Energy Conservation in Utility Area of Pulp and Paper Industry

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ABSTRACT

Conservation of energy not only increases profitability but also extends our future stock of energy with respect to non-replenishable fossil fuel stocks. Further to compete in the global market scenario, energy intensive industries like pulp and paper mills have to operate at maximum possible efficiency, especially with regard to energy consumption where energy cost is second largest cost of the total input costs. The Indian Pulp and Paper industries offer a tremendous scope for energy conservation. In this paper the effort has been made to focus on the needs and approach towards energy conservation.

INTRODUCTION

The concept of Energy Conservation in developed countries was initially started after the oil crisis due to Arab - Israeli war during 1973, when the price of crude oil went up (1) from US $ 3/ barrel (in 1972) to US $ 12 / barrel (in 1974). It was geared up in developing countries with further increase of oil price to US $ 38/barrel (in 1980). Present price of crude oil (2) is US $ 25/ barrel. But in India the concept has gained momentum only after the earth summit held in June' 1992 at Rio-de-Janeiro.

Energy in Paper Mill

India has crossed the landmark of 1,00,000 MW installed capacity of power generation (3) in March'01 (from 1362 MW installed capacity in 1947). During the year 2001 India has generated 499 billion unit of power, out of which 49% of total energy generated (4) is consumed by industries and 10% of the industrial consumption (5) is consumed by paper industries.

The energy cost per MT of paper is approximately 30% (Fig. 1) of the total cost of production. Generally the paper mills are having coal based captive generation and coal is the second largest cost component for paper. Hence it plays a major role to reduce the cost of paper production to make it competitive in the present scenario of global paper market. Hence in paper mills we always talk of coal consumption per MT of paper.

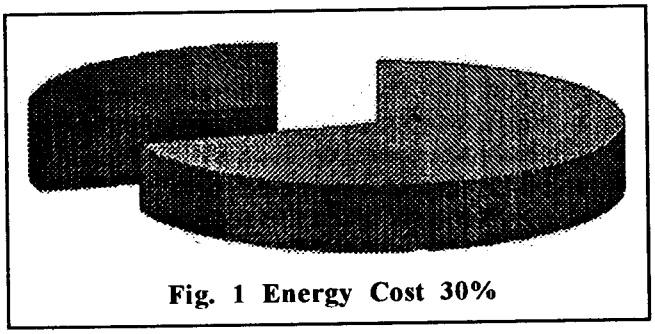

Fig. 1 Energy Cost 30%

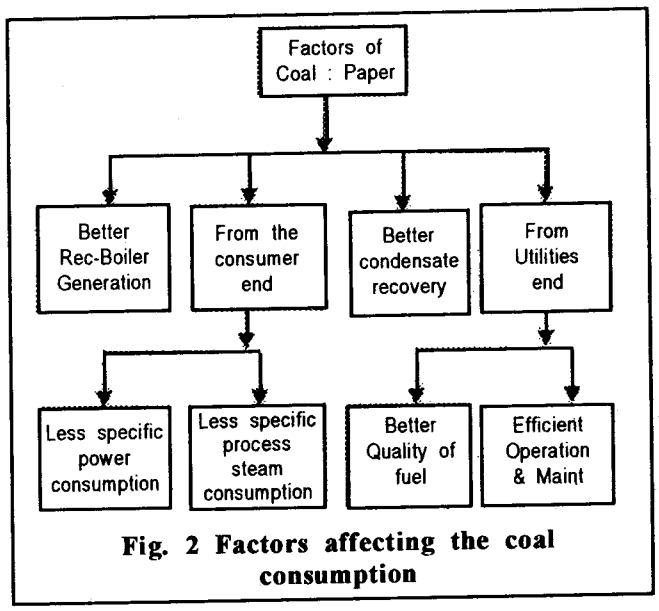

Fig. 2 Factors affecting the coal consumption

Norms with respect to electrical energy (KWHr/ MT of Paper), steam energy (MT/MT of paper) may vary with mill-to-mill and process-to-process. But as a whole the ultimate aim for the productivity is to reduce the energy cost per MT of paper. When we look at the tree (Fig. 2) it appears that there are various factors affecting coal consumption per MT of paper.

