International Journal on Emerging Technologies **4**(1): 169-176(2013)

ISSN No. (Print): 0975-8364
ISSN No. (Online): 2249-3255

Energy Audit on Earth Moving Industry

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(Received 05 May, 2013, Accepted 15 June, 2013)

ABSTRACT: Energy auditing has been conducted to the Liu Gong India Pvt. Ltd., Pithampur Dhar (M.P.) to estimate the Energy consumed in a day, week and monthly. The Energy Auditing for a day is the index of the consumption which normalizes the situation of Energy crisis by providing the conservation schemes. Any organization so called bulk consumer of electrical energy propose to adopt suitable technology or scheme of energy conservation to minimize. The unwanted power shutdown either incidentally or by load shedding.

Energy auditing has been a part and parcel of every consumer of any form of which energy is exhaustible and inexhaustible in nature. In olden days their practice used to exploitation of energy only when it is available for example during crops harvesting wind blow in one direction was very essential for that they used wait overnight whenever wind blows little heavily harvesting process used to be done. Also they used select the season for harvesting exclusively for this purpose because ample labours were also available there will not rain and sufficient sun is available people will not be having any work in the field. That is how energy by nature was used by formers. Now we are being literate energy being used without bothering its existence further. Energy auditing is one tool through which balancing of demand and supply is determined and the positive mismatch cannot be compensated either by organic way or it might be difficult task. Aim of performing this project is to conserve and utilize the energy which is in the form Compressed Air & Electrical Energy, which would be used efficiently, effectively and regularly without any shortage for the future requirement of the industry.

Keywords: Conservation, Feasibility, Recommendations, Payback Period

I. INTRODUCTION

Company: LiuGong India, an arm of the leading China's machinery company, Guangxi LiuGong Machinery Co., Ltd. (LiuGong) having manufacturing experience for more than 50 years, is quite optimistic about its future in India.

Presently LiuGong India with its registered office in Delhi and has its regional offices in metros, logistic centre in Chennai and the manufacturing plant in Pithampur in Madhya Pradesh. LiuGong India Plant is a milestone for Chinese companies in India & China, covers 44 acres fully equipped with the latest machines, equipments with the latest technology and having the fully operational capacity of R&D-Manufacturing-Sales-Service-Parts, which will produce 2,000 units wheel loaders and excavators annually in first phase and other products of the company will be launched in the coming phases. LiuGong will have 3 phases in Pithampur plant attaining FDI investment of around Rs 500 crore in future.

Energy auditing in a integral part of energy conservation and energy management is also part and parallel of conservation. Damage and supply gap is large energy to lead to similar natural defects. Energy disaster such as Tsunami and earth quake. The next generation generating yet to come will be completely light blind. It is because power never be available after this disaster and not ever rehabilitate the reconstruction of buildings. To avoid the energy calamity proposed auditing report use the innovative energy utilization schemes through which the ferocious of situation might blindness can be eradicated.

The primary objective of the energy audit is to determine ways to reduce energy consumption per unit of product output or to lower operating costs. The energy audit provides a benchmark, or reference point, for managing and assessing energy use across the organization and provides the basis for ensuring more effective use of energy.

The energy audit would give a positive orientation to the energy cost reduction, preventive maintenance, and quality control programs which are vital for production and utility activities. Such an audit program will help to keep focus on variations that occur in the energy costs, availability, and reliability of supply of energy, help decide on the appropriate energy mix, identify energy conservation technologies, retrofit for energy conservation equipment, etc

II. METHODOLOGY

The energy audit uses existing or easily obtained data.

- Determine energy consumption in the organization
- Estimate the scope for saving
- Identify the most likely (and easiest areas) for attention
- Identify immediate (especially no-cost/low-cost) improvements/savings
- Set a reference point

Identify areas for more detailed study/measurement

Methodology of this work is concentrated on two important things that need to be developed in order to investigate the performance of the Compressor & Electricity Data which is the location of measurement points and it devices, and experiment set-up.

