ENERGY AUDIT OF TEXTILE INDUSTRY

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***ABSTRACT**: Energy conservation has now become a necessity. Considerable energy saving is possible through proper choice of equipment, and their effective use. The only feasible way to energy crisis, apart from capacity addition, is the efficient use of available energy. For this there is a need of optimization energy, using standard system and procedure so as to reduce energy requirement of per unit of output. The power generation is always less than the required demand. The gap between the power generation and demand is increasing continuously. The gap can be reduced by installing additional power generating capacity and doing energy conservation measure. The additional power generating capacity installation may take long duration but energy conservation can be implemented immediately. There are many way to do energy conservation. In this proposed work, energy management method is applied for energy conservation*

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***Keywords**: Energy Management*

1. INTRODUCTION

The energy process is an organized approach to identify energy waste in a facility, determining how this waste can be eliminated at a reasonable cost with a suitable time frame.Energy audit is widely used and many have different meaning depending on energy service companies. Energy auditing of building can range from a short a walkthrough of the facility to a detailed analysis. It is not only serves to identify energy use among the various services and to identify opportunities for energy conservation but it is also a crucial first step in establishing an energy management program. The audit will produce the data on which such a program is based. The study should reveal to the owner, manager, or management team of the building the options available for reducing energy waste, the costs involved, and the benefits achievable from implementing those energy-conserving opportunities (ECOs).

1.1 The role of an energy audit

Identify areas in the establishment consuming unnecessarily too much energy. Assess energy saving opportunities so as to save money where it counts the most. In the factory, an energy audit increases awareness among plant personnel of energy issues. An energy audit gauges the energy efficiency of the plant against "best practices", when used as a "baseline" for tracking yearly programs against targets. It is the first step towards saving money in the production plant.

1.2 Contents of an audit

An energy audit seeks to document things like energy being used on site per year which includes use of energy and opportunities for savings. In the process it assesses the effectiveness of management structure for controlling energy use and implementing changes. The energy audit report establishes the need for plant metering and monitoring. The plant Manager then institutionalizes the practices thus saving money for the years to come. The energy audit action plan lists the steps and sets the preliminary budget for-the energy management program.

1.3 Analysis of energy use

Identifying areas where energy used is most useful. This enables to focus on areas where the audit should be focused and raises awareness of energy use and cost. The results could be used in the review of management structures and procedures for controlling energy use.

1.4 Important points to consider when collecting site load data Operating hours

It is collected from plant personnel this data should be accurate so as to estimate energy savings correctly. Duty Cycle: Machines, such as large induction motors have varying loads with different power requirements. Hence duty cycle is very important Actual Power Consumed: For electric power users, this is based on either 3-phase current/voltage Readings or power analyser measurements (e.g. direct KW which incorporates power factor). For fuel users, tank readings of monthly consumption estimates and flow meters with localization can be source of measurement.

2. LITERATURE REVIEW

Frank kreith, D.YogiGoswami (2008), have declared that energy is the important factor for production, along with labour, capital, and materials. Energy conservation denotes doing without, maybe giving up facilities to save energy. Due to products diversity and the manufacturing process requirement, the efficient utilization of energy varies with specific industrial operations. The organization of personnel and operations, concerned also varied. Consequently, each company should modify the effective energy management program for its plant operations. There are some universal guidelines, however, for initiating and implementing an energy management program. Many of the large companies have already used energy management programs and also they have realized substantial savings in fuel and electric costs. But in small industries, due to lacking of technical persons and equipment to implement the energy management program is difficult. In these environments, reliance on external consultants may be appropriate to initiate the program. But for successful operation internal is very essential. A well planned, organized, and executed energy management program requires a strong commitment by top management [4].

