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Rational of Energy Consumption of large-scale Industries and Saving opportunities

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Abstract: Energy is the basic necessity for the economic development of a country. Many functions necessary to present-day living grind to halt when the supply of energy stops. It is practically impossible to estimate the actual magnitude of the part that energy has played in the building up of present-day civilization. As a matter of fact, there is a close relationship between the energy used per person and his standard of living. The greater the per capital consumption of energy in a country, the higher is the standard of living of its people.

The Government of India is taking all the steps to irradiate power problems so as to enable growth for all sections of the society. The different methods for meeting this supply demand gap could be encouraging power plants, promoting renewable energy, increasing awareness about global warming and promoting energy conservation. Any one method may not be sufficient. But the energy conservation is the best method amongst other available option.

This Paper suggest the ways and means to conduct Energy audit in large scale industries and available saving opportunities

"Every unit of power saved is equal to 3units of power generated"

Index Terms- Energy, Energy Audit, Energy Consumption, Energy Conservation, Energy Audit Objectives, Energy Conservation Opportunities (ENCOs).

INTRODUCTION

The demand of electricity is increasing with the new development across the globe. This has resulted in increase of pressure on the power utilize to meet the increasing demand of the customers. The gap between supply and demand of energy is continuously increasing despite huge outlay for energy sector seems independence. Further, the burning of fossil fuel is resulting in greenhouse gases, which affects harshly the environment.

Keeping these factors in view and to provide policy guidance, Government of India enacted the energy conservation Act,2001. The shortage of energy in India is growing very fast. The Government has taken many steps like energy conservation Act, 2001, standards and labeling program, Demand Side Management (DSM), Energy Conservation Building Code(ECBC), National energy conservation Award (NECA), Performance achieve and trade (PAT), Bachat Lamp Yojana (BLY), Strengthening Institutional Capacity of State Designated Agencies (SDAs), State Energy Conservation Fund (SECF), Energy Efficiency in Small and Medium Enterprises (SMEs), and Designated Consumers, Professional Certification and Accreditation , to save energy.

The HT consumer includes large industrial units that draw a large amount from the grid to support their manufacturing process. The share of HT consumer in a DISCOM'S. Total consumer base may not be considerable but the quantum of electrical energy consumed by this users is significant. Sustained energy efficiency initiative by this consumers can help reduced energy cost as well as states power deficit. Targeting HT consumers for energy efficiency may be the quickest and surest bay to bridge the power deficits.

The potential of electrical energy saving in India is 25000 MW (which is large enough to wipe out the present energy deficit). Interestingly Maharashtra alone has a potential of saving 5000MW. This shows that the Indian industries have a huge potential for energy saving. This will help India for developing in all section of the society.

LITERATURE SURVEY

The survey of work done in the research area is summarized as under

Nissanga, Nishad Rasanjan Mendis and Nisalperera, srilanka have carried out a detailed energy audit of a medium scale textile industries in Sri Lanka. They have presented an overview of a general energy conservation measures (ECMs), which could be commonly recommended for an industrial facility .they believe that, the energy audit process is an organized approach to identify energy waste in an industries ,determining the ways of eliminating these waste at a reasonable cost.

The procedure they have followed is data analysis of building and utility, walk through survey, base line building energy use evaluation of energy saving measures.

Daljit Singh, Avinash Barveland, Girish Sant, Prayas Energy Group, Pune says even though ceiling fans are probably the most common electrical appliance after electrical light in Indian household and officers, they are rarely mentioned in discussion of energy efficiency(EE). This prediction result in the loss of an opportunity to realize significant saving in energy. Fans consumes about 20% of the electricity in Indian household, and their numbers are growing rapidly. Production of all fans is about 40 million units per year. Subtracting 20% to reflect sales of table and pedestal fans, and 10% for exports, we get annual sales of about 29 million for ceiling fans within India. These fans additions, in turn, require an addition of new generating capacity of about 2000 MW each year. With a growth of 10% per year in sales, we can expect that all the ceiling fans in Indian households in 2020, about 70% will have been added just since2009.Fans are rarely replaced, implying this new stock will have a long life. Therefore, it is important that this new stock be efficient. In this context, we decided to review the fan industry and market in order to determine the opportunities for improving their energy efficiency