III. DATA ANALYSIS

There are three Reciprocating compressors, in the plant. All the compressors have the same capacity with same technical specification. During the energy audit of compressed air system, team was conducted following test:

- Free Air Delivery (FAD) test.
- Loading & unloading

Compressor Specification :

S.No	Parameter	Compressor ID (RSD/SF1/Utility/PM/3800285)
1	Make	ELGI
2	Type	Compressor
3	Product Type	GA-11P
4	Serial No.	PNE-1102021
5	Free Air Delivery (M3/hr)	115.56
6	Maximum Final Presser (Bar)	7.5
5	Motor (KW)	11
6	Receiver Capacity (Liter)	500
7	Cooling	Air
	Motor Detailed	
1	Make	Semens
2	Type	Induction Motor
3	Power (kW)	11
4	Phase	3
5	RPM	2950
6	Frequency (Hz)	50
7	Voltage (V)	420
8	Current (A) Loading/Unloading	21.5/12.4
9	Cos Ø	0.84
10	Rated Specific power consumption(kW/M3/hr)	0.0952

***Note-:** WLU = Wheel Loader Unit, MGU = Motor Grader Unit

Sr. No	**Air compressor reference**	**Units**	**Value for Shot Blasting Unit**	**Value for Paint Line & Testing**	**Value for WLU & MGU**
1	Receiver volume plus volume of pipeline (total volume)	m^3	0.5114	0.5	1.00855
2	Receiver temperature	°C	35	35	35
3	Initial receiver pressure (P1)	kg/cm^2	0	0	0.1
4	Final receiver pressure (P2)	kg/cm^2	7.3	6.5	7
5	Time taken to fill receiver from P1 to P2 (T)	min	2.22	2.09	3.52
6	Atmospheric pressure (Po)	kg/cm^2	1.01	1.01	1.01

Free Air Delivery Test :

S.NO.	CALCULATION FOR	FAD = (P2 - P1/ Po) × (V/T) × {(273+ t1) / (273 + t2)}	Result (Nm^3/ min)	VOLUMETRIC EFFICIENCY (%) =(Actual FAD delivered / Rated FAD) × 100	Result (%)
1	Shot Blasting Unit	=(7.3 – 0/ 1.01) × (0.5114/ 2.22) × {(273+ 27) / (273 + 35)}	1.62	(1.62/1.93) ×100	83
2	Paint Line & Testing	=(6.5 – 0/ 1.01) × (0.5/ 2.09) × {(273+ 27) / (273 + 35)}	1.5	(1.50/1.93) ×100	77.67
3	WLU & MGU (Assembly Line)	=(7 – 0.1/ 1.01) × (1.00855/ 4.0) × {(273+ 27) / (273 + 35)}	1.677	(1.677/1.93) ×100	86

Leakage Test :

Compressor	Value for Shot Blasting Unit	Value for Paint Line & Testing	Value for Wheel loader & Motor Grader Unit
Load time (t1)	Min 0.82	Min 0.76	Min 0.5
Unload time (t2)	Min 8.58	Min 2.26	Min 5.25

S.NO.	CALCULATION FOR	% Leakage = {(t1/ (t1+ t2)} ×100	Result (%)	% Leakage x FAD (m^3/day)	Leakage in One Shift (8x60) (m^3/day)
1	Shot Blasting Unit	{0.82/(0.82+8.58)} ×100	8.72	0.1413	68
2	Paint Line & Testing	{0.77/(0.77+2.26)} ×100	25	0.3812	182.976
3	WLU & MGU (Assembly Line)	{0.5/(0.5+5.25)} ×100	8.7	0.1458	70.031

Reduce Leakage & Wastage By Awareness & Preventive Maintenance.

