Areas of Energy Conservation in A Spinning Mill

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Abstract - *The scope of energy savings is by improving the power factor and thereby increasing the efficiency of motors and thereby finding out the areas of energy audit and analyzing it in the Spinning mill. A comparison for the old motor with energy efficient motor is studied, that would be useful in finding the areas where the energy can be saved. It is the systematic and methodological approach to identify and check the usage and wastage of input energy and hence attempts are made to adjust and reduce the energy requirements. In this cotton spinning mill motors of three phase induction motors are used due to its ruggedness and versatility. Loss of motor efficiency with operation and time is a very common problem in every industry, not only in this industry every other industry faces these challenges every day. This paper deals with, the detailed analysis of energy audit in every area of the spinning mill where the energy loss or the power factor should be improved and sustained to it, the areas like humidification plant, spinning section and so on are the areas where the analysis is to be made. Thus if we take up action and rectifying it there will a dramatic change of energy saving in the spinning mill.*

***Key Words*: Energy Savings, Areas of Audit, Spinning Mill, Motor Efficiency, Humidification Plant, Three Phase Induction Motor**

1.INTRODUCTION

In Spinning mill, electricity consumption and power cost is in increasing trend due to modernized machines and continuous usage of the machines in inefficient operating parameters. So, energy audit is being done studied and thus they are analyzed in order to save the energy in any spinning mill.

In any industry, the three major operating costs include energy (electrical and thermal), labor and materials. Among these, the cost of energy is rated at the top most one in it. The main objectives of this paper is to conduct an energy audit in a spinning mills, and thus to analyse the power consumption areas, where the power is not being used efficiently and to find how the energy is supplied, how it is being used and thus to formulate an action plan in order to save the energy. This is to measure the areas where the energy audit can be done for power consumption. And to find out the areas of energy savings and give the detailed solution for it.

Hence, spinning mill machinery manufacturers are integrating automation in the machines, indirectly requirement of power of the machines is increased. Areas of energy losses are identified; suggestions for cost effective measures to establish efficient energy use and estimation of implementation costs are calculated and discussed. Improved energy performance and reduced energy consumption is explored to assist the possible elimination of energy crisis through energy management.

Spinning Industry in India is one of the vital components of the Indian economy and contributing around 13%. of total industry production, about 4% of India's Gross Domestic Product (GDP), about 16% of the gross export earnings and employing about 35 million people being the second largest provider of employment after agriculture. Taking the installed capacity of spinning machinery only, it ranks second (with 19.7% of total spindles globally), after China. In spinning industry, electricity consumption and power cost is in increasing.

Apart from the power cost, man power is also shortage in spinning mills but we have no issues in today's trends due to environment inside the mill and heavy noise from the spinning machines. Due to these reasons workers are not of the machines is increased, trend due to modernized machines and continuous usage of the machines in inefficient operating parameters. showing interest in working at spinning mills, which compel mill management to deploy more automated machines thus these machines are of motors running in it which thereby have losses due to lack of maintenance this may leads to loss to the company. So these type of energy audit is being conducted in order to maintain a good power factor and eliminating up the losses in it. So this paper mainly focuses on all areas of the spinning mill in order to get a detailed solution to it.

2. PROCESS IN A SPINNING MILL

The process of spinning mills consists of different sections. Different types of cotton are mixed in mixing section; fibres made are sent to blow room to clean, blend, remove micro dusts and to provide uniform feed to the carding machine; which separates and cleans cotton fibres for spinning. In spinning, yarn is made from cotton fibres by drawing out and twisting into a thin strand. Finally, winding is wound on the rolls for the required lengths. So different types of process are explained and the process layout is thus shown below in the fig.1 so we can get the clear idea about the process or the areas of the spinning mill industry.