Dimoudi.A, Kostarela.P (2009), have shown the energy consumption of Institutional buildings, due to their high number in the country, contribute to a considerable overall amount of energy consumption in public buildings that results in an increase of the expenses paid by the national budget. Thus, investigation of alternative solutions for the reduction of energy consumption in Institutional buildings is advisable and necessary. On the other hand, the pedagogic role of Institutional buildings needs the proper regulation of the parameters that influence the internal conditions in classes, as lack of thermal comfort and air quality conditions reduce the learning ability of pupils.
Thus, an energy proficient strategy in school buildings has a dual purpose: energy conservation and enhanced indoor conditions in classrooms. Air quality studies performed at institutional buildings revealed that many of them have serious indoor air quality problems, while improvement of indoor conditions is associated with considerable reduction in energy consumption and a global environmental quality. Improvement in thermal insulation decreases energy consumption, with the case of insulation at the support frame having the highest benefits, Resulting a reduction in energy consumption by Increase in the thickness of the wall insulation decreases the heating requirements and thus, reduces energy consumption up to a solution that is recommended for new and old no insulated buildings [5].
GuozhongZheng, Y ouyin Jing, Hongxia Huang, Guohua Shi, Xutao Zhang (2010), have shown that globally one-third of energy consumption is consumed by building sector. In energy conservation assessment, energy conservation star rating is established and used in the assessment. The objective of building conservation assessment is to establish and limit the maximum energy consumption in buildings and to encourage the utilization of renewable energy and new energy technologies and products [6].

3. CASE STUDY

Type: Textile industry
A Textile industry has been selected as the case study. Preliminary audit carried out on a sample of Vedika Tex. Located At:- Vita MIDC, Dist: -Sangli

3.1 Layout of Vedika Tex Industry

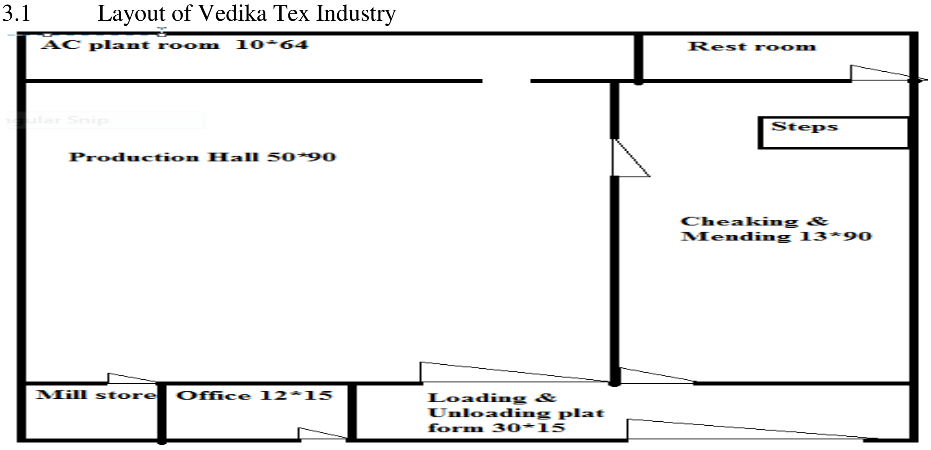

Fig3.1:-Layout of Vedika Tex Industry

3.1.1 Total Sqft. Area

- Total area=9490sq.ft. , Production area-50*90=4500sq.ft
- Checking & Mending area=13*90=1170sq.ft , Office area=12*15=180sq.ft
- Air conditioning Plant room=10*64=640sq.ft., Mill store area=10*15=150sq.ft.
- Loading & Unloading=30*15=450sq.ft. , Worker rooms=12*10*20=2400sq.ft