METHODOLOGY AND PLANNING OF WORK AND INSTRUMENTS USED FOR AUDIT

Audit is done in two phases. In first phase we have done Brief literature survey in the Energy sector and overview more than 35 various International Journal. And permission work for detail Audit and Pre audit Data collected. In second phase we have conducted Actual measurement and On Site data collection done. Analysis of collected Data and various opportunities of Energy saving.

We have done detail energy audit of One of Large-scale industry M/S RC Plasto tanks and Pvt Ltd. Hingana MIDC, Nagpur. Which is leading manufacturer, wholesaler and retailer of a wide range of Water Storage Tank, Threaded Tank Lid, Tank Nipple, Tank Connector, Flush Tank, etc.

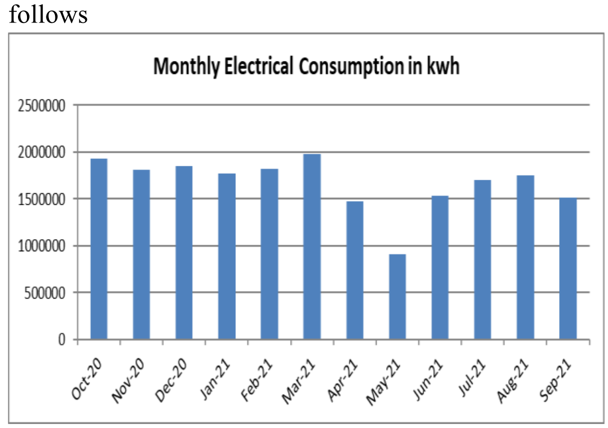
Energy Audit instruments

Thesis work

Plant consumes Energy in form of Electrical Energy & Thermal Energy.

Plant is supplied with 11 kV HT Supply at consumer premises which is further distributed to 3 transformer of 2000 KVA *2 and 3000 KVA *1. And 11 kV supply is stepped down to 430 Volts and further distributed to various shops.

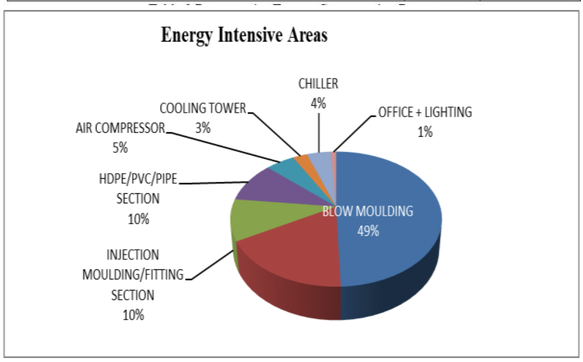
Month wise electricity Consumption of Plant is as follows



Unit has well maintained power factor and availing benefits around 3-3.5% incentive on total bill for maintaining power factor throughout the year

PROCESS WISE ENERGY CONSUMPTION OF PLANT

Overall Process wise Pie Chart (Process + Utility)				
FEEDERS	KW	DIVERSITY FACTOR %	TOTAL KW	% ENERGY USED
BLOW MOULDING	1313.25	0.95	1247.59	49
ROTO MOULDING	464.58	0.95	441.35	17
INJECTION MOULDING/FITTING SECTION	264.18	0.95	250.97	10
HDPE/PVC/PIPE SECTION	262.85	0.95	249.71	10
AIR COMPRESSOR	157.00	0.85	133.45	5
COOLING TOWER	78.24	0.85	66.51	3
CHILLER	129.86	0.85	110.38	4
OFFICE + LIGHTING	29.32	0.85	24.92	1
TOTAL			2524.88	



Note on Power quality and Reactive power Management

As per the site measurements on HT 11 KV Main Incomer, it is seen that, Plant is exceeding the legal compliance limit where considering maximum allowed TDD limit of 12%, As per MSEDCL Legal harmonic Compliance level IEEE519-2014. Current Harmonic Level found above 25 %. As per MSEDCL Bill Average load of the plant is 1739890 KWH running load /month which is equivalent to 2788.29kW (@ 24 Hours a Day and 26 Days a Month). During the power measurement, average load is found as 2033.29KW and peak load as 3300KW which is nearly matching to the bill load.

