Optimizing and Enhancing the Production Capacity of a Paper Machine based on Agricultural Residues

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ABSTRACT

Continuous increase in prices of various inputs without corresponding increase in the prices of final output viz. Paper makes it imperative for paper mills to device ways and means to optimize the operations of all its plants specially the paper machine. One of the best ways to combat ever increase in cost, to increase the production capacities at paper machine with continuous modernization and rebuilds at optimal costes so that overheads per unit of production are either lower or at best maintained despite increase in overheads in absolute terms. Shreyans Industries Ltd at their Ahmedgarh unit set up a paper machine with operating speed of 135 m/min. in 1982 which has been gradually rebuilt and modernized to present speed of 470 m/min. This paper deals with various steps undertaken over last 20 years by the mills to reach this capacity.

INTRODUCTION

Paper industry is a very competitive industry and in order to survive in the market, one has to be competitive both in terms of quality and cost. Input is increasing day by day whereas sales realization is either stagnate or not increasing in the same proportion. It is therefore imperative that number of operations is optimized on continuous basis to reduce the operational cost. At the same time continuous upgradation of paper machine is a must to improve the quality and production levels. In-house upgradation and machine rebuilds on continuous basis help industry in combating ever increase in competition and increase in cost of various inputs.
Various steps undertaken in this direction on paper machine should aim at to achieve either one or more of the following objectives.

a) Increasing production level at the machine.

b) Increasing/optimizing operational efficiencies.

c) Improving the quality of end product.

d) Saving in energy cost both thermal and electrical.

e) Minimizing the down time.

f) Introducing the ease of operations for the Operators.

In Shreyans industries Limited (Ahmedgarh unit) we undertook number of steps to run the paper machine in most effective and economical way. This unit was set up in May 1982 with a capacity of 30 MTs per day corresponding to 10,000 MTs per annum. At present, this unit is producing around 30,000 MTs per annum. The speed of paper machine has been increased from 130 m/min. to present level of 470 m/min. It is further planned to increase the speed to 500 m/min. by March 2003. In this unit a number of steps in different phases were undertaken to achieve these objectives which are detailed below

EXPERIMENTAL

Phase-I

Initially this paper machine (Fig. 1) was equipped with three presses, viz. Suction Press, Solid Press and Reverse Press Operations of reverse press were very cumbersome and most of the time, the same was bypassed. Operating the same resulted in significant fall in operational efficiencies. In the first step, the reverse press was converted into a straight through inverse press. The dryness of paper was increased by 2% which resulted in significant saving in steam consumption and also increase in speed of the machine to the level of 190 m/min. from initial speed of 130 m/min. (Period 1985-86).

Phase-II

The dryer section of the machine (Fig. 2) was driven through a chain drive system running on sprockets. This

