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ELECTRICAL ENERGY AUDIT IN PAPER MILL

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Abstract

The electrical energy is the most common and widely used energy in India. The aim of the paper is to conduct an in-depth study to reduce the energy consumption in paper mill. Identification of area of energy wastage and energy conservation measures are recommended. Also detailed analysis of data collection is done to increase the efficiency. Estimation of implemented cost and payback period for each recommended action had been made. Energy saving and development of new energy are the well accepted solution to fulfil the growing demands in expectations. Execution of energy audit in paper mill can develop the plant efficiency and thus dropping the amount of wastage.

***Key Words*:**Peristaltic flow, Slip, Wall properties, Heat transfer, Bingham fluid and Non- uniform channel.

1 Introduction:

Economic growth of country depends on energy. In developing countries, energy need is very high so they are making huge investment to produce more energy. Sources that are available or stored in nature are Primary energy. Coal,oil, natural gas, and

biomass (such as wood)are some of the primary sources.The energy sources that are available in the market for a definite price are known as commercial energy. Some important forms of commercial energy are electricity, coal and petroleum products. Non-commercial energy sources that are not available in the commercial market .Non-commercial energy sources include fuels such as firewood, cattle dung and agricultural wastes. These are also called traditional fuels. Renewable energy is obtained from sources that are essentially inexhaustible. Examples of renewable resources include wind power, solar power, geothermal energy, tidal power and hydroelectric power . Energy saving and energy cost saving are the two main objectives for electrical energy conservation.

Developing countries is about 75 percent of the world's population .The energy consumption of some developed country is only 45 percent of the world total energy consumption. Energy consumption level is very high in developed countries. Compared to highly industrialized developed countries the people growth in the developing countries has kept the per capita energy consumption low. The world average energy consumption per person is equivalent to 2.2 tonnes of coal.

2 ENERGY AUDIT

In the area of energy management Energy Audit is a systematic approach for decision-making. It balance the energy inputs with its use, and tries to recognize all the energy streams . It quantifies energy procedure according to its distinct functions.Energy audit in industries is an useful tool in pursuing and defining widespread energy management program.

2.1 Need for Energy Audit:

In any industry, energy (both electrical and thermal), labour and materials are the main three operating expenses. Energy Audit will help to understand more about the ways energy and fuel are used in any industry. And it is very useful in identifying the areas where waste can occur and where range for enhancement exists.The Energy Audit would give a best way to the energy cost decline,

anticipatory maintenance and quality control programmes which are vital for production and utility activities

3 TYPES OF ENERGY AUDIT:

The type of Energy Audit to be performed depends on:

- Industry type
- Depth to final audit is needed, and
- Cost reduction desired

Thus Energy Audit can be classified into the following two types.

i) Audit I

ii) Audit II

3.1 Audit I Methodology:

It is a Preliminary energy audit method and is a relatively quick exercise to

- Identify the energy usage in the organization
- Identify and find the area of saving
- Identify the low-cost development and savings
- Fix a set point
- Identify areas for more detailed study and measurement

3.2 Audit II Methodology:

It provides a detailed energy audit . This type of audit gives the most accurate energy savings and cost. It consider the interactive effects of all projects, and accounts for the energy use of all major equipment, and includes detailed energy cost saving calculations and project cost.

Detailed energy auditing is carried out in three phases: Phase I, II and III.

Phase I -Pre Audit :

For efficient working a structured methodology must be carry out. An initial study of the site and the planning of the procedures is very important for an audit .

The data to be collected during phase I audit includes:

1. Energy utilised by various department,and process equipment used.
2. balance data for raw materials and recycled materials used.
3. Material flow diagram and tariff data
4. Process flow diagram and Energy cost
5. production and supply of site services (eg. compressed air, steam).
6. Type of energy supply
7. prospective for fuel substitution, method modifications, and the use of co-generation systems (combined heat and power generation).
8. Energy organization procedures and energy knowledge education programs within the organization..

It is necessary to collect basis data by the audit members

- various Tools, processes and equipment details
- Amount & type of input materials used
- Amount of Water used
- Amount of Fuel used
- total amount of Electrical energy used
- level of Steam utilization
- level and type of wastes generated
- Percentage rejection / reprocessing

4 ENERGY SAVING IN BOILER

A boiler is an vessel that enclosed and provides a means for combustion heat to be passed into water until it becomes hot water or steam. For further process the steam under pressure is then usable for transferring the heat. In Water tube boilers the conditions are reversed with the water passing through the tubes and the hot gases passing outside the tubes . These boilers can be of single- or multiple-drum type. The water tube boiler have high efficiencies than fire tube boiler.