At present there is no any penalty is enforced over plant for Harmonics compliance limit. In future penalty may be enforced over plant for not maintaining plant harmonics level within legal compliance limit.

Due to poor power quality many invisible losses are there in power flow and which may affect transformer health.

To avoid such penalty issue and other technical issue related to poor power quality we have recommended to install active Harmonic filter of 100 Amp. For which ROI is not calculated.

REACTIVE POWER MANAGEMENT

While power measurement it is noted that, Reactive power management is controlled manually involving 2-3 manpower staff and process involves manually making ON OFF of capacitors manually.

Many of Capacitor's panels observed derated whereas watt loss impact of the derated panel is observed around 8 lacks per annum.

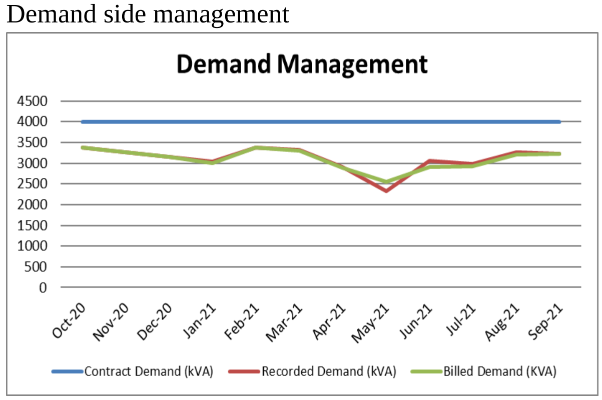
Some fixed capacitors are connected at load end due to which excess reactive power observed. Existing capacitors are amplifying current harmonics due to which power quality of plant derated which is result in Overcurrent, cable heating, malfunction of MCBS, and various power quality issues.

Since MSEDCL have adopted kVAh billing method for billing, it become necessary to have precise control over reactive power.

We have recommended modification in existing reactive power panel for each transformer which will compensate the reactive power precisely with fine control along with Static compensator to compensate peak demand having feedback taken from HT side which will help to avoid cost impact due to kVAh billing. For Investment suggested ROI will be 18 months considering Watt loss impact of existing derated capacitors, Cost of KVAh billing, Power quality issues and maintenance cost etc.

No cost Recommendation

Demand side management

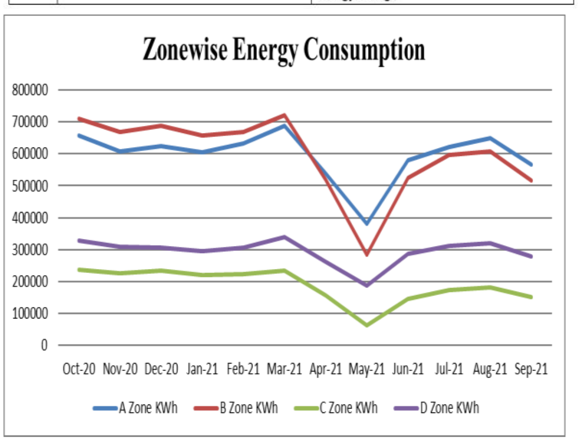


Contract demand is 4000 KVA throughout the year. The highest actual demand reached / consumed by the plant is 3386 KVA in Oct- 2020 in a Year. Average billed demand is 3097 KVA which is 77% of Contract Demand. We suggest to make strategic plan to monitor the demand closely and can be curtailed by demand staggering by monitoring and changing operation sequence of high energy consuming and especially frequent switching equipment's or low power factor equipment's like Compressors, Chillers and specific machines. Switch timing or time duration of making high current demanding equipment's shall be differed by 15-20 minutes rather than switching all of sudden or without knowledge. Here we would like to suggest to form a Task force including the Production, PPC, and Maintenance for above activity. Once the SOPs are set, it would be easier to monitor. Further, automation is also possible to control demand. Initially it is recommended to increase awareness and take benefit with no or low investment.