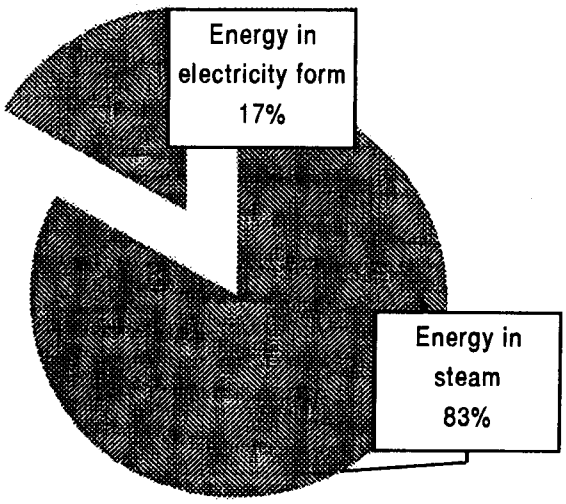

Fig. 3 Energy on consumption basis

Better Recovery Boiler Generation

The use of biomass energy has two prong advantages in paper industries, one is steam generation and another is reduction in waste. The paper industry generates (6) around 2.5 times as waste materials per MT of finished paper. Out of this black liquor alone is 1.5 - 1.7 MT per MT of paper. With this, black liquor Recovery Boiler may contribute up to 25-30% of steam over the total requirement resulting in reduction of steam generation from coal fired boiler and hence reduction in coal consumption (increase in every percent contribution of steam generation on total steam requirement from recovery boiler may reduce(6) the specific coal consumption by 0.027%.

From the consumer end

An integrated paper mill which consumes(6) energy approx 17% of total energy requirement in the form of power and approx 83% of total energy in the form of steam (on consumption basis), can contribute a lot to reduce the specific coal consumption by implementing and practicing the followings:

- Implementing energy conservation schemes.
- Developing energy awareness.
- Better capacity utilization.
- Efficient use of steam and power.
- Reducing the losses.

Reduction in specific power consumption by 100 units and specific process steam consumption(6) by 1 MT can reduce the specific coal consumption by 0.05 and 0.08 MT per MT of paper respectively.

Better Condensate Recovery

In a paper mill condensate return recovers heat, reduces water losses and D.M. Plant Load. In fact 10% of the heat energy (as steam) or we can say 8% of the total energy (as steam & electricity) and 70% of the polished water is recoverable from condensate recovery as shown in Fig 4. Every 10% of condensate recovery reduces the specific coal consumption approximately by 0.01 MT.

From the Utilities end

Utility area in a paper industry in general provides power, steam, water and air for all the process plants and to make it available to the plants, Utility department itself needs considerable amount of energy. There are two main approaches to improve the Utilities performance to reduce specific coal consumption.

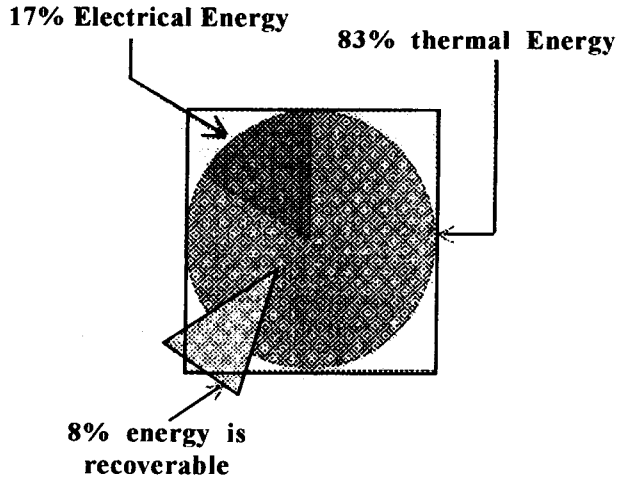

Fig. 4 Different types of energy

By better quality of fuel

For any captive power plant in Indian paper industries, coal is used as the basic fuel and as regards its quality, only B-grade is available for paper industries and many mills are getting still inferior grade of coal. Lower grade of coal means higher ash and moisture content resulting high consumption leading to more breakdowns. In case of B-grade coal increase in every 1% of ash content in coal results in decrease of approximately 100 Kcal/Kg of heat value in coal and finally affects the specific coal consumption by 0.027 MT. Further in the same way increase of 1% moisture content in coal reduces the useful heat value of coal by 145 Kcal/Kg with a reduction in coal 0.039 MT per MT of paper. Further higher ash content means high ash generation resulting in more problem for handling and disposal of ash.

