Energy management in pulp & paper industry

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Introduction :

Energy is a scarce commodity. Its consumption has inereased manifold with the pace of development. Danger exists that a lot of our energy sources, if used mindlessly, may fast get exhausted. No doubt newer sources of energy are being explored, there is an **URGENT** need to conserve existing ones. It becomes essential to identify large consumers of energy, evaluate their performance with reference to conservation and evolve necessary policies, technologies and skills to conserve energy.

2. Energy Conservation as a Way of Life :

In all Industries, various departments take it for granted that energy is available in abundance for them. Hence developing the awarness of all concerned to conserve energy is much more important than evolving newer technologies and skills. We all have to adopt 'Energy Conservation' as a way of life almost similar to our daily good habits.

3. Energy Conservation Trend in Pulp & Paper Industry :

There has been a continuous growth of Indian Paper Industry since the installation of first paper mill in 1832. At present there are 305 paper mills in the country, accounting for a total installed capacity of 30.14 lakh lonnes. The share of large paper mill is 48% of the installed capacity. This requires approx. 44306 $\times 10^3$ Million Kilo Calories of energy per year (at an average of 14.7 MKCal/Ton of paper). 20% of this is in the form of electrical energy and rest is thermal energy. On an average large integrated mills consume 1500 units per ton. Average cost of energy lies between 20% to 40% of the total production cost.

From 1980 to 1989 the annual growth rate of large paper mills (installed annual capacity of 20,000 tonnes and above) is only 3.4% as against 14.5% of small paper mills (installed annual capacity of less than 20,000 tonnes).

Steam requirement of typical Indian integrated pulp and paper mill is given below :

Area	Steam (T) per ton of paper
Digester House	2.00
Bleaching	0.20
Evaporator	1.72
Causticizer	0.62
Feed Water Heating	1.15
Auxiliaries	1.43
Paper M/s. (incl. Stock)	4.00
Miscellaneous	0.50
	11 62

Specific electrical energy consumption of various process centres is given below (Basis : Weight average figures of 8 Nos. of Units as per Energy Audit Study by the Bureau of Industrial Costs & Prices).

Process Centre	Weighted Average Units per ton of Paper
a) Chipper House	58
b) Pulp Mill	256
c) Stock Preparation	238
d) Paper Machine	518
e) Soda Recovery	

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4 Factors Affecting Energy Consumption :

A large number of parameters affect the consumption pattern of energy directly or indirectly. Some of the important parameters are given below :

4.1 CAPACITY UTILISATION RATE :

There is minimum specific energy consumption if the unit runs at the peak of its capacity. Important f.ctors are :

a) Efficiencies of equipments like pumps, blowers fans, air compressors, steam turbines, AC Induction motors etc. are very much dependant on its percentage loading. At lower loading the efficiency drops.

b) Lighting loads and heating loads practically remain same at all the production rates.

c) Heat losses through insulated/non insulated surface are independent of production rate.

d) Leakages (though supposed to be arrested) of air, water, steam, liquor etc. vary little with rate of production.

4.2 CLIMATE AND LOCATION :

Nature of climate, weather conditions and geographical locations affect the rate of heat losses etc. and hence energy.

4.3 ACE OF EQUIPMENTS :

Inspite of all efforts made by Management to keep the equipments in healthy condition by way of good maintenance, renovation and modernisation, ageing effect cannot be totally eliminated. Thermal and Electrical efficiencies gradually deteriorate.

4.4 SIZE OF THE UNIT :

Under similar conditions better energy efficiencies are achieved with large unit sizes.

4.5 QUALITY OF PAPER :

a) Qualities with higher bleached products and higher brightness require more energy.

b) Higher percentage use of secondary fibre reduces energy.

c) More use of secondary fibre reduces energy.

4.6 PROCESS ADOPTED :

Different process require different level of energy :

a) Kraft Pulping - - It is less energy consuming process.

b) Chemical Pulping - - It is higher energy consuming process.

c) Ground Wood Pulping - - It is higher energy consuming process.