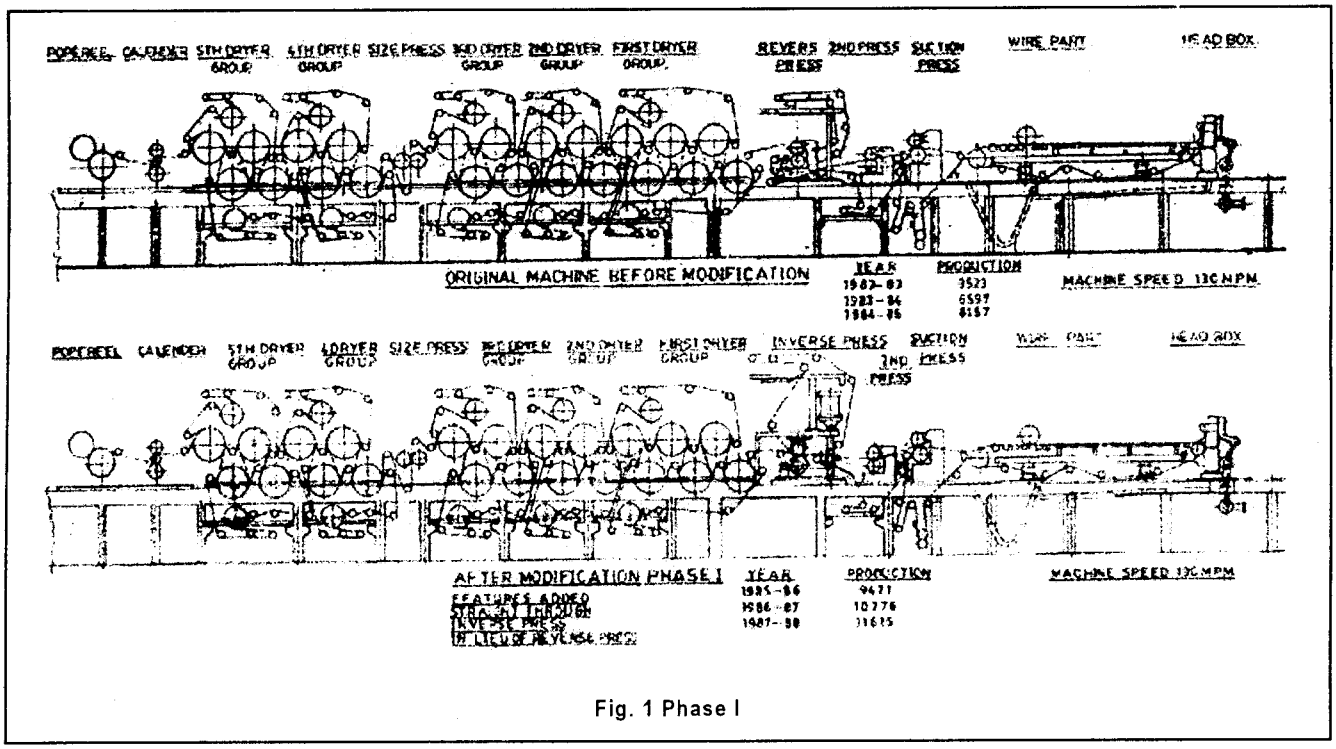

Fig. 1 Phase I

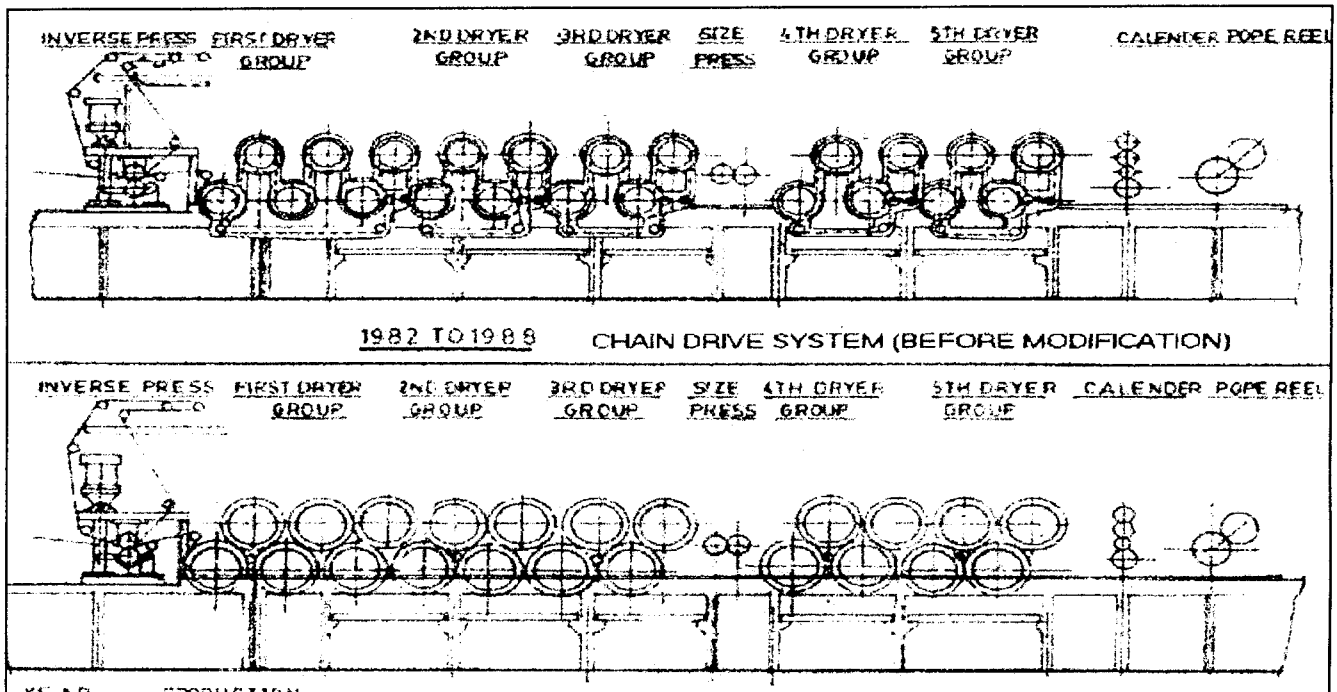

Fig. 2 Phase II Featurees addes spur Gear and Pinion Drive in liev of chain drive for dryer

resulted in continuous draw variation and alsc the life of chain was very limited and not more than two to three months. The down times because of breakdowns on drive parts and also for changing the chain were significant. The maintenance cost was also very high. The chain drive system was replaced by Standard Spur Gear and Pinion Drive system. This resulted in significant decrease in down time and maintenance cost in drive system and