By efficient operation and maintenance of power plant

Better utilization of heat i.e., improving the efficieny of Boiler and TG can be achieved by implementing the followings:

Increase in thermal efficiency of Boiler

For efficient combustion in Boiler all the major parameters like fuel sizing and control over excess air supply, exit flue gas temperature, unburnt fly ash and bottom ash, feed water quality, fire side scaling are to be regularly monitored.

Generally,

a. for every 22°C reduction in flue gas temperature by passing through an economizer or air pre-heater, or every 6°C rise in feed water temperature through an economizer, or 20°C rise in combustion air temperature there is 1% saving in fuel in boiler.

b. 1 mm thick scale deposit on the waterside could increase fuel consumption by 5- 8%.

c. Incomplete conbustion leading to formation of carbon monoxide in place of carbon dioxide can liberate (7) of only 52% of the total heat in the fuel. Replacement vane / dampers control of ID, FD fans by variable frequency drive may reduce the power consumption as well as better control over the flow of air.

Increase in efficiency of turbine

a. To increase the turbine efficieny the proper insulation and optimum vacuum in condenser are to be set right. For a process industries like paper mill where steam at varied pressure is required for different plants, co -generation with extraction matching with required pressure and then condensing can improve the efficiency as a whole of the power plant.

b. Replacing the heavy weight cooling tower fan by hollow type PVC blade with aerodynamic design can reduce the power consumption with effective cooling.

Increase in efficiency of distribution system

Maintaining the quality of products:

Steam

- Supply of steam at right pressure and corresponding saturation temperature (as per requirement) may improve the heat transfer efficiency and in turn reduces the steam consumption.
- Monitoring and repair/ replacing the steam trap in time in various steam lines may reduce steam wastage.
- The better insulation in steam distribution sections may reduce the heat losses through radiation.
- Arresting of leakages of steam (if any) can improve the efficiency by reducing heat losses.

Power

- Maintaining the power factor > 0.9 by installing capacitor bank can reduce power consumption considerably.
- Reducing frequency up to 49 Hz keeping the voltage constant may reduce the power consumption.

Air

- Supply of compressed air at required pressure by incorporating unloading provision can redcuce the excess power consumption of compressor.
- Arresting leakages of air up to the consumption end, continuous monitoring of the operating parameters of the compressors may help a lot in reducing energy consumption.
- Replacing number of old type screw compressors/ old aged reciprocating compressors by one energy efficient centrifugal compressor may help in the line.

The different areas for energy conservation are summarised in Table 1.

Table 1 Areas of energy conservation

Name of the Area	Potential of Energy conservation
Decrease of 1% ash content in coal (for A&B grade)	May decrease the specific coal consumption per MT of Paper by 0.027
Decrease of 1% moisture content in coal (for A&B grade)	May decrease the specific coal consumption per MT of Paper by 0.039
Increase in 10% of condensate recovery on recoverable basis	May decrease the specific coal consumption per MT of Paper by 0.01
Increase in 1% of recovery boiler contribution on total requirement basis.	May decrease the specific coal consumption per MT of Paper by 0.027
Decrease in 1 MT of process steam consumption per MT of paper.	May decrease the specific coal consumption per MT of Paper by 0.08
Decrease in 100 KWHr of power consumption per MT of paper.	May decrease the specific coal consumption per MT of Paper by 0.05.

Increase in availability of Boiler and TG by implementing better 'O and M' methods

Start up of Boiler and TG needs lot of coal and costly grid power. Better operation and maintenance practices can avoid frequency of such cold start of unforeseen breakdowns.