5. Energy Conservation Measures in Paper Industry :

The measures can be broadly divided in the following 3 categories :

a) Short term measures
b) Medium Term Measures
c) Long Term Measures

a) Short Term Measures :

These are mainly related with improved house keeping and cleanliness and consists of following measures :

i) Combustion Control in Boilers by controlling. Co_2, O_2, and Co.

ii) Prevention of leakage of steam, hot water, hot air, condensate and liquors.

iii) Improving methods of condensate recovery.

iv) Improving thermal insulations.

v) Monitoring system power factor.

vi) Monitoring wasteful use of light, fan and other equipments.

vii) Optimise process parameters by careful monitoring equipment especially running of Refiners, Vaccum Pumps, cooling fans etc.

viii) Improving maintenance of measuring and recording equipments for electrical parameters, steam, water, pressure and air.

ix) Rearrangement of running sequence of equipments.

x) Incorporating Electrical interlocks between various drives to reduce idle running.

b) MEDIUM TERM MEASURES:

i) Provision of heat trap devices in boilers i.e. in economisers and air preheaters.

ii) Improved method of steam utilisation in Paper Machines and Evaporators by cascading in machine and use of vaccum pumps in place of ejectors.

iii) Improving heat recovery system from digester blow (improved heat exchangers and improved maintenance of heat exchangers)

iv) Replacement or interchange of over sized pumps and motors with most optimum size.

v) Increasing the no. of effeets in the evaporators.

vi) Increased use of recycled water, thus reducing fresh water consumption.

vii) Optimising available hot water utility.

viii) Provision of wet-end moisture gauge to optimise Process Efficiency.

ix) Use of low pressure steam in First Dryer group. if not already adopted.

c) LONG TERM MEASURES :

i) Improving co-generation system by installiug high pressure boilers and corresponding steam turbines.

ii) To burn saw dust, bark and other wastes in waste heat boilers to supplement energy source.

iii) Introduction of Centralised Compressed air system.

iv) Introduction of Centralised Refining system to maximum possibie extent.

v) Balancing of HP and LP steam system so that there is no steam blow.

vi) Conservation on conventional coal fired Boilers to fluidised bed system so that low grade coal can be efficiently used.

vii) Replacement of multiple size of equipment with large high efficient equipments.

viii) To addopt new energy efficient technique/ equipments, such as disc refiners, thermo compressors for evaporators and machines, improved centricleaners, improved method of mechanical power transmission (flat belt in place of 'V' belts).

ix) Computerised use of batch digesters.

x) Introduction of cold blow system.

xi) Introducing Water Conservancy Schemes in Pulp Mill.

xii) Converting fixed speed drives to variable speed drives for fan pumps, blowers, ID and FD fans for multigrade machines.

6. Measures Identified By Most Of The Paper Mills In India For Energy Conservation

A number of Indian Paper Mills are engaged in Energy Conservation and the measures identified by them are as listed below :

1) Chipper House performance Improvement
2) Digester House performance Improvement
3) Water conservation
4) Waste heat Recovery Improvement
5) Blow Heat Recovey System
6) Improvement of System P.F.
7) Introduction of energy efficient lighting.
8) M.D. Monitoring.
9) Least use of oil fired boilers
10) Improvement of Co-generation
11) Vapour compression system.
12) Selection of correct size of motors and pumps.
13) Replacing conventional M.C. Sets with Thyrister Drives.
14) Using veriable speed AC Motors for pumps when variable discharge is required.
15) Introduction of portable combustion analyser and micro process based controllers for C.F. Boilers.
16) Optimisation of compressors
17) Parallel running of captive generators with State Grid Power.
18) Increasing the number of effects of evaporator
19) Suction Press Machine in place of plane press.
20) Introduction of high efficiency boilers (CF Boilers.

21) Installation of reliable metering equipment.

7. Energy Conservation Targets :

In view of the fact that energy efficiency is affected by a large number of factors, different mills have to fix their own targets will mainly depend on following factors :

a) Technological feasibility.
b) Economic feasibility

In spite of technological and economic feasibility the targets will depend on the degree of improvement expected in energy conservation.