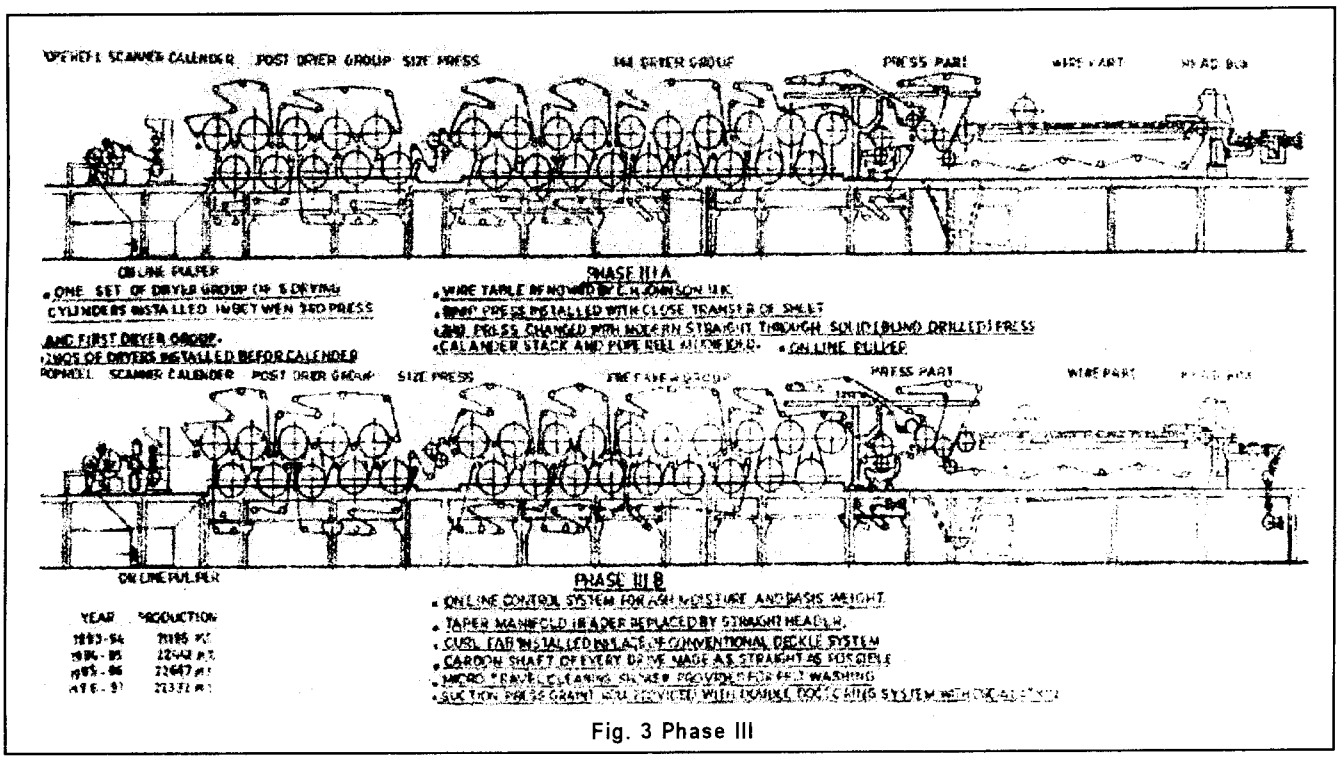

Fig. 3 Phase III

production was increased to a level to almost 15,000 MTs per annum corresponding to a speed of 225-250 m/min. (Year 1988-89).

Phase-III

A major built up was undertaken (Fig. 3) in the year 1991. Various steps taken up during this modernization were:

a) All drainage elements, viz. Table rolls on wire part were replaced by six sets of angle ceramic foils, two sets of low vacuum units and one set of duoflow hivac unit.

b) Open head box at paper machine was replaced by a pressurized head box.

c) Existing suction and solid press was replaced by a modern bi-nip press with close transfer of sheet from wire.

d) 3rd inverse press was replaced by a modern straight through solid (blind drill) press with press loading upto 120 kg/cm. load.

e) An additional dryer group consisting of five dryers was added to increase the drying capacity.

f) Existing calender stack bracket and pope reel were changed and two additional dryers were added before calender.

The entire exercise was done to increase the design speed to the level of 375 m/min. (operating speed at 325 m/min). The production capacity was increased to 20,000 MTs per annum.

Simultaneously, in 1993 machine direction auto control system (Fig. 4) supplied by Valmet, Canada was installed with online measurement and control of GSM, moisture and ash. This helped us in increasing the production to a level of 22, 500 MTs per annum with considerable economy in consumption of steam, fibre and also uniformity in quality in terms of lower variation in GSM, ash and mositure. In order to enhance the production further and also to reduce the cost, following steps were taken over a period of time. These steps may not look very important but did contribute significantly towards stable of production levels.

1. The closed head box was commissioned by us at a taper manifold header and we found lot of flow variations across the width of the slice. To overcome this difficulity, the taper manifold header was replaced by a straight branch type header resulting in much smoother flow across the width.

2. To minimize the breaks from the edges fab (fab curl) was installed in place of conventional deckle system resulting in improvement in flow at edges resulting in less number of breaks from the edges and also saving in fresh water consumption.

3. We experienced number of breaks at wet end due to draw variation with symptoms of nail scratching. We felt that this may be due to speed variation occurring because of drive cardon shaft being at angle to