It consists of different other sections like mixing at first, Mixing is the first and foremost important process in the spinning process. Mixing is a process by which different grade of same fiber are kept together. And then comes into the blow room where the supplied compressed bale is turn into a uniform lap of particular length by opening, cleaning, blending or mixing, and the next important section is the carding during this carding process, two surfaces of wire or metallic card cloth, moving in the same direction but at different speeds on the card machine, comb the cotton into a fine web of generally parallel Fibers and then next comes to the drawing frame and simplex frame where thus the six carded cotton is being made into one simplex material. Spinning machines is the next section to be carried out after the simplex frame thus there now many automation machines being carried in it. The final thing is made into a yarn or to a spindle this may be called as a winding. So these are the process that we can see in any cotton spinning industry.

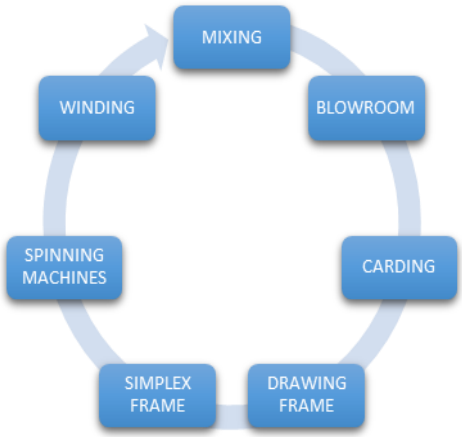

Fig -1:Spinning Mill Process

3.METHODOLOGY

An energy audit is a survey or inspection that analysis the energy flows for energy conservation in any industry, process or system to decrease the amount of energy input into the system without affecting the output. It will show where the power consumption is more in the given system. It can also be called as controlling of the power to avoid losses for maximize efficiency.

ENERGY AUDIT = SAVINGS IN MONEY + LOSSLESS + SUSTAINABLE DEVELOPMENT

Nowadays people are more concerned about energy efficiency, energy consumption and energy conservations in buildings. Energy audit is considered as the one of comprehensive methods in checking the energy wastage and usage in buildings. This paper presents the preliminary study of energy audit that has been conducted in spinning mill.

3.1 Objective of Energy Audit

In any spinning mill, the top most operating cost would be energy both electrical and of thermal, labor and of materials. If one were to relate to the manageability of the cost or potential cost savings in each of the above components, energy would invariably emerge as a top ranker, this energy management function would constitutes a strategic area for cost reduction. Energy audit will help to understand more about the ways energy and fuel are used in any industry, and help in identifying the areas where waste can occur and where scope for improvement exists. The energy audit would give a positive orientation to the energy cost reduction, preventive maintenance and quality control programmes which are vital for production and utility activities. Such an audit programme will help to keep focus on variations which occur in the energy costs, availability and reliability of supply of energy, decide on appropriate energy mix, identify energy conservation technologies. Thus an audit is performed on the basis of the below process in fig.2 firstly the audit pre-data is collected and then a detailed audit is taken. Thus an analysis is done in order to compare the details and finally a suggestions are implemented to the industry for changing up the process.

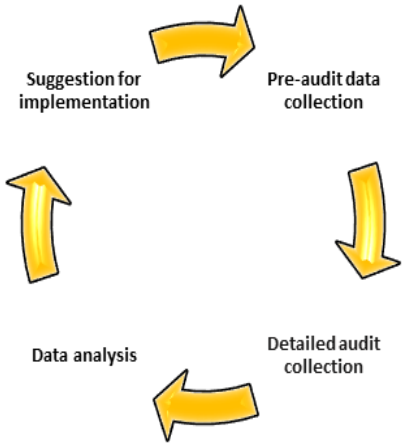

Fig -2: Process in an audit

3.2 Types of Energy Audit

There are almost three types of energy audit being conducted in any other industry depending upon the type of load and any other proceedings they are varied and thus the types are preliminary audit, general audit and investment grade audit. The preliminary audit alternatively called a simple audit, screening audit or walk through audit, is the simplest and quickest type of audit. whereas the general audit alternatively called a mini-audit; site energy audit or complete site energy audit expands on the preliminary audit described above by collecting more detailed information about facility operation and performing a more detailed evaluation of energy conservation. In most corporate settings, upgrades to a facility's energy infrastructure must compete with non- energy related investments for capital funding. Both energy and non-energy investments are rated on a single set of financial criteria that generally stress the

expected return on investment. Thus the type of Audit depends upon the

- Function and the type of industry selected
- Depth of final audit is needed, and
- Magnitude and the potential cost reduction desired