S.NO.	Location	% of Leakage	Targeted % Reduction	Working Hours/Day	Expected Energy Saving (Kwh/Yr)
1	Shot Blasting Unit	25	20	17	14,698
2	Paint Line Unit	8.7	3	8	1045
3	Wheel Loader & Motor Grader Unit	8.7	3	8	1037
4	**Total**				**16,780**

Expected Energy Saving= **16,780** kWh/Year.
Expected Saving @ Rs.7/- per kWh= **1, 17,460/-**
Expected Investment **= Nil**
Simple Payback Period = Immediate

Suggestion for Energy Efficiency In Compressed Air System

- Reduced Compressor delivery pressure, wherever possible to save energy.
- Provide extra air receivers at point of high cycle air demand which permits operation without extra compressor capacity.
- Compressed air leakage of 40-50% is not uncommon. Carry out periodic leak tests to estimate the quantity of leakage.
- Compressed air piping layout should be made preferably as ring main to provide desired pressure to all users.
- A smaller dedicated compressor can be installed at load point located far off from the central compressor house, instead o supplying air through lengthy pipelines.
- Pneumatic equipment should not be operated above the recommended operating pressure as this not only wastes energy but can also lead to excessive wear of equipment's components which leads to further energy wastage.
- Pneumatic tools such as drill and grinders consume about 20 times more energy then motor driven tools. Hence they have to be used efficiently. Whenever possible, they should be replaced with electrically operated tools.
- If pressure requirement for process are widely different (e.g. 3 bar to 7 bars), it is advisable to have two separate compressed air system.

IV. ELECTRICITY DATA

LiuGong India Pvt. Ltd. (Motor Grader Unit, Canteen & Campus Lightening Area) has presently taken the power supply from **MPMKVV. Co. Ltd** with the help of 33 KV Industrial urban feeders under tariff 2110 HV- 3.1 with Contracted Maximum Demand **(CMD)** is **76 KVA.**

Electrical Energy Consumption and Bills:

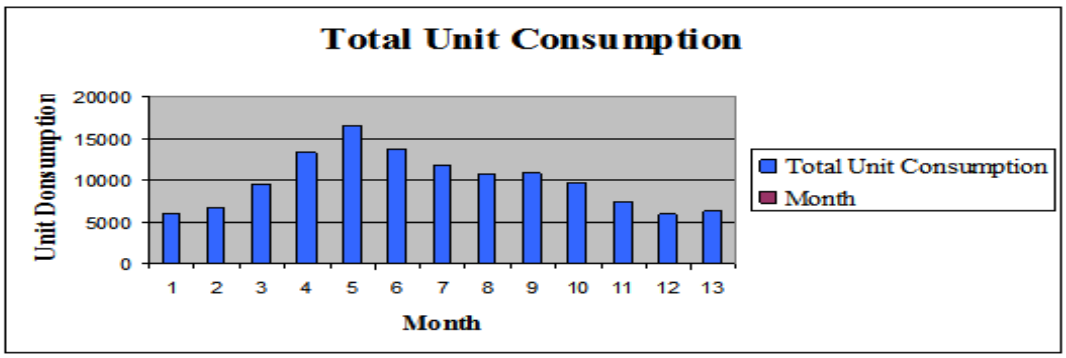
The analysis of the electricity bill was done by using latest tariff schedule for **HV-3.1 33 KV** Industrial (Urban) feeder. The tariff schedule is given in appendix 3.1.

Electricity billing is following manner under tariff schedule HV- 3.1.

PARTICULARS	UNITS	VALUE
Demand charges	Rs./kVA	Rs. 335/-
Energy Charges	Rs./kWh	Rs. 4.70/-
Low PF Surcharges (+)	1% to 2% on Energy charges etc. for every point	As per PF recorded below 0.90 and applicable
PF Rebate (-)	1% to 5% on Energy charges rebate	As per Pf recorded above 0.95
TOD surcharges (+)	Rs/kWh	Rs. 5.405/-
TOD rebate (-)	Rs/kWh	Rs. 4.35/-
CESS (duty)@ 15 %	Rs/kWh	Rs. 0.405/-
Meter rent	Rs/month	Rs. 2000/-
Rate per unit	Rs/kWh	Rs. 7.0./-

Monthly Electricity Consumption of the Plant 2012-2013.