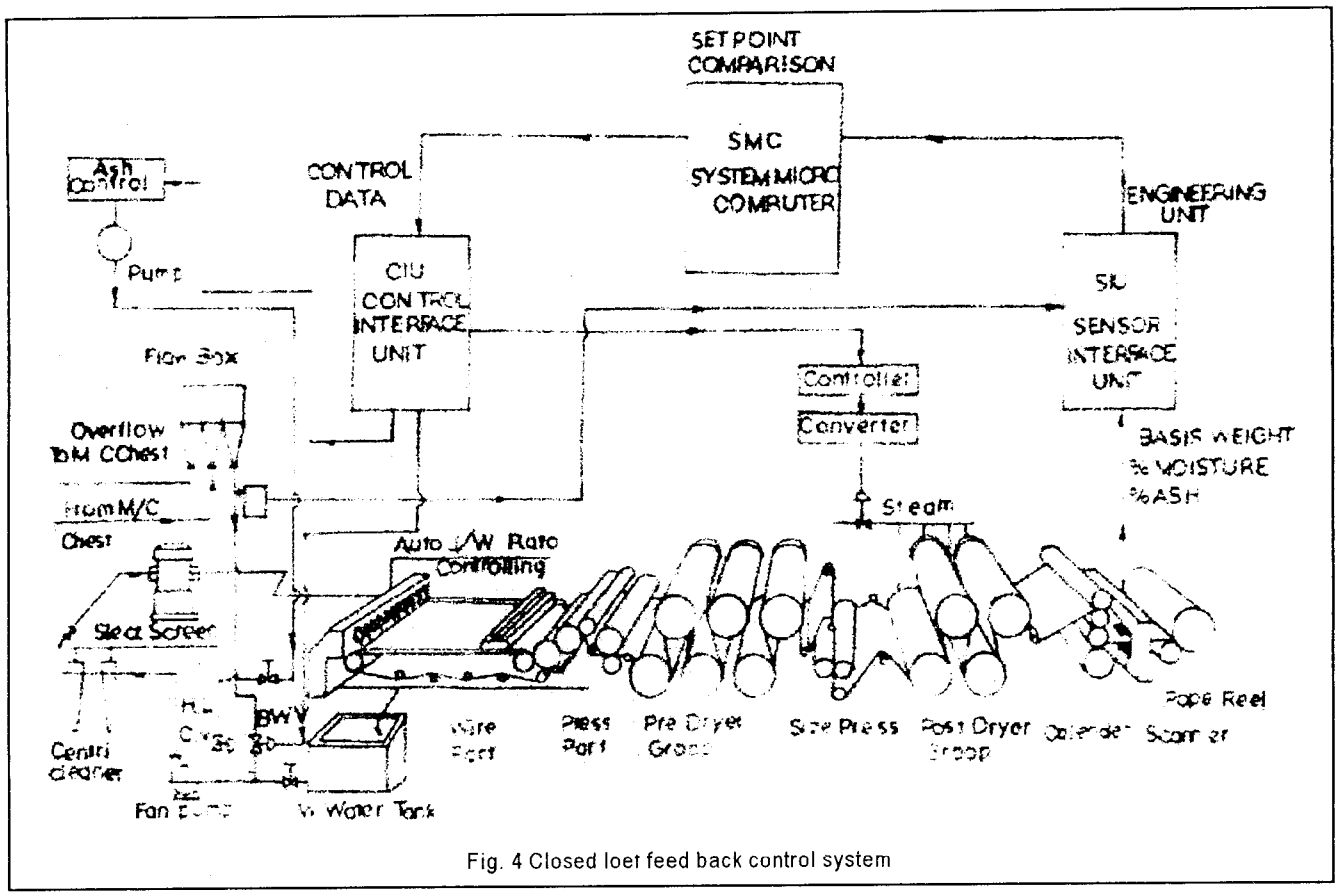

Fig. 4 Closed loet feed back control system

various press rolls. Hence we adjusted the levesl of various drive motors so that the centre of cardon shaft was in line with the centre of driven rolls thus making the cardon shaft as straight as possible. We experienced significant reduction in number of breaks and the machine speed was gradually increased to 400 m/min.

4. All paper machine clothings including fabric and press felts were provided with micro travel cleaning showers with a fresh water pressure at 25 kg/cm square at wire and 10 kg/cm square at press. Also continuous chemical cleaning was done at press felt. All the steps resulted in better machine runnability.