TOD MANAGEMENT

Time of Day (or TOD) tariff is a tariff structure in which different rates are applicable for use of electricity at different time of the day. The surcharge / rebate on energy charges according to the period of consumption shall be as per following table.

Sr. No.	Peak / Off-peak Period	Surcharge / Rebate on energy charges on energy consumed during the corresponding period
A	Mid Night (00AM to 6AM) & Night (10PM to 12PM)	-1.50 Rs/unit less than normal rate of energy charge
B	Morning (6 AM to 9 AM)& Afternoon (12 noon to 8PM)	Normal rate of Energy Charge
C	Morning (9 AM to 12 AM)	0.80 Rs/unit more than normal rate of energy charge
D	Evening (6 AM to 10 PM)	1.10 Rs/unit more than normal rate of energy charge



Annual average of TOD unit cosumptions shows that plant have utilized - A Zone @ 2864 KW, B Zone @ 2551 KW, C Zone @ 2403 KW, D Zone @ 2827KW. It is observed that the highest consumption is in A-Zone i.e., Avg. 595635 KWH which is 27 % throughout year which is good practice by plant. It is advised to find out options to utliize A zone rebate of 1.50 Rs/ KVAH which if made equivalent to B, C or D Zone by shifting activities from D & C Zone (Penalty of 1.10 & 0.80 Rs/ KVAH), may yield to additional cost saving of 14,00,000 to 23,00,000 RS/ Annum without any investment.

Plant should find out various options / operations which can be done mostly in A Zone timing. This is an additional saving without investment. However, Plant should make efforts to reduce non essential load from C & D zones to get tariff benefits. Plant has to increase their load on A-Zone for getting rebate on energy charges. From the analysis it is seen thatplant has consume Average 2661KW in each tariff zone (A, B, C & D), It indicates that plant of operations is 24/7 without gap.

OBSERVATION AND ENERGY SAVING OPPORTUNITY IN VARIOUS UTILITIES

Assessment of Air Compressor

Compressors consumes about 5 % of total energy of the plant. We foresee good opportunities in these areas to save energy. Cost of Compressed Air in the plant is 928.81 Rs / Hour i.e., 3209974 Rs/ Annum. In the New blow molding section (6 layer), air leak quantity observed 38.87 CFM.i.e. loss of 7.463 kW. By adopting stringent air leak detection and rectification program can prevent air leakages up to 10 – 12 % of the existing. In terms of Rs plant have opportunity to save 6.44 lacks per annum by arresting these leakages.

Key recommendation

It should be remembered that, reduced FAD also signs of suction filters get choked up. Kindly give attention towards inlet suction filters. Clean suction filters regularly. Compressor efficiency will be reduced by 2 percent for every 250 mm WC pressure drop across the filter. Do not kept open the compressor unit (Lid covers), atmospheric dust can clog the suction filters. Compressor free air delivery test must be done periodically to check the present operating capacity against its design capacity and corrective steps must be taken if required. Regular performance assessment of compressed air system is necessary. It's recommended to carry out ultrasonic compressed air leakage detection inside of the plant. As compressed air leakage is of no productive use, it definitely saves lot of energy required for the generation of compressed air.