In Energy auditing the methodology for the detailed audit is thus described and thus they are explained in detail about the steps to be taken care thus the detailed energy auditing is carried out in three phases. Pre-Audit Phase, Audit Phase, Post-Audit Phase

In the Pre Audit phase a structured methodology to carry out an audit is necessary for efficient working. An initial study of the site should always be carried out, as the planning of the producers necessary for an audit is most important.

In audit phase the audit report will include a description of energy inputs and product outputs by major department or by major processing functions, and will evaluate the efficiency of each step of the manufacturing process. Means of improving these efficiencies will be listed, and at least a preliminary assessment of the cost of the improvements will be made to indicate the expected payback on any capital investment needed. The audit report should conclude with specific recommendations for detailed engineering studies and feasibility analyses, which must then be performed to justify the implementation of those conservation measures that require investment.

Whereas for the Post audit phase the detailed analysis is made and thus analyzed for the Post audit phase taking up the detailed analysis of the action plan and scheduling the implementation process.

3.3 Energy Audit Equipment's used

There are some equipment's used for the energy auditing without that the detailed analysis cannot be made or done properly. So these are the equipment's used in Energy auditing in any industry other than spinning mill

- Load manager meter
- Lux meter
- Power quality analyser
- Temperature indicator
- Tachometer
- Digital clamp meter
- Combustion Analyser
- Gas leak detector

4. OBSERVATION

The source of energy to the Spinning mill is from the nearby substation located near to it by the electricity board. It has four distribution transformers with different KVA one is 800KVA and the other three is of 500KVA. And there are different Genset of different KVA in it. The power capacitors are also being installed in it to improve the power factor and there are almost 9 capacitor banks in it of 100KVAR. So these are the details from which the source of energy to the spinning mill.

4.1 Energy Flow in Spinning Mill

The flow of energy is so simple but not like our residential buildings it is first from the Substation i.e. of 22KV substation and then next it goes to the Transformers as we mentioned above it of four transformers and next to the MV Panels and then to the SSBs of each sections and thus finally to the loads like lighting, motors, drives, conditioning units and many others connected to it, it is shown in the fig.3

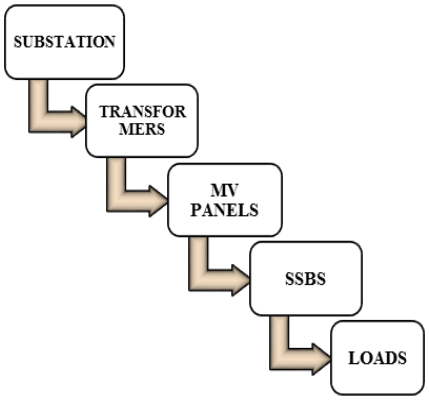

Fig -3: Energy flow Structure

4.2 Connected Load Details

Various departments like blow room, carding, drawing, simplex, spinning and winding their installed capacity and thus their load used for a day is thus calculated in order to see the production of spindles per day. In each department the type of load like machines or filter or air conditioning is thus added to see the load details and how they are consumed for a day and their production for a day is also being calculated and thus listed in the table 1

Table -1: Connected load details

Department	Areas	Load (KW)	Hrs/day	KWh/day	Production (Kg)
Blow room	Machines	64.00	22.00	1408	8935
	filter	16.35	22.00	360	
carding	Machines	96.56	22.00	2124	8577
	filter	31.00	22.00	682	
drawing	Machines	30.30	22.00	667	7462
	Air Cond.	30.00	22.00	660	
simplex	Machines	31.40	22.00	691	7432
	Air Cond.	36.40	24.00	874	
spinning	Machines	650.00	22.56	14664	7358
	Air Cond.	172.00	24.00	4128	
winding	Machines	43.23	22.00	951	7260
	Air Cond.	53.00	24.00	1272	
compressor		55	24	1320	
Lighting		37.50	24	900	
Total		**1346.7**		**30701**	**47024**

4.3 Types of Load

Basically, in this spinning mill there are almost four types of load is being used in it. They are lighting load, motor load, air conditioning load and compressors. So these are the various types of loads being used in this spinning mill. where the motor load is being used more in all the sections. The chart 1 shows that how the energy is used effectively by various load.