5. Pick up press granite roll was provided with double doctoring system with oscillation. Again this resulted in continuous cleaning of granite roll surface thereby improving machine efficiency. Chemical dosing was started in V-box of suction pick up roll in order to continuously clean shell holes thus increasing time interval between two drillings and also better runnability in the meanwhile.

All these steps helped us to increase the saleable production from 22,500 TPA to 26,000 TPA.

Phase-IV

As mentioned earlier, the complete machine rebuild (Fig. 5) was done for a design speed of 375 m/min. and once we went beyond a speed of 400 m/min., the flow on the wire became unstable because of inadequate hydraulic capacity of head box. In year 1999 we installed an octopus unit ahead of head box to dampen the pulsation and to increase the hydraulic capacity. Subsequent to the above speed, the complete approach flow system was remodeled to overcome the problem of slime formation because of lower velocity of stuff and also number of bends in the pipeline caused hindrance in flow. Machine pressure screens which were installed earlier at ground floor level were shifted to machine floor level itself thus resulted in reduction in pipeline length and number of bends.

The full system cleaning also became easier because of reduction in length and also availability of overhead crane at machine floor level. Simultaneously, with a view to optimize the drying capacity each dryer was equipped with air vent, efficient steam trap and condensate removal system. All these steps have resulted in achieving the present speed level of 470 m/min. and we expect to end current financial year with saleable

