Energy conservation in the paper machine section using computer control

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SUMMARY

Application of electronics in our pulp and paper mills is getting more attention exclusively from the point of view of conserving raw material and energy. The interacting nature of basic parameters of paper with the relative process control is discussed with data from Indian and American Paper Mills.

Continuing energy shortages and higher prices have special significance to Paper Industry. The major areas of energy consumption in Paper Industry is shown in figure 1. The net purchased energy (after accounting for recovery boilers) will be of the order of 45 to 50 percent. 32% of the total heat energy is required for drying range has potential not just from the energy point of view alone but also optimisation from productivity angle. So, control of these basic paramaters have many benefits because of their mutually influencing nature of the process.

There are five areas in Paper making on which significant savings of energy is possible. They are:

* Moisture Increase
* Basis Weight Decrease
* Broke and Rejects Decrease
* Energy Monitor and Management Information System

Moisture Increase

Though it is a well know fact that increased moisture on reel will demand less drying energy, the challenge before a process control system is how closely it can supervise the moisture target set by the Process Manager. By this way two mutually related methods by which energy saving is achieved by a supervisory control package.

1. Less water is to be evaporated
2. Less pulp is to be put through

If consistent moisture improvement 1.75% is achieved (from 5% to 6.75%) in a 20000 TPY fine paper mill without loss of quality, 922 TPY of less water is to be evaporated. Evaporation of water from paper is not a linear function as more heat will be required as the set moisture target is approached (Fig. 2).The average steam demand per ton of paper is 3 tons. 922 TPY of bonded water will require 2766 Tons of steam for evaporation. So energy loss on this account will be Rs. 2.77 Lakhs.

Moisture increase of 1.75% on fine paper is based on a few surveys and data collected. However, in our mills moisture

FIGURE—1

PRIME ENERGY USERS IN INTEGRATED PULP AND PAPER MILLS

Process	Average % of Total Energy
Pulping	34%
Recovery (Boiler, Evaporater, Lime Kiln)	22%
Drying	32%

*JNM Systems & Services Pvt. Ltd., Poona.

FIGURE—2

ENERGY SAVED BY INCREASING SHEET MOISTURE TARGET

$$\frac{20{,}000 \times 0.95}{0.38} = 50{,}000 \text{ TPY fibre and water into dryers}$$

20,000 TPY fibre and water leaving dryers

30,000 TPY water evaporation in dryers at 5% reel moisture.

$$\frac{20{,}000 \times 0.9325}{0.38} = 49{,}078 \text{ TPY}$$

20,000 TPY

29,078 TPY of water evaporated in dryers at 6.75% reel moisture.

where 0.95 fractional dry weight at 5% moisture
0.935 fractional dry weight at 6.75% moisture

0.38 fractional dry weight entering dryers

So, 922 TPY of less water evaporated at 6.75% reel moisture

analysis is carried out once a shift which will not give any guideline for proper assessment From this angle, the real picture of moisture variation in Machine Direction and Cross Direction is expected to have standard denation (2 Sigma) of the order of 2.5% to 3.0% (total spread) while the present spread on a statistical population of less than 50 is 1 70% around the average moisture value of 5.0%. This analysis combined with 15 years of experience in the data collected on manually controlled fine paper moisture overseas establishes the moisture spread described above. Two computer supervisory control packages are adopted to achieve stable moisture improvement:—

1. Moisture Target Shift due to Tight Control and Spread Reduction.
2. Target Adaptive Control.

Hundreds of Measurex Computer Control and truly accurate Basis Weight and Moisture Sensors have reduced the moisture spread from 60 to 70%. So on a moisture spread of 1.70%, and a spread reduction of 50%, will allow a target shift of 0.75% from 5.0%. The range of moisture values collected range from 7.0 to 4.5% reveals that the acceptable paper with 7.0% moisture is a good possibility. Target Adaptive Control package does this job without allowing the maximum permissible moisture target of 7.0% never exceeded.

On a conservative approach to the above moisture control, the following projections result:

(1) Steam Energy savings on 1.75% oveall moisture improvement = Rs. 2.77 lacs.

(2) Raw material saving proportional to 1.75% moisture increase = Rs. 12.25 lacs.

