Some aspects of energy conservation : A case study

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ABSTRACT

Paper Mills, unlike other energy intensive Industries consume large amount of energy in the form of power as well as steam. Increasing cost of energy and inputs has forced the Industry to adopt measures for conservation of energy and reduce specific energy consumption levels. In this paper, an attempt is made to describe various measures adopted for energy conservation in M/s. Star Paper Mills Ltd , Saharanpur. With the help of technology upgradation, replacement of old design equipment with the new energy efficient design equipment and the waste heat recovery systems.

INTRODUCTION :

The steep rise in the cost of energy in recent years has made it imperative for industries to look for the measures to reduce their energy needs. In the case of new plant designs, this aspect is well considered and technologies have come out with more energy efficient process, while most of the existing plants and processes are built without serious consideration to energy concepts. For such situations, it has become necessary to review the processing steps and consider the new energy recovery concepts.

Paper industries, unlike other energy intensive industries, consume large amount of energy in the form of Power as well as Fuels. During the past decade the cost of energy inputs increased sharply. Figure –1 is a typical plot narrating the variation of price hike of coal, furnace oil, diesel oil and electrical power as a function of year. It revels that the cost of power, coal, furnace oil, and Diesel oil increased to 3 36, 3.14, 2.54 and 2 06 times respectively in the year 1988-89 from the year 1979-80.

The fuel and power component in a paper industry is as high as 25% of the total cost of production and any further rise in the cost of fuel and power may even upset the financial viability of this vital Paper Industry. The high figures are due to a variety

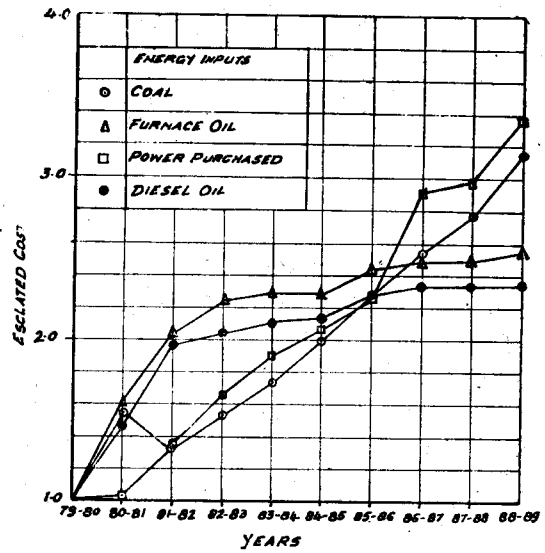

FIG.1 - VARIATION OF PRICE HIKE OF COAL, FURNACE OIL, DIESEL OIL AND ELECTRICAL POWER AS FUNCTION OF THE YEAR.

of reasons including type of raw materials, obsolete technology/equipment, poor house-keeping, improper insulation on hot surfaces, faulty operation of heat transfer equipments, steam leaks, poor monitoring and controls, improper handling of condensate, blow downs and mal-functioning of steam traps etc. Thus any energy management programme will help in identifying strategies to improve plant performance.

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Paper Industry is an energy intensive industry. The major energy consuming plants are chippers, Digesters, Refiners/beaters, Paper Machines and Evaporator plant. This paper highlights some of the short and long-term programme of energy conservation, which have been implemented and also on going in the mills to reduce the specific energy consumption level. Following paragraphs describe the section-wise energy conservation programmes.

A. PULP MILL

1. Chipper House :

(a) Previously, 100 HP motor was installed with a hydraulic drive for wood feeding conveyor to Norman chipper. A decision was taken to shorten the length of the conveyor by 40 M, keeping the feed rate constant. Simultaneously, it was decided to replace the existing hydraulic drive with an Electro-Mechanical drive. Accordingly, an Electro-Mechanical drive was installed with 50 HP motor. So a net saving of 50 HP installed power was a tained alongwith the saving in hydraulic oil and the elimination of costly imported spares. The mill is not facing any problem with this new arrangement.

(b) Earlier, the Norman Chipper, which is driven by 900 HP motor, was running for two shifts to chip the desired quantity of wood. Now the running hours of the chipper are reduced to 10 hours per day by improving the feed rate and reducing the idle running of the chipper. Thus the power saving is attained.