8. Energy Conservation Efforts At JK Paper Mills :

JK Paper Mills has gradually expanded from 1962 till date with present installed paper plant capacity of 55,500 t/annum and Coating Plant capacity of 5,000 t/annum. In spite of installation of additional machines equipments, effluent and pollution control plants during last few years, overall energy consumption per tonne of finished production has shown a declining trend from 15.929 M K Cal in 1985 to 13.438 in 1989 (Annexure-A). Targated results were achieved through systematic changes and modernisaiion, involving phasing out of a number of inefficient equipments and replacing them with energy efficient ones. Energy is reviewed at the highest level with full support from top management. Some of the measures identified and implemented for conservation of thermal and electr'cal energy at JK Paper Mills during last five years are given as under.

Measure 1

To reduce thermal energy condensate level controllers were installed in Digester Preheaters. This is very successful measure resulting in following savings :

Year	Rs. lakhs
1987	16.18
1988	13.30
1989	15.40
Total ...	45.88

Prior to installation of level controller, the steam condensate from the Preheaters or Digesters were being discharged through steam traps. Most of the time the traps did not function properly. Appreciable quantity of live steam was passing along with condensate which was a waste on heat energy. Hence level controllers in all the preheaters were installed to control the discharge of live steam with condensate,

Measures – 2

In order to reduce electrical energy the process flow system of pulp from Couch pit pump modified. Delivery line from Couch pit pump of PM III to Thickener was diverted directly to Wagner Filter. This has resulted in 100% elimination of running of helping stock pump (7.5 Kw). This resulted in a saving of 50,000 Kwh/year.

Meesures—3

To reduce electrical energy consumption and water consumtion by reclaiming mills effluent a scheme suggested by M/s IVL of Sweden was implemented. It is a successful scheme resulting in electrical energy saving of 5,36,000 Kwh/year and 655 MG of fresh water/year.

Besides there has been a saving of fibre in screening plant of old Pulp Mill to the tune of 63.5 T/year (0.176% of annual pulp production-1985/86). Besides additional reclaimed water is available for process at 0.4 MG/day (144 MG/year).

Measure—4

Installation of efficient Coal Fired Boiler with Micro processor control system. This scheme has resulted in improved availability of steam for power generation and process requirement. Besides there had been following annual savings :

i) Reduction in extra cost for running of oil Fired Boiler in comparison to CF Boiler (30 T/hr) — Rs 21.27 lakh
ii) Saving in Electricity — 16.88 lakh Kwh/year
iii) Reduction in Coal Handling — Rs. 3.57 lakh/year

With the scheme dependance of petroleum fuel is greately reduced.

Measure—5

To reduce Electrical Energy, Double Disc Refiners

were installed in place of existing Conical Refiners in Stock Preparation area. These are successful measures. Besides energy saving, we have achieved ;

- Reduction in maintenance cost by way of reduced spares cost and reduced manpower cost.
- Improvement in Paper quality specially when using Hardwood.
- Improved runnability of Machines.

Measure—6

To reduce electrical energy the sludge pumps were optimised in order to save 45000 Kwh/year in Effluent Treatment Plant. Lower Kw (11 Kw) pumps installed in place of higher Kw (22 Kw) from the Plant itself by reshifting. Running successfully.

Measure—7

At Digester House fixed type of Silo belt conveyors were fixed in place of movable belt conveyors. This is a very successful scheme. In addition to electrical energy saving to the tune of 3,58,C00 per year it is possible to have additional production due to the availability of extra Chipper hours after this modification. (Approx. 900 T chips per month based on 2 Chipper running).

Measure—8

By optimising the process, It could be possible to bypass the acid chest pump and acid chest agitator for supply of pulp to Bamboo Chest of PM 11. Instead, now pulp is supplied directly to PM 11 pulp chest resulting in 21,600 KwH/year.