3.2 Weaving Processing Operations

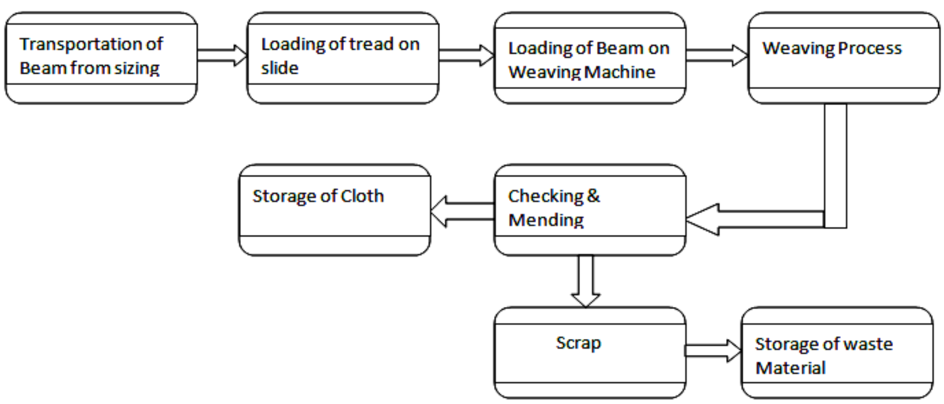

Fig3.2. Process flow diagram for Weaving Processing operation

Weaving Process-The weaving process consists of five basic operations, shedding, picking, and beating-up, left off and take up.
Shedding-Separating the warp yarns into two layers by lifting and lowering the shafts, to form a tunnel known as the 'shed'. See Figure 2.

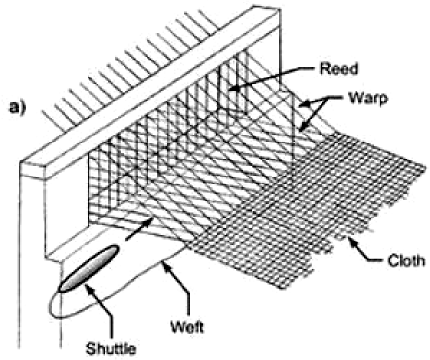

Fig 3.2.1 Shredding

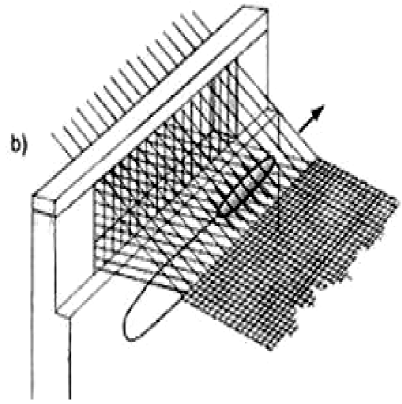

Fig3.2.2 Picking

Picking or Filling**:** Passing the weft yarn (pick) across the warp threads through the shed.

Beating-up: Pushing the newly inserted weft yarn back into the fell using the reed. See Figure 4.

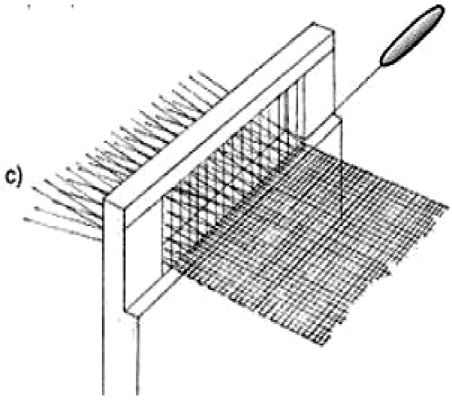

Fig 3.2.3 Beating-up

Let off: The warp yarns are unwound from the warp beam during the above three processes.
Take up: The woven fabric is wound on the cloth beam during the above three processes.
The above operations must be synchronized to occur in the correct sequence and not interfere with one another. The full sequence is repeated for the insertion and interlacing of each weft yarn length with the warp yarns, and is therefore called 'The Weaving Cycle' [8].

3.3 Checking & Mending:

In checking & mending process check quality of cloth, checking missing thread & measure peak of cloth. The quality& price of cloth depends by numbers of peak in cloth. Folding and storage process also including in Checking & Mending process.

Fig 3.3.1 Checking & Mending

Fig3.3.2 peak measuring device

3.4 Industry energy consumption

This section is mainly concentrated on the energy consumption patterns of the factory. Apart from statistics a breakdown of the energy usage is presented under all major functional areas. These statistics are vital for understanding the present energy scenario of the industry.

3.4.1 Industry Energy Sources: The electricity for the Industry is supplied through a grid connected power system. The data are collected to identify the contribution of the energy sources.

3.4.2 Equipment Energy Consumption: The Industry energy consumption is identified in terms of the equipments. The results are obtained, after having the data analysis during the Industry visit. Data loggers, power analysers, clip-on meters, etc are used to measure the energy consumption of the Industry. When the electrical energy is discriminated by equipment wise, the major electrical energy user being the air conditioners, which is 16.66% of the total electrical energy usage while the Weaving machines 66.66%, Candy machine 6.66%, Total lighting consumption 3%(Tube 2.55%, GLS lamp 0.35%, CFL 0.096%), compressors 6.11%and Grinding machines 1.11 % and Fans 0.44% of the total energy.