(3) Energy saving to produce less pulp equivalent to moisture increase of 1.75% = Rs. 1.22 lacs.

Basic Data used for the above calculations are:

Annual Production–20000 T Fine Paper

Steam consumption to dry one ton of paper —3 Tons

Steam Consumption to produce one ton of pulp —3.5 Tons

Steam Cost per Ton of Paper —Rs. 350/-

Steam cost —Rs. 100/- per Ton

Also amazing economic results are possible on dryer limited paper machines where control package on Dryer Limit—Machine Speed optimisation programme will help productivity improvement from 3 to 6% for every 1% increase in Moisture level. This aspact has been proved in many paper Machines especially multilayer board machines.

Also the energy savings achieved by Measurex System on Chinese paper machines(People's Republic of China) just on Moisture improvement is Rmb 81900 (Rs. 3.9 lacs) (1984 results).

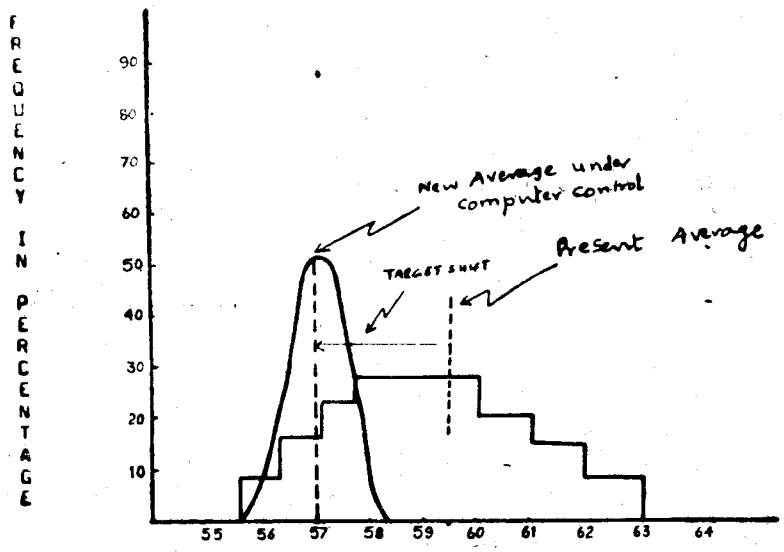
Basis Weight Decrease

A machine direction basis weight spread is reduced by 60% (conserative projection). A typical frequency distribution of Basis Weight of cream wove (60 gsm) is shown in Fig. 3. The present total spread of 4.49 gsm on computer control reduces to 1.572 (60% reduction) and this in turn enables a target shift by 1.62%. On a 20000 TPY machine, this reduction yields 324 Tons of Pulp Just energy savings on this account will be Rs. 1.13 lacs leave alone the raw material savings of Rs. 11.34 lacs. (Furnish cost is assumed to be Rs. 3500/-per Ton).

BROKE AND REJECTS DECREASE :

Other areas of energy loss are recycline of broke, rejects due to Basis Weight/Moisture out of specification, start up losses, and at finishing stage. For the basic machine parameters described earlier, the savings due

FIGURE—3



TYPICAL FREQUENCY DISTRIBUTION OF BASIS WEIGHT IN A FINE PAPER MILL BASED ON ACTUAL DATA

to contribution factor (total cost less furnish cost) will yield an economics of Rs. 3.5 lacs on a computer control.

ENERGY MONITORING AND REPORTING :

Most of the integrated paper mills have intiated energy audit on various sections of the mill. This programme will have much more meaning if a proper MIS data is made available on the various energy flows. Online displays of production ratios like Energy/Ton of pulping, Energp/Ton of paper drying will guide the Process Engineer to set norms for productivity. Also such ratios act as diagnostic tools to plug the energy waste well in time.

OTHER AREAS OF PROCESS CONTROL :

Ash measurement and control has once again the same effect as BW reduction described earlier. Co-ordinated speed and grade change programmes contribute largely to productivity improvement.

CONCLUSION :

A simple Machine Direction Basis Weight and Moisture Control provides the key to not only conserving scarce fibre but also heat energy. We have not discussed another area of cross direction Moisture Control from the energy conservation point of view. The payback on 100 TPD plant using just MD Control is expected to be 12 to 18 months.