Sr. No.	Month & Year	Total Unit Consumption (kwh)	Total Amount	Rs./Kwh
1	1-Jan-2012	5890	52047.00	8.84
2	1-Feb-2012	6620	53062.00	8.02
3	1-Mar-2012	9430	64736.00	6.86
4	1-Apr-2012	13990	84920.00	6.07
5	1-May-2012	16600	97919.00	5.90
6	1-Jun-2012	13750	97607.00	7.10
7	1-Jul-2012	11690	83041.00	7.10
8	1-Aug-2012	10690	79661.00	7.45
9	1-Sep-2012	10780	80239.00	7.44
10	1-Oct-2012	9620	74327.00	7.73
11	1-Nov-2012	7300	63069.00	8.64
12	1-Dec-2012	5910	57740.00	9.77
13	1-Jan-2013	6290	58525.00	9.30
	Total	**1,28,560**	**9,46,893.00**	**7.71**



Monthly Electricity Consumption of the plant 2012-13

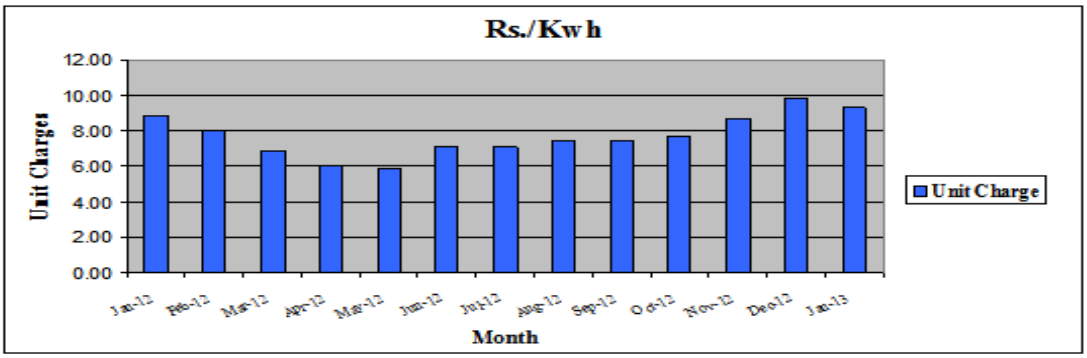


Figure: Monthly Energy Charges (Rs./ kWh) of Plant

V. ELECTRICITY DATA

LiuGong India Pvt. Ltd. (Wheel Loader, office Building, and Trading Unit & Testing Unit) has presently taken the power supply from **MPMKVV.CO. Ltd.** with the help of **33KV** Industrial urban feeder under **tariff 2110 HV-3.1** with Contracted Maximum Demand **(CMD)** is **105 KVA.**

Monthly Electricity Consumption of the Plant 2012-2013.

Sr. No.	Month & Year	Total Unit Consumption (kwh)	Total Amount	Rs./Kwh
1	1-Jan-2012	14515	95288.00	6.56
2	1-Feb-2012	17170	107566.00	6.26
3	1-Mar-2012	25435	145628.00	5.73
4	1-Apr-2012	29235	164468.00	5.63
5	1-May-2012	32995	182750.00	5.54
6	1-Jun-2012	25300	169238.00	6.69
7	1-Jul-2012	19400	132012.00	6.80
8	1-Aug-2012	17440	124688.00	7.15
9	1-Sep-2012	17220	122884.00	7.14
10	1-Oct-2012	15425	114265.00	7.41
11	1-Nov-2012	14940	111653.00	7.47
12	1-Dec-2012	11875	95604.00	8.05
13	1-Jan-2013	11100	90986.00	8.20
	Total	**252050**	**1657030.00**	**6.82**