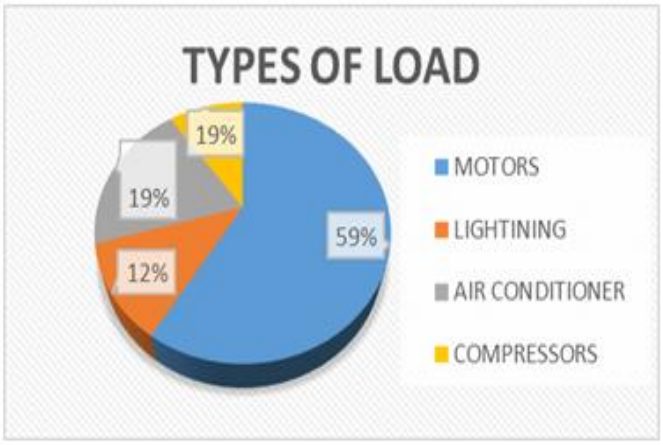

Chart -1: Types of Load

So the motor load is being used is of 59% for various sections in the spinning mills. where a detailed analysis is done to check where the motor load is being used effectively in which section. Thus the use of compressors is about 10%, Optimize air consumption & pressure for cleaning air application (this is one of the largest wastage in most of the textile industries) Have effective controls on the operation of the compressors for better optimization & sequencing. In which the air conditioners is about 19%. where air conditioning is the process of treating air also as to control simultaneously its temperature, humidity, cleanliness and distribution to meet the requirements of "conditioned space". An air conditioning system may use heating, cooling, humidifying, de-humidifying and filtering units of combination of these depending upon the outside weather. Lighting is about 12% in which collecting all the details of the tube light there all together 900 plus tube lights are being used for the entire departments.

The motors used is of all the sections in the spinning mills so the energy used for the different motors, so the detailed analysis for each department like blow room it uses around 11 motors and thus for the carding it is used around 23 motors and for drawing we have 13 motors connected to the machines, after that 11 simplex motors are being connected to the machines. After this the main area or section of spinning section is gone it is around 27 motors being used in it, and for the winding or auto cone machine the motors used is of 11 motors.

5. AREAS OF AUDIT

5.1 In Motors

- Changing the faulty motors with new and efficient motors
- Change the V-belts to cogged V-belts

About 60% of this industrial load is induction motor load. While Comparing with the other alternatives the induction motor is cheaper and easier to maintain. The induction motor is made up of stator, which is a stationary part in the motor, and thus the other one is rotor the rotating part in the motor. The stator consists of a series of fine wire windings of very low resistance permanently attached to the frame of the motor. A magnetic field is developed in the windings as a voltage and a current is applied to the stator winding terminals. By the way the stator windings are arranged, the magnetic field appears to synchronously rotate electrically around inside of the housing of the motor. And commonly used prime mover for various equipment's in industrial applications is induction motors. Thus replacing the V-belt to cogged V- belt there won't be any slippage so thus their efficiency will be higher as compared to the V-belt state. So it is recommended to change the type of belt to the required one in which their belt connected to the motor wont slip away thus it may lead to loss of efficiency.

5.2 In Humidification

- Replace the aluminium blades with FRP blades

In the humidification plant the atmospheric conditions with respect to temperature and humidity play a very important role in the manufacturing process of spinning yarns. The properties like dimensions, weight, tensile strength, rigidity etc. Fibre-reinforced plastic (FRP) also called fibre-reinforced polymer, or fiber-reinforced plastic) is a composite material made of a polymer matrix reinforced with fibres. In which they have two fans all together they are

- Return air fan
- Supply air fans

The return air fans return the air to the plant room from where it is circulated or exhausted in the mill. The supply fans supply air to the mill from the plant room. Air washer is a device for intimately mixing water and air. This intimate contact between these two element is best brought-for application- by drawing air through a spray chamber in which atomized water is kept in transmit.