2. Digester House :

A decision was taken to stop the fibrilisers and Johnson's Vibrating Screens to be installed before Washers. The knots received from the Vibrator to be cooked again with the fresh chips. Accordingly, four numbers of Johnson's Vibrating Screens were placed before washers with 5 HP motor each and recooking of knots was done. A net saving of 130 HP installed power was attained alongwith improved quality of pulp, since the shives quantity was reduced considerably in the pulp.

3. Brown Stock Washers :

In Eimco Washing street, two numbers of 100 HP, old design vacuum pumps were replaced by one number of 150 HP rating energy efficient vacuum pump, thereby attaining a net saving of 50 HP installed power.

4. Screens :

The mill has installed a high consistency Pressure Screen imported from M/s S W. Hooper & Co., Canada which can be operated at 3% consistency to replace the existing conventional low consistency operating at 1.0—1.5%. The screens have recently been commisioned and the results are under observation.

5. Bleaching Plant :

The mill is switching over from low consistency bleaching to medium consistency bleaching. The mill has recently installed and commissioned a new bleaching Plant of 80 TPD capacity with CEH bleaching sequence, the bleaching is being done at 12% consistency instead of 3.5% consistency. The results are under observation.

B STOCK PREPARATION & PAPER MACHINES :

1. Stock Preparation :

(a) Previously, seven numbers beaters were installed with 560 HP installed power, In place of these beaters, one No. Sprout Waldron Disc Refiner with 300 HP motor was installed alongwith two numbers mixing chests. So a net saving of 50 HP installed power was attained alongwith uniform refining, higher throughput and improved °SR which resulted in higher production and better quality of paper.

(b) In Stock Preparation of Paper Machine Nos. 2, 3 and 4; the rearrangement of refiners alongwith an addition of One No. Sprout Waldron Refiner was done to eliminate some of the energy inefficient Conical Refiners. This has facilitated the mill to attain the higher throughput, higher °SR and lesser specific power consumption.

2. Paper Machine No. 1 :

On Paper Machine No. 1, there were bush bearings in the dryers, which were giving frequent trouble in terms of wear & tear, and higher power consumption. The bush bearings have been replaced with roller bearings, resulting in power saving and less down-time.

3. Paper Machine No 2 :

On Paper Machine No. 2, in post dryer section, Hood & Pocket Ventilation system has been ins alled to improve the evaporation rate and reduce the ste.m consumption in post dryer group. The system is recently commissioned and the performance is under observation.

4. Paper Machine No. 3 :

Paper Machine No. 3 was driven by Motor Generating set. The Management had taken a decision to change its drive from M.G. set to Thyristor control drive. The same has been commissioned and a net 20 KWH power saving is attained alongwith better speed control of the machine.

C. SODA RECOVERY :

1. Multiple Effect Evaporator system :

(a) In the multiple effect evaporator system, we have a forced circulation Finisher effect in series. The flash vapours from the Finisher effect was vented to atmosphere earlier. Now this venting has been closed and some of the vapours are utilised to preheat the black liqur through an intermediate heater. The steam saving of about 24 TPD has been achieved.

(b) Condensate flash steam from 1st effect of multiple effect evaporator and finisher effect callendria was earlier vented to atmosphere. Now we are utilising this flash steam to heat boiler feed water. Steam consumption in Deaerator has thus been reduced to about 6 TPD.

(c) By installing a desuperheater in L.P. Steam line of multiple effect evaporator, we have reduced the L.P steam consumption by about 5 TPD. Also the scaling problem in tubes have been reduced.

(d) We are having a five effects multiple effect evaporator system. All the effects were having 50 mm O D. C S. tubes. The first two effects needed cleaning at intervals of 8/10 days. Thus when one effect is isolated for cleaning, the system runs as four effects. We have now inst lled S.S. Tubes in I & II effects The frequency of tube cleaning is once in 15/20 days. The steam saving has been achieved as steam economy in four effects is 3 0 whereas with five effects it is 3.7.