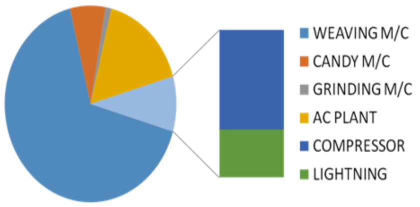

Fig3.4 Industry energy consumption

3.4.3 Electrical Demand: The textile industry considered is a High-Tension consumer, receiving electricity from the Maharashtra State Electricity Board (MSEB). The permitted Maximum Demand is 100Hp, and the Actual Demand is 90 Hp. And Power factor 0.85%.

3.5 Calculation

Formula for calculation of electrical energy unit consumption

Unit= (Numbers of equipment*working hours*watt of Equipment * working days)/1000

Working condition of industry and their working hours

Wednesday to Monday (Tuesday OFF)

- Machine -24 hours/day, Mill store-12hours/day,(8pm to 8am)
- Room and corridor-14hours/day, (6pm to 8pm), Terrace-12hours/day,(7pm to 7am)
- Open passage-12hours/day,(7pm to 7am), Checking and mending room-7hours/day,(10am to5pm)
- Office-7hours/day,(10am to5pm), Compressor-2hours/day

Tuesday one shift is OFF for maintenance purpose (8am to 8pm)

- Checking and mending room- OFF
- Office- OFF
- AC Plant-12hr OFF
- Compressor-8hr ON

3.5.1 Connected load and consumption

CFL:-Table 1

AREA	(NUM*HR*WATT*DAYS)/1000	UNIT(KWH/MONTH)
Office	(13*7*5*26)/1000	11.83
Total		11.83

Fluorescent tubes:-Table 2

AREA	(NUM*HR*WATT*DAYS)/1000	UNIT(KWH/MONTH)
Production hall	(24*24*40*30)/1000	691.2
Store room	(1*12*40*30)/1000	14.4
Room and corridor	(7*14*40*30)/1000	117.6
Terrace	(1*12*40*30)/1000	14.4
Open passage	(4*12*40*30)/1000	57.6
Mill store	(2*12*40*30)/1000	28.8
Checking and mending room	(4*7*40*26)/1000	29.12
Total	-	953.12

GLS lamp:-TABLE 3

AREA	(NUM*HR*WATT*DAYS)/1000	UNIT(KWH/MONTH)
Mill store	(1*12*60*30)/1000	21.6
Room	(2*14*60*30)/1000	50.4
Bathroom	(1*1*60*230)/1000	1.8
Total		73.8

Power point:-

- For grinding purpose 1HP motor are used and ON for a 1hr approximately in a day

{1*(1*746)*30}/1000=23.38

Fig3.5: Grinding Machine

Air conditioning plant:Air conditioning plant is OFF for one day in a week during maintenance of plant.

[(15*746)*24*28]/1000=7519.68

Compressor:

- It is ON for 2 hours in a day for cleaning purpose.
- And during maintenance it is ON for 8 hours.

{[(5.5*746)*2*26]+[(5.5*746)*8*4]}/1000=393.88

Candy machine:

ON for 24 hr for 26 days

{2*(3*746)*24*26}/1000=2793.024

Weaving machine:

- Ideal rating of weaving machine is 3HP.
- But it actually operated at 2.25 HP.
- Additional 0.25 HP is used for switching operation.
- Hence the total operated rating of machine is 2.5HP.

(3-0.75+0.25=2.5HP)

{24*(2.5*746)*24*26}/1000=27930.24 Unit

3.5.2Total consumption-

TABLE 4

Total consumption

Equipment	KWh/month
Fluorescent tubes	953.12
CFL	11.83
GLS	73.80
Fan	86.76
Power point	23.38
Ac plant	7519.68
Compressor	393.88
Candy m/c	2793.024
Weaving m/c	27930.24
TV	72
Total	39857.714

These calculations are ideal by considering equipment rating and unity power factor.