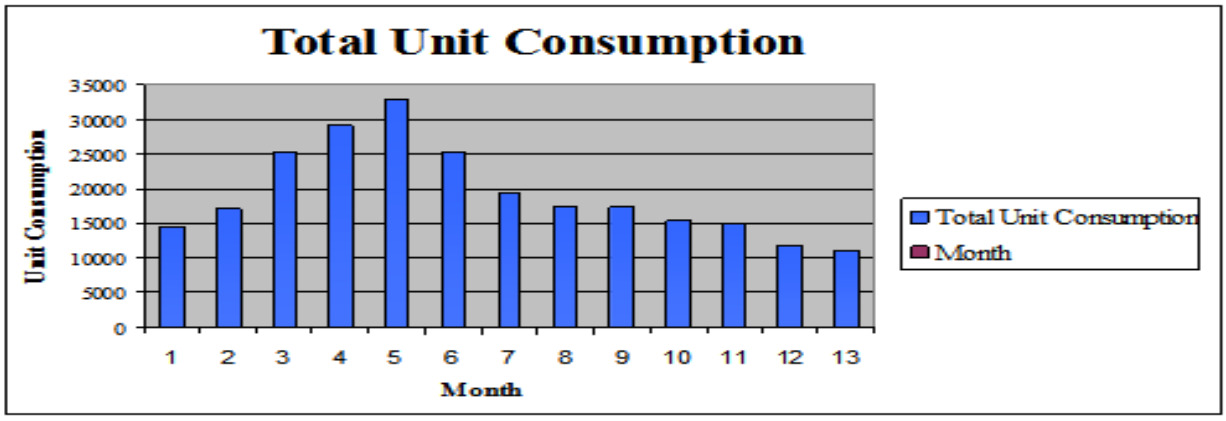


Figure: Monthly Electricity Consumption of the Plant 2012-13

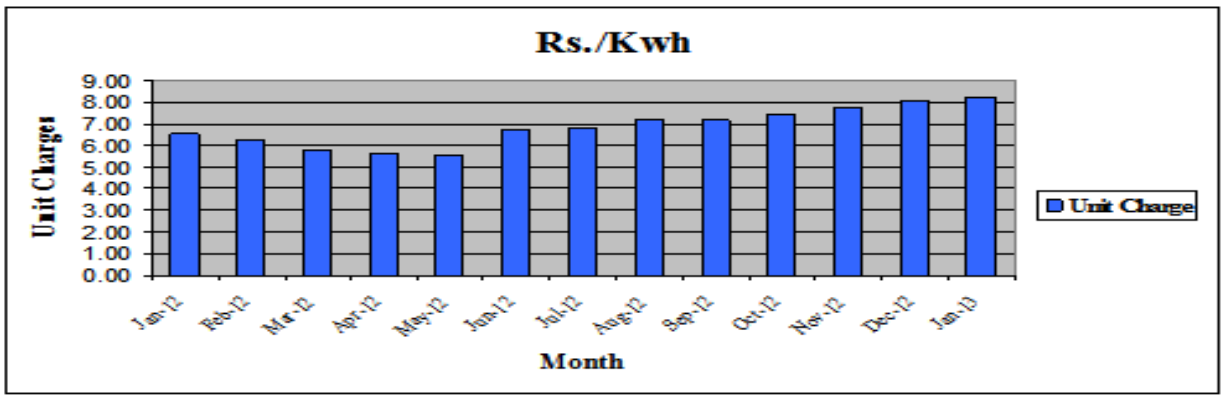


Figure: Monthly Energy Charges (Rs./ kWh) of Plant

Energy Conservation Measure with Cost Economics

Demand Side Management

By Discarding 76KVA Feeder (Demand Side Management)

During the Energy Audit last 13 month electricity bill was analysis in the following table :