Humidification plants are catering to the temperature requirement at different sections. The humidification plant consists of a set of supply fans & return fans. These humidification plants generally have aluminium blades for air washer fans. Thus the recent FRP blades have improved aerodynamics characteristics and are much more energy efficient as compared to Al blades this would reduce the power consumption of the fans by 15-20%.

5.3 In Spinning machines

- Replacement of aluminium ring cup adopter with plastic adopter

In the spinning machine section there are certain machines which are used to spin up the spindle that is the second last step from the spinning mill process. So there is a cup adopter in every set of the spinning machine thus the weight if u see it is little high compared to the plastic so thus replacing it to the plastic cup adopter in the spinning machine set the weight thereby decreases so the load acting upon the motor decreases in which thereby the efficiency and thus of the production may increases due to low weight and thus the process speed may increase.

5.4 Others

- Changing the transformer to auto transformer

Actually the transformer is of off load transformer in which if the load is thus varied we need to change the tap of the transformer manually so thus if we change them to the on load transformer the load won't get varied so the machines runs continuously all the time without affecting up the production, but it can only be recommended for the future work because there are certain illustration or guidelines to be followed up so thus there are only recommended.

6. ANALYSIS

6.1 Analysis of Old and New Motor

The analysis for the old rewound motor and of energy efficient motor is thus analyzed, compared and thus the graph is thus drawn in the chart 2. Thus the values taken is of theoretical values to determine the savings analysis in it.

Table -2: Comparison of Old Motor Vs New Motor

Motor	KW	Efficiency (%)	Loading (%)	Req. Input (KW)
Old motor	373KW	89%	80%	335.28
New motor	373KW	94%	80%	318.10
KW Savings				17.18

Use of high efficiency or Energy efficient motors. The energy efficient motors have reduced losses through improved design, better materials and improved manufacturing techniques. Whereas a simple calculation is done and thus the table is illustrated above in table 2 for the new and old motors

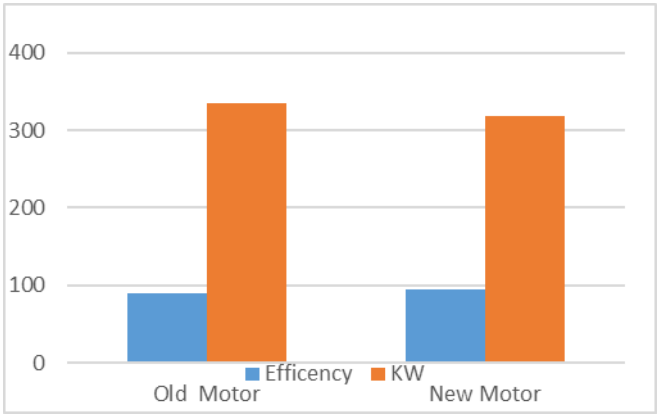

Chart -2: Comparison of Old Motor Vs New Motor

Thus it is evident that the old motor has less efficiency compared to the new motor so if we calculate the Kilo Watt Savings thus for the new motor the savings will be less so we can save the energy up to 5%. This is only for the one motor if u thus compare with the all motors and thus calculate the savings it can be around 17% of energy savings in a month for one motor.

6.2 Analysis for replacing the V-belt to Cogged Belt

About one-third of the electric motors in the industrial and commercial sectors use V-belt drives for the motors. Belt drives provide flexibility in the positioning of the motor relative to the load. Pulleys or sheaves of varying diameters allow the speed of the driven equipment to be increased or decreased. A properly designed belt transmission system provides high efficiency, low noise, does not require lubrication, and presents low maintenance requirements. However, certain types of belts are more efficient than others, offering potential energy cost savings.

