instruments to study the on-line load patterns and collect data on V, I, KVA, KVAR,

KWH, Power Factor, Frequency, Harmonics, Temperatures, RPM, Flow, Lux levels etc. Wherever necessary, we assessed the performance of equipments with respect to energy consumption and the output, compare these with the benchmarks and discuss the possibility of improving the efficiency.

Lighting:

Measurements of light intensity and all major electrical parameters viz., voltage, current, PF, KW were done. Type of lamps and chokes used ; along with their control system was studied to find out better alternatives.

ANALYSIS:

Load analysis and data analysis vis a vis the rated and designed parameters was done. We studied the load curves, cyclic patterns and harmonics in the systems to improve the overall performance and optimize the energy utilization. They worked out various energy saving proposals and discussed to find the economic viability. Wastage of energy at all levels was evaluated for its techno-commercial exploitation.

IV. ENERGY CONSUMING EQUIPMENTS

Energy is consumed in the form of

- Electricity (supplied by ELECTRICITY DEPARTMENT, SILVASSA)
- Fuel (LDO used in Ovens)

Electrical energy consuming equipments

1. Compressed air system
2. Water Distribution (Pumping System)
    a) Cooling Tower
    b) Drinking Water
    c) Degreasing Plant
3. Plant Machinery (Hydraulic system, Seam Welding, Conveyors)
4. Fans & blowers
5. Lighting (Plant & exterior)
6. Office & canteen load

Thermal energy consuming equipments

Ovens: Ovens used in different operations are.

1. Compound baking oven (Rubber material drying for base covers)
2. Drying oven (After rinsing)
3. Paint baking oven- 3 Nos. (After Painting)

A. Energy Consumption & Cost (Electricity & LDO)

Energy consumption (TOE) April 2010 to March 2011	
Electricity	LDO
89.67	174

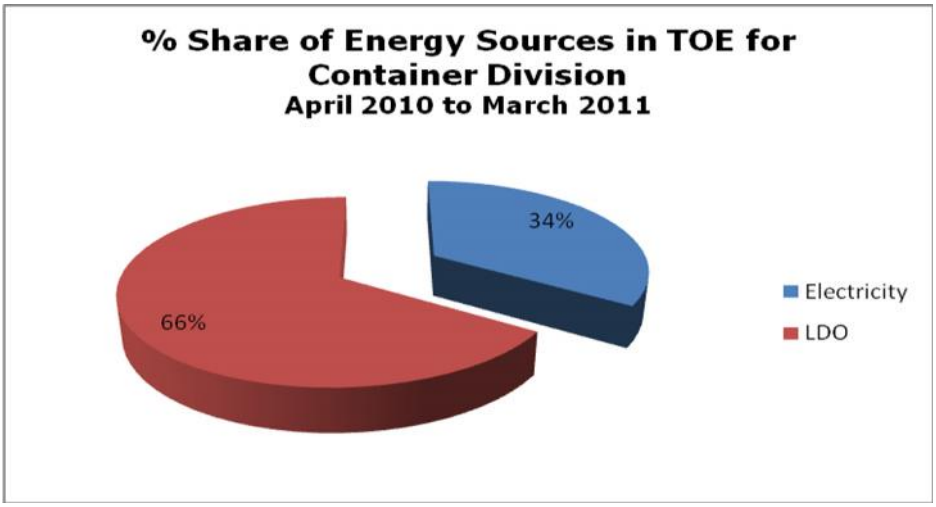

Fig1: Percentage Share of Energy Source

B. ELECTRICITY DEPARTMENT, SILVASSA Bill summary

(Period April 2010 to Mar 2011)

Table 2 Electricity Bill Detail

	Units	Max	Mini	Avg	Total
CD	kVA	743	743	743	
Billing Demand	KW	661	588	616	
Max Demand	kW	660	589	616	
Unit Consumed	KWH	147900	104412	125864	1510368
Current Bill	Rs	859299	527280.6	677822.1	8133865
Total Bill	Rs	1079988	489595.7	839147.4	10069768
PF		0.997	0.9672	0.9876	

C. Load Profile & Section wise Energy Consumption

The measurement of various power parameters was done using state of art power analyzer. The measurements of these parameters for outgoing load of the transformer were recorded continuously for period of 42 hours. We had recorded power parameters for 42 hours of the operational load of the container division. The load profile for the entire container division for 42 hours is given below:

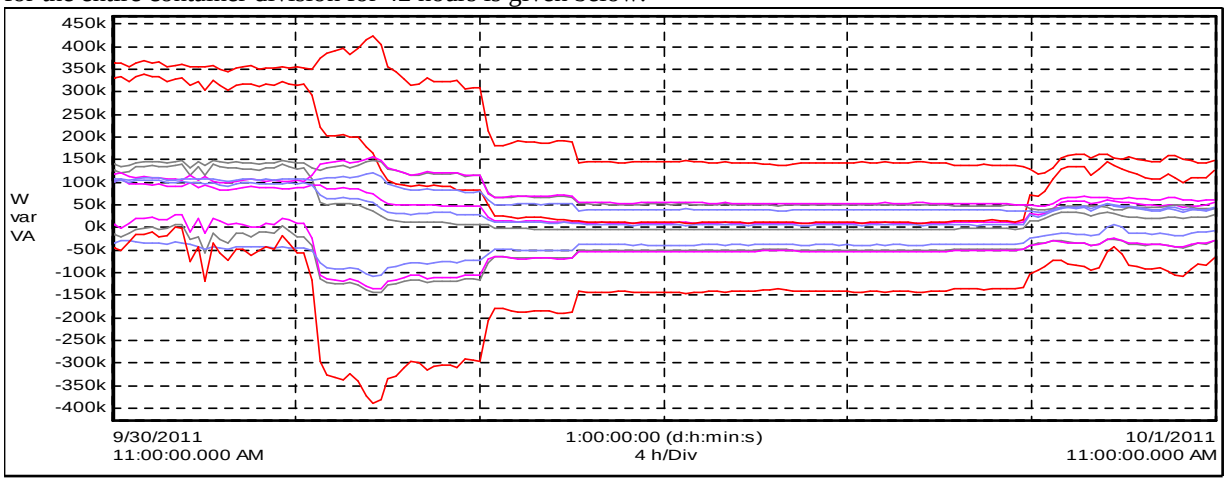

Fig 2: Container Division Main Incomer Recording Profile

Reading of **container** division of (KW, KVAR & KVA) was done for 24 hour reading was taken from Friday at 11.00 am to Saturday 11.00 am, Friday (30/9/2011) normal functioning of plant was done, maintenance was going on Saturday (1/10/2011).

V. ENERGY SAVING RECOMMENDATION

Recommendation 1: Saving by proper positioning of compressor suction

Atlas-Copco compressor # 1, 2 & 3 suction is installed just above the motor. Due to heat generation by motors, temperature of suction air is expected to be 4 to 6 ^{O}C more than that of ambient air temperature. It is advised to change the position of suction. Every 4^{O}C rise in inlet air temperature increases power consumption by 1%[5]. Besides this it is suggested to exhaust room hot air properly, so that temperatures can be further reduced & efficiency improved.

Increase in inlet air temperature of Allas-copco compressor	= 4 ^{O}C
Present average power consumption during load (2 compressors)	= 71 kW
Present Load time per day (80% Load time*Daily 10 Hours)	= 8 Hrs
Annual saving in power consumption (@1% for 300 days/annum)	= 1704 kWh
Annual cost saving (@ Rs. 7/ kWh)	**= 0.12 Lakh Rs**
Investment required	**= 0.20 Lakh Rs**

Payback : 20 months

Recommendation 2: Replacement of FTLs with T5+ Lights

Particulars	**Present**	**T5+**	**Savings**
Power watts/hour	52	28	24
Life – hours	8000	18000	10000
Heat Load, Watts	22	2	20
Harmonics, TDH	30 %	< 10 %	> 20%

Savings (24 W/tube x 8 Hr x 300 days)	= 57.6 kWH/year/tube
Total Nos of FTLs considered for replacement	= 100
Energy saving kWH per year	= 5760
Cost saving Rs. per year @ 7 RsKWH	= 0.40 Lakh Rs.
Total Investment in Rs @ 400/fitting	= 0.40 Lakh Rs.
Payback Period	= 12 Months

VI. SUMMARY OF ENERGY SAVINGS MEASURES

S.No.	Recommendation	Annual Saving		Investment	Payback
		Lakh kWH	Lakh Rs	Lakh Rs	Months
1	Saving by reducing air leakages up to 10%	0.9	6.39	1.5	3
2	Saving by proper positioning of compressor suction	0.02	0.12	0.2	20
3	Saving in compressor during non-operation of machines	0.24	1.68	NIL	Immediate
4	Saving by sending closed loop return hot water directly to the cooling Tower	0.14	1	Negligible	Immediate
5	Saving by sending only high temperature return water to the cooling Tower	0.36	2.5	Negligible	Immediate
6	Saving in O/F pumping power by sending compressor return water (closed loop) directly to the cooling Tower	0.05	0.38	Negligible	Immediate
7	Control of Cooling tower & pumps as per machine & compressor operation	0.18	1.26	0.2	2
8	Installation of Aerofoil design Axial flow FRP fan in Cooling tower	0.03	0.18	0.45	30
9	Replacement of FTLs with T5+ Lights	0.06	0.4	0.4	12
10	Savings by installation of occupancy sensors	0.06	0.42	0.5	14
11	Replacement of bulbs with LED indication lamps	0.01	0.03	0.06	24
12	Reduction of voltage in lighting load	0.04	0.25	0.6	30
13	Saving by proper surface insulation of Ovens	0.7	1.6	2	15
14	Savings by installation of VFD in Hydraulic Power Packs	0.35	2.5	10	48
15	Automation of Degreasing & Rinsing Pumps as per conveyor operation	0.12	0.84	0.75	11
16	Saving by automation of conveyor operations	0.2	1.4	1.5	13
17	Installation of sandwiched flat belts in place of V-belts	0.11	0.7	2	35
Total		**2.87**	**21.65**	**20.16**	**11.2**

CONCLUSION

Energy auditing is not an exact science, but a number of opportunities are available for improving the accuracy of the recommendations. We also addressed several problem areas which can result in over-optimistic savings projections, and suggested ways to prevent mistakes. Finally, several areas where additional research, analysis, and data collection are needed were identified. Once this additional information is obtained, we can all produce better and more accurate energy audit results.

We had given total of 17 recommendations in which total investment was 20.16 Lakh Rs & the payback period was 11.2 months. Barrel Plant manager have already implemented recommendation with negligible investment and immediate payback. Plant manager had sent remaining recommendation to top management for final approval requiring investment & implementation.

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