3.6 Electricity bill of Vedika textile industry of 2015 (Jan-July)

In industry total load divide on five meters are classified on the basis on order

Meater1=25Hp (6 Weaving machine and other light load)

Meater2=27Hp (15Hp AC plant, 5Hp candy machine and 5.5Hp compressor)

Metrer3, 4, 5=18Hp (6 Weaving machine)

TABLE 5

Electricity bill of Vedika textile industry of 2015 (Jan-July)

Meter	Jan	Feb	Mar	April	May	June	July
1	5060	6552	5391	5899	4846	4535	6210
2	3930	5961	4932	5180	4302	4987	5773
3	5351	6405	5485	6663	4956	5304	6220
4	9661	11887	9532	10611	9456	10674	12811
5	6167	8191	6873	6620	5678	6993	6205
Total	30169	38996	32213	34973	29235	33093	37219

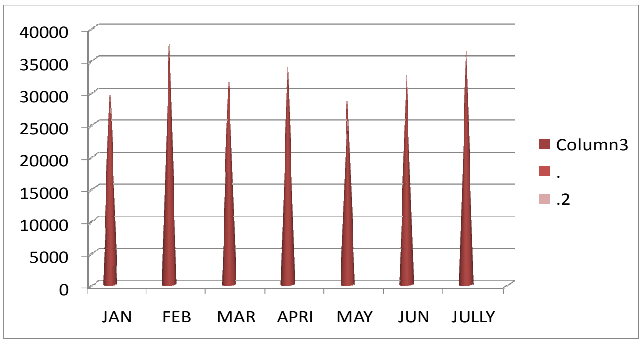

Fig 3.6:- Electricity bill of Vedika tex industry of 2015 (Jan-July)

3.7 Schedule of Site Audit-

Primary audit:-

1. Visit to site – Vedika Tex.Industry Date-14&15-aug-2015
2. Observed ratings of all equipment and noted.
3. Analyzed the total power demand, number of equipment, types of equipment, and application of equipment.

Secondary audit: -Date –28, 29&30-aug-2015& 12, 13-sept-2015

1. Observed and calculated work hour of each equipment.
2. Collected previous electricity bill of 2015 (Jan-July).
3. Observed and discussed the problems related to electricity bill and other problems.
4. Find out Weaving Machine were not working maximum for 2 to 25 min in a hour.
5. Analyzed a data of electrical energy consumption and we are comparatively equal with their electricity bill.

3.8 Problems observed

1. Due to high load fluctuation flickering of light load leads to blow off of luminaries.
2. We observed conventional air conditioning system for ventilation which led to larger consumption of electricity,
3. More consumption, less efficiency and noise due to older machine.

4. SUGETION FOR VEDIKA TEXTILE INDUSTRY

4.1 Replacement fluorescent tube, GLS Lamp, CFL to LED TUBE

Table 4.1.1 Replacement fluorescent tube to LED TUBE

	Fluorescent tubes		**LED Tube (20 W)**	
AREA	**(NUM*HR*WATT*DAYS)/1000**	**UNIT(KWH/MONTH)**	**(NUM*HR*WATT*DAYS)/1000**	**UNIT(KWH/MONTH)**
Production hall	(24*24*40*30)/1000	691.2	(24*24*20*30)/1000	345.6
Store room	(1*12*40*30)/1000	14.4	(1*12*20*30)/1000	7.2
Room and corridor	(7*14*40*30)/1000	117.6	(7*14*20*30)/1000	58.8
Terrace	(1*12*40*30)/1000	14.4	(1*12*20*30)/1000	7.2
Open passage	(4*12*40*30)/1000	57.6	(4*12*20*30)/1000	28.8
Mill store	(2*12*40*30)/1000	28.8	(2*12*20*30)/1000	14.4
Checking and mending room	(4*7*40*26)/1000	29.12	(4*7*20*26)/1000	14.560
Total	-	953.12	-	490.960

Table 4.1.2 Replacement CFL to LED TUBE

	CFL		**LED (2 W)**	
AREA	**(NUM*HR*WATT*DAYS)/1000**	**UNIT(KWH/MONTH)**	**(NUM*HR*WATT*DAYS)/1000**	**UNIT(KWH/MONTH)**
Office	(13*7*5*26)/1000	11.83	(13*7*2*26)/1000	4.732
Total		11.83		4.732