The majority of belt drives use V-belts. V-belts use a trapezoidal type of cross section to create a wedging action on the pulleys to increase friction and the belt's power transfer capability. Joined or multiple belts are specified for heavy loads. V-belt drives can have a peak efficiency up to 95% to 98% at the time of installation. Efficiency is also dependent on size, driven torque, under or over-belting, and V-belt design and construction. Efficiency deteriorates by as much as 5% to a nominal efficiency of 93% over time if slippage occurs because the belt is not periodically re-tensioned.

Cogged belts have slots that run perpendicular to the belt's length. The slots reduce the belt's bending resistance. Cogged belts can be used with the same pulleys as equivalently rated V-belts. A table is shown below in the table 3. A simple theoretical calculation is enlisted below with a graph below chart 3.

Table -3: V-belt vs Cogged belt

Description	Energy Saving Calculation
Weight of Aluminium adopter	54 grams
Weight of Plastic adopter	33 grams
Difference in Weight	21 kg
Power consumed by aluminium adopter	50.4 kW
Power consumed by Plastic adopter	49 kW
Energy saving per motor	1.4 kW (2.77 %)
Annual saving per m/c = 1.4 x 365x24 hr/day x 6 (units Price)	61320

They run cooler, last longer, and have an efficiency that is about 5% higher than that of standard V-belts. which is shown below in the chart 3.

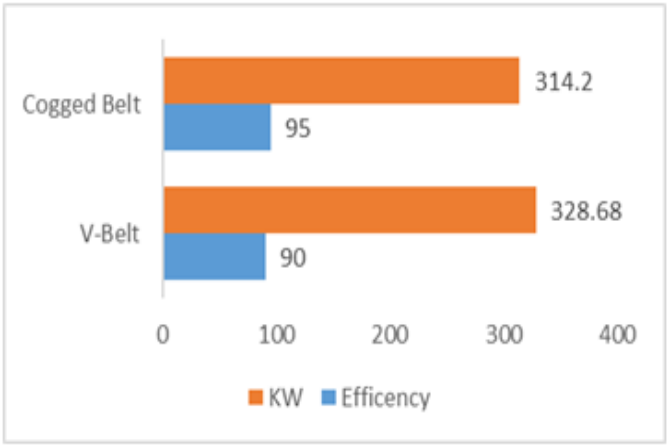

Chart -3: V-belt vs Cogged belt

6.3 Al cup adopter to Plastic adopter

Study of replacement of heavier aluminium adopter with a light weight hard plastic adopters is given in the Table 4. Adopters are fixed on the spinning machine in the ring frame index to that attached next to it. Ring Rail moves up and down to wind the spun yarn on the ring bobbin.

When aluminium adopter is replaced with a light plastic adopter, it reduces the motor load and save the energy up to 2.77 %. Annual saving from this activity is validated and enlisted in the table. where aluminium is weight compared to the plastic adopters so thus they are being replaced in it and where the initial cost is also not much high compared to aluminium so the plastic adopters are being used.

Table -4: Analysis of cup adopters

Belt	KW	Efficiency (%)	Loading (%)	Req. Input (KW)
V belt	373KW	90%	80%	328.68
Cogged belt	373KW	95%	80%	314.20
KW Savings				**14.48**

7.CONCLUSION

In this paper it is stated that the areas of audit can be done in the industry for various section in the spinning mill like the use of old motor may have less efficiency and more energy losses, so in which thus changing to the new and efficient motor it thereby increases the efficiency for the motor, and thus replacing the V-belt to Cogged belt may increase the efficiency. Where the initial investment may consume little less amount and thereby giving less losses in the machines. In spinning machines, the aluminum cup adopter is thus replaced to plastic in order to gain a high efficiency. In the present time energy price goes high day by day as compared to the equipment price such as motors. Even new motors consume 4 to 5 times energy of its initial price in one year and improperly rewound motors consume 6 to 8-time energy in one year as compared to its price and rewound motor consume 2.5 to 3 times more energy than new motor. So we concluded that the difference between the prices of purchase for new and rewound motor is very less, but rewound motors consume much more energy as compare to new motors. Thus the energy can be saved and efficiency is increased up to 10%-15%

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