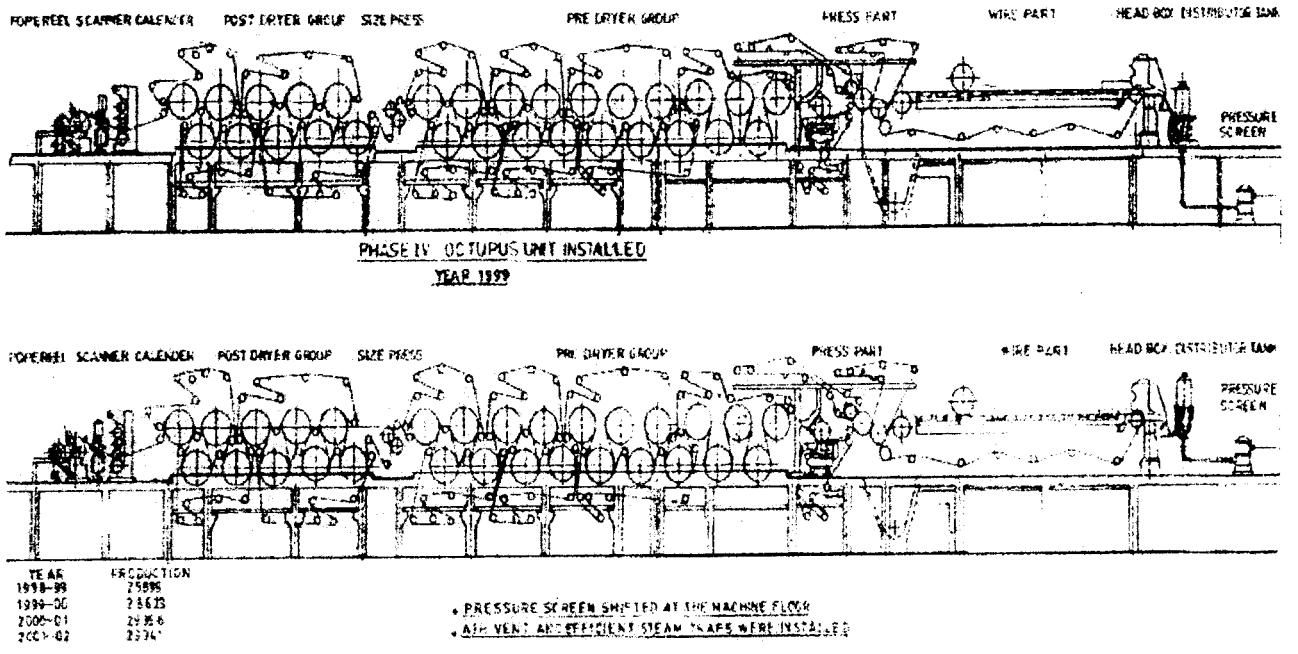

Fig. 5 Phase IV

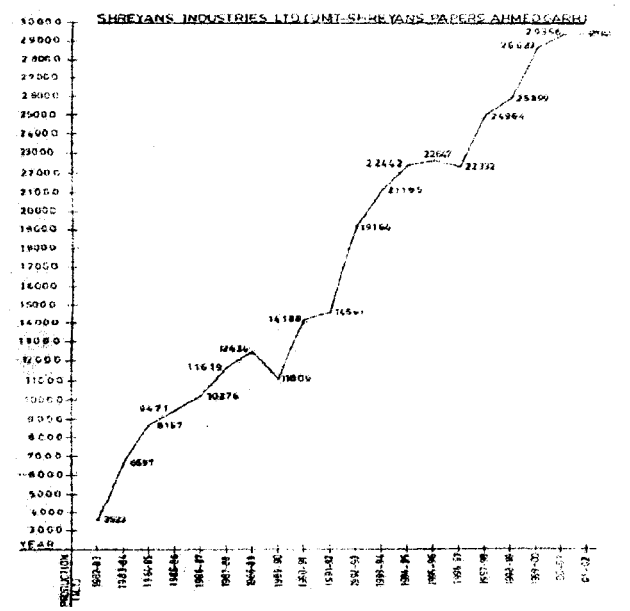

Fig. 6 Increase in production (MT)

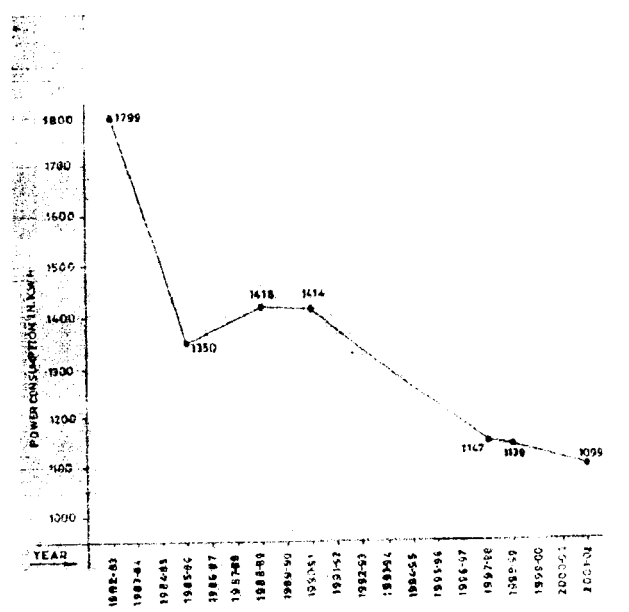

Fig. 7 Power Consumption per tonne of Paper from 1982 to 2002

production of 31,000 MTs (Fig. 6).

Energy Conservation

Besides the above steps which were undertaken from time to time to increase the speed of the machine, following steps have been undertaken to save on energy consumption (Fig. 7 and 8) on the machine.

1. We had done number of times water management (Fig. 9) on wire/fabric table and found that above machine speed of 350 m/min. There is hardly increase in sheet dryness (not more than 1%) at the couch roll. In the year 1997, we removed the suction couch and