Table 4.1.3 Replacement GLS Lamp to LED TUBE

	GLS lamp		**LED (5W)**	
AREA	**(NUM*HR*WATT*DAYS)/1000**	**UNIT(KWH/MONTH)**	**(NUM*HR*WATT*DAYS)/1000**	**UNIT(KWH/MONTH)**
Mill store	(1*12*60*30)/1000	21.6	(1*12*5*30)/1000	1.8
Room	(2*14*60*30)/1000	50.4	(2*14*5*30)/1000	4.2
Bathroom	(1*1*60*230)/1000	1.8	(1*1*5*230)/1000	1.5
Total		73.8		6.15

Table 4.1.4 Total consumption

Fluorescent tubes, GLS lamp, CFL	1038.750 per Month
LED (20W),(2W),(5W)	501.842 per Month
UNIT Saving	536.908 per Month

Table 4.1.5 Costing of replacement and Recovery

LED	**Rate in RS**	**Requirement**	**Total costing**
20W	650	43	27950
2W	100	13	1300
5W	150	4	600
Total			29850

Saving money per month = 536.90*5.60 = 3006 Rs/month
Recovery period = 29850/3006 = 10 Month

4.2 Replacement Ducting plant to Semi Ducting plant

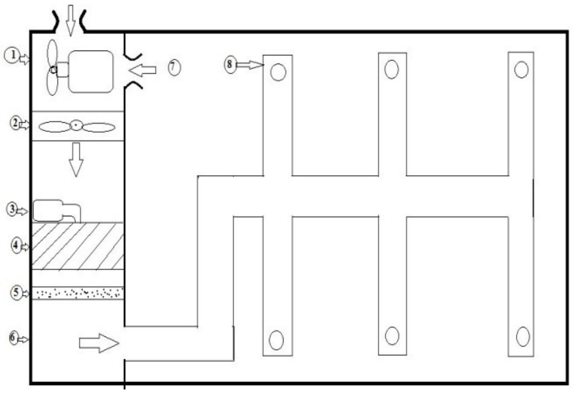

Fig 4.2.1 Ducting plant

1) Return air Fan
2) Inlet Fan
3) Pump motor
4) Cooling Tower
5) Filter
6) Inlet Air
7) Return Air
8) Cooled Outlet Air

Disadvantage of Ducting plant

1) More Installation cost
2) More Energy Consumption
3) Poor Temperature and Humidity control
4) Required separate construction to installation

These Disadvantages overcome in new Semi Duct AC plant.

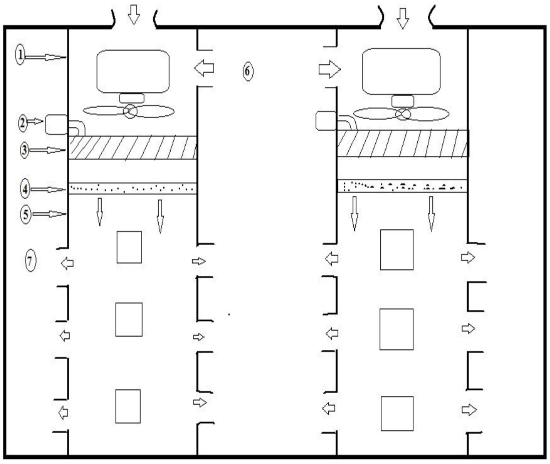

Fig 4.2.2 Semi Duct plant

1) Cooling Fan
2) Pump motor
3) Cooling Tower
4) Filter
5) Inlet Air
6) Return Air
7) Cooled Air

Table 4.2 Suggestion for Ac plant

Parameter	**Ducting Ac plant**	**Semi duct Ac plant**
HP	15hp	7hp
Motor RPM	1440rmp	2900rmp
Unit consumption/month	(15hp*746*24hr*28d)/1000 =7519.680 kwh/month	(7hp*746*12hr*26d)/1000 =1629.264 kwh/month (3.5hp*746*12hr*30d)/1000 =939.96 kwh/month
Total Unit consumption	7519.680 kwh/month	2569.224 kwh/month