Sr. No.	Month & Year	Actual KVA Consumption		Total Consumption (KVA)	Billing KVA (90% of CD)		Total Billing (KVA)	Difference (KVA) = Billing - Actual	Additional Fixed Charge (Rs./KVA) paid on 90% CD
		MPE57804 (105 KVA)	MPE56284 (76 KVA)		MPE57804 (105 KVA)	MPE56284 (76 KVA)			
1	1-Jan-2012	21	24	45	95	68	163	118	39530/-
2	1-Feb-2012	23	28	51	95	68	163	112	37520/-
3	1-Mar-2012	25	38	63	95	68	163	100	28000/-
4	1-Apr-2012	34	51	85	95	68	163	78	33500/-
5	1-May-2012	28	55	83	95	68	163	80	26800/-
6	1-Jun-2012	35	52	87	95	68	163	76	25460/-
7	1-Jul-2012	27	44	71	95	68	163	92	30820/-
8	1-Aug-2012	28	36	64	95	68	163	99	33165/-
9	1-Sep-2012	28	39	67	95	68	163	96	32160/-
10	1-Oct-2012	32	42	74	95	68	163	89	29815/-
11	1-Nov-2012	33	28	61	95	68	163	102	34170/-
12	1-Dec-2012	26	21	47	95	68	163	116	38860/-
13	1-Jan-2013	26	22	48	95	68	163	115	38525/-
	Total							**1273**	**422305/-**

VI. OBSERVATION

- As per the rule of minimum demand charges 90% of the CD, plant is paying fixed charges (Rs. 335/KVA) on 95 KVA per month for MPE57804 (105 KVA).
- Similarly pant is paying fixed charges (Rs. 335/KVA) on 68 KVA per month MPE56248 (76 KVA)
- Total amount paid by plant Rs. 4,22,305/- in last year on additional pay on 1273 KVA

VII. RECOMMENDATION

It is Recommended to management take the action for permanent disconnect the 76KVA Contract Demand feeder & shift all load on MPE57804 (105) Feeder.

Saving Calculation

- **Expected Demand Saving** = 1018KVA Per year
- **Expected Money Saving** = Rs. 3, 41, 030 /- Per year

Suggestion for Energy Saving through Power Consumption

- All Interior walls should be painted using Enameled paint which would reflect light.
- All Air conditional rooms should be Air light and doors should be Hydraulic closing system. Outside air entry in to the air conditioned room is not hygienic.
- Provision can be made for cooled water storage facility wherever possible attached AC room, so that multipurpose utilization of AC to cool the water will reduce the power consumption by 30% .
- Replacement of CRT monitor by LCD monitor not only gives the cost benefit interns of energy saving but also play a significant role of radiations due high potential .when CRT is used high voltage level handling by CRT at HT electrodes may emit harmful radiations beyond the screen which affect the vision.

- Human being get in touch for trouble shooting may receive great risk of deadly shock if they touch the charged body which is normally charged up to 10000volts (approximately). In LCD monitor all such problems can be minimized.
- Energy saving by replacing LCD desktop with LAPTOP illustrate the benefit s in terms of portability, space saving, maintenance cost of desktop computers and additional cost of peripherals. Also cost of damage and other electrical problems. Critical space management and cost involved can be removed. Wiring for LAN and labour cost can also be prevented.
- Unnecessary power consumption by negligence of user and system administrator for not switching off while leaving the office will have more vulnerability for damage due to short circuit and heavy voltage due to lightning .
- It is recommended to replace fluorescent lamps by CFL which are handy by construction and possibility of breakage is less. Installation is easy and the labour charge required for replacement of burnt tubes and defected choke lamps is a costly affair. Disposal of burnt tubes will disturb the habitat place of both human being and animals. The release of krypton and argon gases is more dangerous, it may lead to ecological imbalance if it in mass destruction.
- Switch off the photocopier machine at the main outlet itself when not in use or in other words machine should not be kept in stand by and sleep mode which consumes power.

VIII. CONCLUSION

The Proposed project gives strong warning to the consumer not only in terms of the energy bills also the energy crisis in the near future to all sectors of people and in this project the recommendations reduces the around 15-20% of the energy and 25-30% of cost reduction excluding some issues takes more payback period and some are economically not fit will also be taken in to account in a long run. There is a scope of improvement to include the advanced lighting scheme to reduce further 10% of the cost.

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