(e) Earlier the evaporation system had one Surface Condenser of 378.5 m^2 surface area. With that in circuit and with the Barometric Condenser, we were able to meet the requirement of evaporation of 14/15 digesters black liquor. But due to inadequate surface area, we were not able to process black liquor of more than 14 digesters. In addition when only four effects in multiple effect evaporator were in operation for four days in a month, the water evaporation further went down, consuming more steam at the same time due to less vaccum, To improve vaccum, we had to open water in Barometric Condensor. It was decided to instal a new large surface condenser instead of smaller one. A new surface condenser of 430 M^2 surface area has been installed and commissioned in place of old surface condenser. The vaccum in last effect improves upto 620/630 mm of Hg. Earlier the available temperature drop was about 73°C due to less vaccum ; whereas with the new surface condenser, it is 80°C. The saving in the steam consumption is 4 2 TPD. There is additional saving of water which was used in Barometric Condenser. This saving is 196 M^2/day of water.

2. Cifood's Recovery Boiler :

Previously, we were facing the problem of unstable furnace conditions while running the Cifood's Recovery Boiler. It was mainly due to low feed water temperature and sudden load fluctuation. The feed water, which was entering the boiler after deaerator was at 105°C, which was fairly low This was the reason for unstable furnace conditions. It was decided to instal a suitable economiser in the flue gas circuit to increase the feed water temperature.

In the month of Sept. '89, a vertical tube economiser has been installed, and commissioned in the flue gas circuit. Table-1 shows the steam generation befo e and after the economiser installation in Cifood's Boiler.

TABLE—1

Steam generation before and after the Economiser installation in Cifood's Recovery Boiler.

Month & year	Steam generated by solids, Tons	Black liquor solids fired Tons	Steam/Tonne of Black liquor solids	Average steam per tonne of Black liq. solids.
March'89	3519	1364	2.58)	
April'98	4437	1775	2.50)	2.526 Tons
May'89	4108	1600	2.56)	steam per
June'89	4490	1807	2.48)	ton of Black
July'89	4895	1911	2.56)	liquor solids
Aug.'89	3579	1443	2.48)	
Oct.'89	3343	1300	2.571)	2.633 Tons steam
Nov.'89	2288	870	2.630)	per ton of Black
Dec.'89	4725	1750	2.700)	liquor solids.

From the Table-1 it is evident that the installation of economiser in Cifoods' Recovery Boiler is justified since the 0.107 Tons extra eteam per ton of Black liquor solids fired is effective.

D. MISCELLANEOUS :

1. Coal Fired Boilers :

Submerged ash conveyor with a rating of 7.5 HP was installed in place of four numbers Ash extractors in WIL Boilers totalling 12 HP, so a net saving of 4.5 HP was attained besides the reduction in working strength and better working conditions.

2 Steam traps :

For better removal of condensate, ten numbers thermodynamic steam traps have been installed, so the efficiency of the steam distribution system has improved.

3. Vacuum Pumps :

A decision wastaken to replace the old worn-out and inefficient Vacuum pumps with latest design energy efficient Vacuum pumps. A new vacuum pump has been installed at Paper Machine No 2 while a new vacuum pump is being installed on Paper Machine No 1. The performance is under observation.

4. Rearrangement of Installed Electrical Motors :

The rearrangement of existing electrical motors connected with different equipment/machines in the plant is being done. Motors which are running on its peak load, are being replaced by higher H.P. Motors, while the motors which are underloaded, are being replaced with lower H.P. motors, so as to attain the maximum efficiency of the motors. It is also evident from motor efficiency curve (1) as shown in Figure 2. Also we know the no load current of the higher H P. Motor is also higher, as it is evident f om Figure No. 3. The no load current of 75 HP motor is 29 Amps. So if a motor of 75 HP is installed in place of 50 HP motor, an additional power consumption w'll be to the tune of Rs. 50,000/- per annum just on no load current. Besides this the motor efficiency will also be lower.