Saving Units by using Semi duct Ac plant/month = 4950.456 kwh/month

4.2.1Costing of Replacement & Recovery:-

Semi ducting plant=1.5 lack * 2 = 3 lack
Construction cost = 50000
Glass wool =1.5 lack
Total = 5 lack
Saving money per year = 12*4950.456
= 59405.472*5.60
= 332670.6432 Rs/month
Recovery year = 1.5 year
After Recovery profit = 27722.55 per Month

4.3 Replacement of Ruti c to Rapier loom machine

Fig 4.3.1 Lakshmi RUTI-C 1000 shuttle weaving machine

Fig 4.3.2 Rapier Weaving Machine

Table 4.3 Replacement of Ruti c to Rapier loom machine

China Rapier loom	**(double width 230 rpm)**	**Ruti c**	**450 rpm**
24 machine o/p	(75000meter*2)=150000meter	24 machine o/p	110000meter
Total income	150000*4.0=600000Rs	Total income	(110000*4.0)=440000Rs
Worker salary Light bill Mill store	(200000+110000+50000)= 360000Rs	Worker salary Light bill Mill store	(200000+160000+50000)=410000Rs
Total income	(600000-360000)=240000Rs	Total income	(440000-410000)=30000Rs

Total saving after replacing machine = (240000-30000)
= 210000 Rs

4.4 Total saving after conducting Energy Audit

- Saving units per month = (Replacement fluorescent tube, GLS Lamp, CFL to LED TUBE) = 536.908 units/month
- Saving units per month = (Replacement Ducting plant to Semi Ducting plant) = 4950.456 units/month
- Total saving units per month = 5487.364 units/month
- Money saving per month = (5487.364*5.60) =30729.2384 Rs/month
- Money saving per year = (30729.2384*12) = 368750.8608 Rs/year
- Money saving per month for china rapier loom machine=210000Rs
- Total money saving per month =(30729.2384+210000) = 240729.2384 Rs/month

5. CONCLUSION

By conducting energy audit in Vedika Textile industry it is found that energy consumption is mainly due to weaving machine, light load, grinding machine, air conditioning, candy machine, compressor, etc. Measurement of actual consumption was done on the basis of the rating of machine, working hours, and billing.

It is inferred that air conditioning equipment, traditional and inefficient weaving machine, fluorescent tube, air conditioning plant and other light load are responsible for wastage of energy. Due to Irregular load variation, flickering of light leads to blowing off luminaries.

These all parameters which are responsible for inefficient energy consumption are replaced by,

- CFL, GLS, and Fluorescents tube are replaced by LED Tube lights and bulbs with estimated cost and recovery period.
- AC ducting plant replaced by semi ducting plant with estimated cost and recovery period.
- Suggesting use of renewable energy sources such as solar power plant and hybrid solar wind power plant with estimated cost and recovery period.
- Replacement of old weaving machine (Ruti-c) to new machine (china rapier) with estimated cost and recovery period.

These all our suggestion approved by company owner (Vedika Tex) and New India Textile group and ready to implement in his new projects. The total saving money after conducting our energy audit is **240729.2384 Rs/month.**

6. ACKNOWLEDGMENT

We take pleasure to acknowledge Principal Dr. Milind Rohakale, of SKN Sinhgad Institute of Technology& Science, Lonavala for providing good environment for studies and continuous support in achieving our goals. I would like to express gratitude and indebtedness to Prof. Sachin Datey, HOD (EE) and all the faculties of Electrical Dept., for their valuable advice and guidance without which this project would not have seen the light of the day. We are also thankful to Prof. Swapna Manurkar(EE) for providing us constant guidance and giving us regular feedback on the work done by us, which helped us a great deal to complete our project in time and with desired outputs. We would like to thank the owner of the Vedika Tex Mr.Santosh Gaikwad for his guidance and support the satisfaction and euphoria that accompany the successful completion of the task would be great, but incomplete without the mention of the people who made it possible, whose constant guidance and encouragement crown all the efforts with success. In this context, I would like to thank all the other staff members, both teaching and non-teaching, which have extended their timely help and eased our task.

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