A view of Coal Consumption at Nagaon Paper Mill

In Nagaon Paper Mill the energy cost per MT of Paper was 27% of the total variable cost in the year

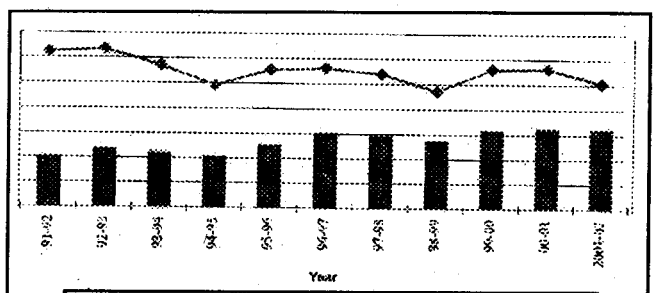

Fig. 5 Trends of Energy Cost

of 91-92, the same is 18.8% during 2001 - 2002. This is in spite of increase in coal prices by 60% since 1991-92. Trend of year wise energy cost per MT of paper and the coal cost per MT are shown in Fig. 5.

Energy cost per MT of paper is almost in the constant

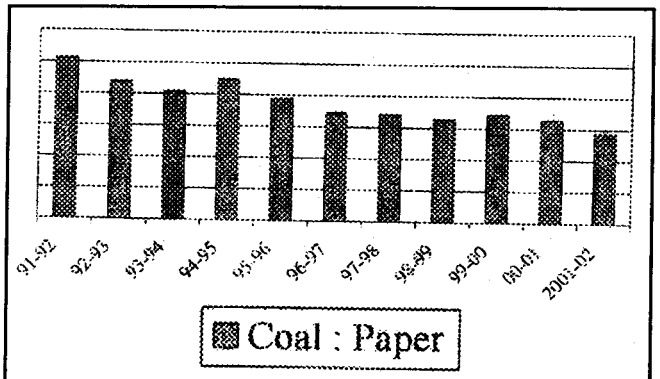

Fig. 6 Coal Consumption

level in spite of increase in energy (coal) cost is due to decrease in consumption of coal per MT of paper. The year wise coal consumption per MT of paper is shown in Fig. 6.

Measures taken to achieve the same

1. Replacing chain grate stocker having tension arrangement by roto-grate chain stocker having free expansion and drum type feeder with four blade distributor by drag chain feeder with multiple blade distributor.
2. Optimizing the water consumption by reutilization of the same and monitoring over the consumption by incorporating flow meters in different major consuming points.
3. Running the generator at low frequency (49.0Hz).
4. Increasing the condensate recovery by putting flow meters in different lines and monitoring on day-to-day basis.
5. Trimming of pulp impellors where ever feasible.
6. Installing variable frequency drive in place of damper control.

Measures implemented recently and under execution

1. Installation of three numbers of lamella type Evaporator in series of LTV street to increase the concentration of black liquor to 70%.
2. Retrofitting of two numbers of additional economizers replacing the cascade evaporator.
3. Retrofitting of additional economizer in coal fired boiler to bring down the stack temperature from 230°C to 180°C.
4. Replacing the old analogue type A.V.R. with rotating exciter by D.V.R. with static excitation to have better control over voltage and better availability of TG power.
5. Installation of centralized power monitoring system to have better monitoring on day-to-day basis.

Measures being planned in future

1. Making the Cooling tower a closed circuit for the chemical treatment of the water. This is to maintain the cleanliness factor in turbine condenser to get the optimum vacuum throughout the year.
2. Installation of waste heat C.F.B.C. boiler.
3. Installation of one centrifugal compressor of higher capacity to replace existing two reciprocating air compressor.
4. Installation of five H.T. capacitor banks to improve power factors.

CONCLUSION

Energy conservation does not mean blindly cutting down the energy consumption. It is a disciplined activity organized for more efficient use of energy without reduction in production level or lowering product quality. It is not one time exercise but a

continuous proces. Constant review and adjustments or improvements, wherever required, will lead to sustained improvements in the energy conservation scenario. This subject needs close co-ordination between various sections like Process, Engineering, R&D, Finance and Personnel etc. and should not be viewed as a technical problem alone. Target setting, monitoring, reporting and expediting energy conservation measures needs to be established to sustain all round improvements and enhance energy consciousness among all members of the industry. Constant encouragement and participation of top management gives a zip to implementation of energy conservation measures. Awareness of leakages or wastages, in terms of costs, needs to be broadly circulated to all concerned. Incorporating periodic energy audits will help in exploring new avenues of energy conservation.

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