Assessment of Cooling Tower

Cooling Towers consumes about 3% of Total Energy i.e., 462.90 KW/Hr. in the plant Observed cooling tower effectiveness is 43.10 %. It should be up to 50 - 55 %. Its recommended to give attention towards fills condition, cooling tower water flow inside the pvc fill area, its geometry through deck area, fan blade pitch angle, L/G ratio (Liquid to Gas ratio) etc. Observed cooling tower range is 2.5 deg.cen, which observed towards lower side as compared to 3.5 to 4 deg.cen. (Practically possible range across cooling tower unit). Facility dept. should always try to maintain Delta T upto 3.5 -5 deg.cen with regular checking of blade pitch angle and flow through the cooling tower unit. This definitely helps to reduce the pumping power consumption.

Observed L/G ratio is 2.79. Liquid to Gas ratio of a cooling tower is the ratio between the water and the air mass flow rates. Against design value, seasonal variations require adjustment and tuning of water and air flow rates to get the best cooling tower effectiveness through measures like water box loading changes and blade angle adjustment. (7 to 10 degree).

Observed 5 nos. of cooling water circulation pumps installed. By reducing existing smaller capacity pumps with present flow requirement and with proper pump suction and discharge piping layout, we can definitely save 5 to 6 % of present electrical energy consumption.

Observed present heat load on cooling tower is up to 151.11 TR, whereas installed capacity is of 260 TR. Percentage capacity utilization is 58.12 %.

For reduction in fan power, it’s recommended to replace existing Alu. Cooling tower fan blades with hollow FRP blades if any. (Due to both cooling towers are in running condition, not possible to check the fan blade material).

Observed cooling water circulation pumps run with efficiencies from 59.30 %,57.77 %,52.78 % and 50.59 % respectively. During shutdown of cooling water system, inline Strainers, descaling is necessary for primary plus secondary cooling water supply circuit to remove scale, slime formation inside the piping circuit.

To enhance cooling tower effectiveness, its essential to check condition of water spreader assembly nozzles for proper water geometry, spreader nozzles should cover maximum area of pvc fills. Indicative photograph attached below,

Observed hot well and cold well of cooling tower sump tank is mixes with each other. Due to this cooling tower effectiveness nullifies as cooling water supply temperature gets increased up to cooling water return from plant. In such situation cooling tower fan power consumption is shear of no use. Hence care should be taken that both hot well and cold well water separated properly. Indicative photograph as follows

Key recommendation

During every preventive maintenance of cooling tower, pl. check sprays nozzle condition and fills media in the cooling tower unit. Algae, scale growth observed in cooling tower sump area. Its obstacles the flow through cooling tower and ultimately reduces capacity, creates chocking problems and retardation of performance. It recommends to carryout effective cooling tower chemical treatment programme.

Replacement of CT Fins immediately and decide frequency/periodicity. Install effective communication mechanism (Preferably IOT Based System) to have the problem in either the RO system communicated and in turn attended on time as soon it happens. Similar System should be implemented to the CT Pumps and Fans to check and control Pump

Operation sequence, temperature, pressure of Water Line. Cooling tower being the part of Chilled water circuit, any changes done may affect to the chiller performance hence proper engineering study is needed. Check and make the Temperature based CT Fan Control system effective ASAP.

CONCLUSION

We have done detailed audit of the M/S RC Plasto tanks and pipes pvt ltd. In which we have studied the electrical Infrastructure of the plant and Electrical consumption by the plant for various process.

We have measured the power at HT side, Main incomer PCC and downstream level. Identified various losses associated with the various process and utilities. Though currently plant have not been facing any penalty for poor power quality, in upcoming year plant may face penalty and some technical problems associated with poor power quality hence Recommendation for power quality is given in the detailed report.

We have studied the existing reactive power management of the industry and for the precise maintenance and Incentive recommended some modifications in the existing Reactive power management panel with static compensator with payback period of 18 months.

We have done detailed audit of mechanical utilities such as compressor, cooling tower, chiller etc. and observed some losses associate with the same, detail recommendation for same given in the report along with some preventive maintenance tips to increase the effectiveness and efficiency of the electrical utilities.

With proper demand side management and TOD management plant have opportunity to save 14 to 23 lacks Rs per annum without doing any investment.

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