4.1 Energy Conservation Proposal in boiler:

Energy conservation in boiler is very essential.The designed value of boiler efficiency is 77.6%.But the actual running value of boiler efficiency is only 76.15%.so this efficiency value can be improved by two ways.By reducing the excess air and by reducing the exhaust flue gas temperature then the efficiency can be improved by 77.49%.By using this two methods fuel saving per annum will be1100 tonnes /annum

Direct Method:

Boiler Efficiency $= \dfrac{ms * (HsHf) * 100}{mf * GCV}$

ms$\rightarrow$ flow rate of steam, kg/hr

Hs $\rightarrow$ Steam enthalpy, kJ/kg

Hf $\rightarrow$ Feed water enthalpy, kJ/kg

mf$\rightarrow$ firing rate of fuel, kg/hr

GCV $\rightarrow$ Gross calorific value, kJ/kg

The efficiency of the actual boiler is76.15%.This efficiency can be improved by

1. Reduce the excess air(50% to 31.25%)
2. Reduce the exhaust flue gas temperature (160C to 140C). By using this energy conservation proposal efficiency is improved to 77.47%

Table 1.Boiler data

LOSSES	DESIGN(Five Cail Babcock)	ACTUAL	PROPOSAL
L1	4.1	5.348	4.205
L2	4.05	4.159	4.10
L3	4.04	4.127	4.070
L4	0.149	0.2147	0.1577
L5	4.64	4.64	4.64
L6	0.97	0.97	0.97
L7	1.50	1.50	1.50
L8	2.883	2.883	2.883
TOTAL LOSSES%	22.4	23.85	22.53
EFFICIENCY%	77.6%	76.15%	77.47%

Table 2.Enery Saving Details

Existing system	Proposed system	Savings
Boiler efficiency=76.159% Fuel Consumption at 76.15% efficiency= 8.1837TPH	Boiler efficiency =77.47% Fuel Consumption at 77.47% efficiency= 8.044 TPH	Fuel saving per hour= 139 kg/hr
Fuel saving per annum = 3.336*330= 1100 tonnes/annum Amount saved = 1100*500= 55 lakhs/annum		

5 PERFORMANCE ANALYSIS OF TURBINE

Overall Plant Efficiency:

Actual Turbine Efficiency = 1kwh / Actual Turbine Heat rate= 860 / 2608.96 = 32.9%

Design Turbine Efficiency = 1kwh / Design Turbine Heat rate= 860 / 2336.5 = 36.8%

Nearly 4 % has been dropped from turbine design efficiency

Reasons may be due to

1. Higher exhaust pressure/lower vacuum in condenser increases steam consumption in turbine, hence turbine will be low.

2. Blade profile loss may be big, hence blade profile efficiency is low which results in higher heat rate and lower turbine efficiency.

3. Efficiency of governing stage is low resulting in higher heat rate and lower turbine efficiency.

6 ENERGY CONSERVATION IN MOTORS

Rewinding burnt-out motors is very common in most of the industries . The increase of rewound motors in some industries is 60 % of the total population. Rewinding the motor can maintain motor efficiency at previous levels, but losses in efficiency results in many cases. There are many factors which are affected by rewinding are winding and slot design, winding material, insulation performance, and operating temperature.

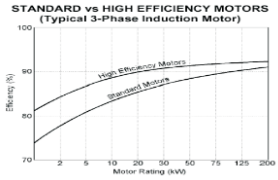

Fig 1.standard vs high efficiency motor

If winding design is changed the Efficiency can be improved .The stator losses are reduced by using wires of greater cross section so efficiency increases.During rewinding, orginal design can be preserved .

6.1 REPLACEMENT OF REWOUND MOTOR WITH ENERGY EFFICIENT MOTORS:

In this industry 60% of motor are rewound so it looses some 7% of efficiency when rewound .so this rewound motor should replaced by energy efficient motor.the energy cost saving by replacing an oldmotor with an EEM is given by the following formula[4]

S=PLCT(100/B-100/A)
Where S=annual saving
P=KW rating of motor B
L=load factor
C=average electricity
T=running time(hours/year)
A=Efficiency of motor A
B=Efficiency of motor B

Table 3 Energy Conservation in motor

Existing system	Proposed system	savings
1.60% Of Motors Have Been Rewound 2.All motors have lower operating efficiency 3.Operate at 80% of rated load 4.Existing motor efficiency=80%	Increase motor efficiency to 90%. Replace all rewound motors by EEM	Annual saving =39 lakhs
Payback=total investment/total cost saving=390000*12/3000000=15 Months Return on investment=1/payback=6.6 per month		

7 CONCLUSION:

The energy audit carried out at TNPL yields a substantial savings in fuel. About 139 kg/hr of fuel is saved and hence amount saved is 55 lakhs/annum. The performance of turbine is studied. Energy conservation in motors has been done by the replacement of rewound motor with energy efficient motors with an energy saving of 994400 kwh and cost saving of 39 lakhs with a payback of 8 months.

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