Measure—9

Three nos. of lower kW (55 kW) Thickener back water pumps in New Pulp Mill Screening Section · replace by one no. of higher kw (75 kW) pump. Thus place of earlier 2 Nos. running simultaneously, one no. of higher rating runs, resulting in a saving of 1,30,000 KwH/year.

Measure—10

Intermittant running of pumps at Talcum slurry servicing tank of stock preparation No. 1 instead of continuous running as previously. This has resulted in annual saving of 63,400 Units.

Measure—11

A Black Liquor Fired Boiler of 300 TPD Solids capacity installed to improve co-generation of electricity and to reduce overall electricity consumption of existing I.P. Boilers. Now instead of running 2 Nos. of smaller LP Boilers of 16 kg/cm² (g), one No. of higher capacity higher pressure (36 kg/cm² g) is running following savings are achieved.

- Extra steam generation at 36 kg/cm²g to the tune of 1264.8 T. in 1982 due to increased efficiency.
- Reduction in fuel oil consumption by 340m³ in 1989 with reference to previous years.
- Reduction in electric power consumption by 10.8 lakh units in 1989 with reference to previous years.
- Increase in Chemical Recovery by 2.1% with reference to 1987.
- Reduction in manpower (19 Nos) due to more automation in the boiler equivalent to Rs. 4.2 lakh per year.

The net gain due to this scheme is approx. Rs. 72.97 lakhs in 1989 alone.

Measure—12

Stopping of fresh water booster pump during wrapper run of PM 1. During wrapper run Old Bleaching is kept shut, but above pump used to run earlier for Thickner in screening plant. Now it is not run, thus an estimated saving of 4,700 Units/year.

Measure—13

Running arrangement of Cooling water pumps for CF Boiler No. III and IV is rearranged. Now only one no. of 4.5 kw capacity pumps runs against two nos. of 4.5 kw and 3.5 kw pumps earlier. Saving is 22.850 Unitrs/year.

Messure—14

Installation of 5.4 MW Turboset for co-generation of Electricity. Trial run started in December 1988. An annual saving of Rs 27.65 lakhs was envisaged on an investment of Rs. 647.15 lakhs. The scheme is very successful. Dependance on State Electricity Board is very much reduced and quality of power supply is very much improved in terms of voltage dips and low voltage etc. There had been a saving of Rs. 122.51

lakh in 1989 due to differential cost of self generation and State Elect icity Board power.

With this scheme, the dependance on petroleum fuel (Diesel) is greatly reduce as running of DG set is now in emergency only.

Measures –15

By re-arranging the pumping scheme of reclaimed water in Water Reclamation plant it could be possible to save electricity at an estimated rate of 26000 Units/year. This was done simply by providing an inter-connection between new water reservior and old water reservior. Besides, loss of water due to overflow is also marginally reduced.

Measures—16

By installing Electronic Soft starter-cum-energy saver at Rechipper of Chipper House, one of the Compressor at Paper Machine No. III and Air Knife Blower of Coating Plant electrical energy saving of 81 000 KwH/year is achieved. Besides energy saving, the starting has become jerk free.

Measure—17

By doing a mechanical modification at Bleach Filter No. 3 of old Pulp Mill, the entire power of bottom screw conveyor motor is saved. This amounts to 28,000 Units/year. The scheme is successful utilising the gravitation fall of pulp from top Screw Conveyor to Hypo Tower No. 3 via a newly provided square chute.

Measure—18

By converting existing 40 Watt Tube lights to 36 Watt continuously at an average rate of 500 tubes/month, there is a recurring saving of 10% on electrical energy. This amounts to 56,000 Units/year.

Measure—19

By providing thermal insulation to 2 Nos. of White Liquor tanks in Digester House the heat losses from the tank surface are reduced which are equivalent to 172 T. of Coal per annum.

Miscellaneous :

Besides, electronic ballasts are introduced for flouroscent T/L and a number of electrical interlocks are introduced to reduce idle run of equipments.

Conclusion :

This is just the beginning of an endless journey towards efficient use of all forms of energy. Encouraging policies of Government agencies, Industrial Development Bank's incentives and endless efforts of all concerned are bound to yield better results for all of us.

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