5. Installation of De-superheating station in the steam line to Paper Machine :

Previously, there was no desuperheating station in the steam line going to Paper Machine. The steam

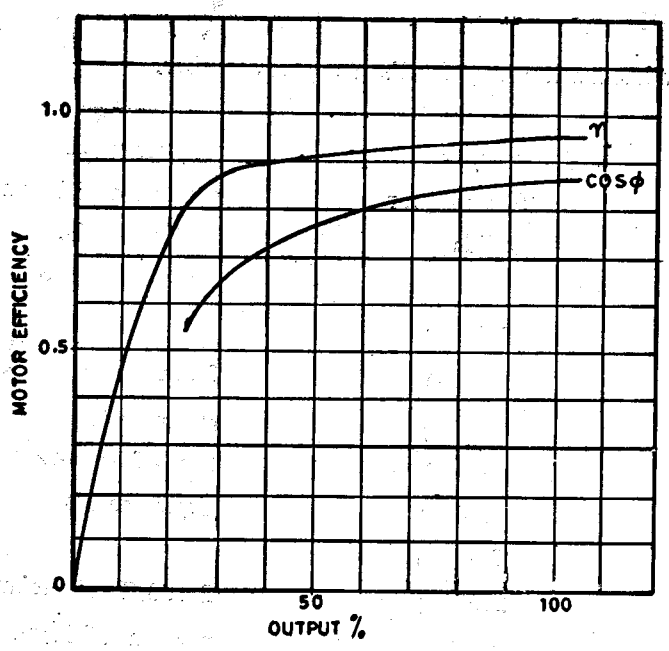

FIG. 2 MOTOR PERFORMANCE CURVE

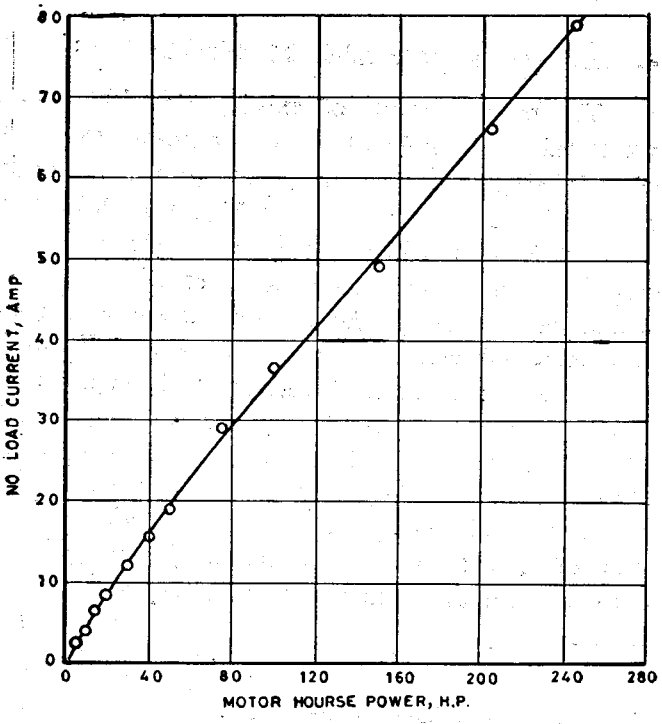

FIG. 3 NO LOAD CURRENT OF A C MOTORS

was directly taken from the first and second pass of the turbine. The steam used to be superheated and it was adversely affecting the drying rate and higher steam consumption. Now the desuperheating stations have been installed in 40 psig and 80 psig steam lines coming to Paper Machines. A saving of about 10 T of steam per day has already been achieved.

CONCLUSIONS :

Energy conservation is basically like saving, a lot of drops, to fill a tank. As explained above, we are trying to load the equipments to the capacity, so that the specific energy consumption is minimum. We are also trying to reduce the consumption of energy inputs, in terms of coal and power by stopping the steam leakages, proper insulation of hot surfaces, replacement of old inefficient equipments with the new efficient equipments and waste heat recovery system. The effect of the above measures is resulted in reduced consumption of energy inputs on per ton of paper as tabulated in Table-2.

TABLE—2

Cousumption of energy inputs on per ton of Finished Paper.

Energy inputs		Years 1985-86	1986-87	1987-88
Coal,	Ton	1·538	1.412	1.240
Power,	Kwh	1583	1462	1404

From the above Table-2, it is evident that the Coal and Power consumption per ton of paper has come down.

Besides the above, some of the energy conservation programmes are on going in the mills. These include the installation of FFFF Concentrator in multiple effect evaporator plant, installation of Double Disc Refiners to replaee Conical Refiners and conversion of existing chain grate type boiler to fluidized bed type boilers. Thus, if any energy conservation programme is adopted by the mill, the consumption of energy inputs will reduce to a lower level and the economy of the mill will improve.

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