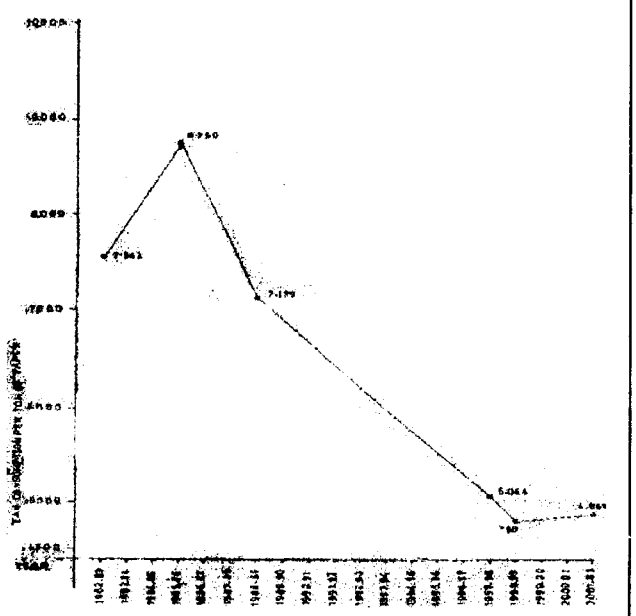

Fig. 8 Steam Consumption per tonne of Paper from 1982 to 2002

instead put the solid one thereby saving the power employed for its vacuum pump of capacity 125 cubic meter per hour (200 KW).

2. For felt conditioning, we had one header and all the vacuum tubes of each press section were connected with this header. We experienced whenever any of the felt is changed by a new one, the vacuum intensity is reduced in the other vacuum tubes also which are running with old felts resulting in crushing problem and this eventually compensated by employing additional vacuum pump. To get rid of this problem each vacuum tube of press section was connected with separate pump of required capacity taking load factor of 10 CFM/square inch of vacuum tube slot. By employing single independent pump for each tube, we could shut vacuum pump of 50 cubic meter/hour (75 KW).
3. We have installed air vent on each and every dryer can in addition to the steam traps and nonreturn valves. By doing this, we could speed up the machine as the steam consumption has gradually come down to around 2.6 tonne per tonne of paper from 3.0 tonne per tonne of paper.

Future Plans

As stated earlier, we plan to increase the machine speed to 500 m/min. from existing speed of 470 m/min. to achieve annual saleable production level of 34,000 MTs. To achieve these levels, we are in process of :

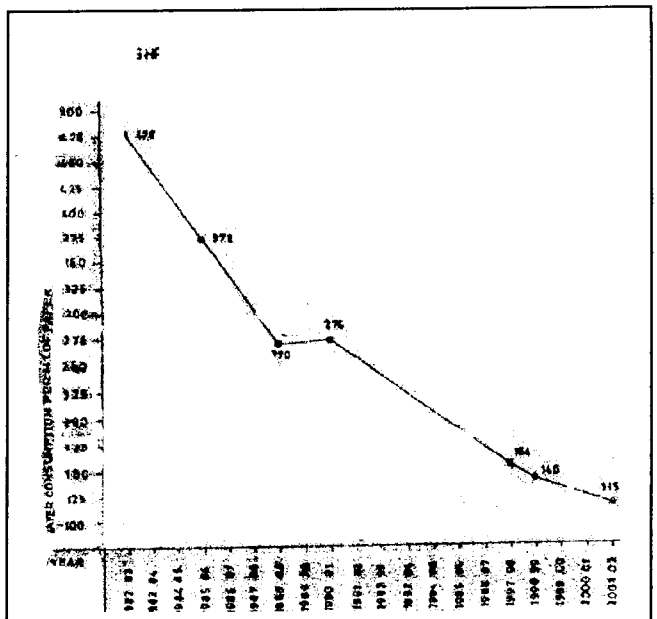

Fig. 9 Water Consumption per M.T. of Paper

1. Installing one more duo suction box at wire part to take care of hydraulic load on the forming table.
2. Existing dryer section, calender and pope reel are being run through a line shaft system which is being replaced by digital sectional drive which is likely to be commissioned by March 2003.
3. The dryer section is being overhauled where turn by turn each dryer will be mechanically balanced to run at a speed of 500 m/min. and above. The section dryer group which is on an uni-run system will be separated by installing two separate dryer screens at top and bottom to increase the drying capacity.

CONCLUSION

In order to survive in competitive market, it is imperative that paper machines are upgraded on continuous basis by incorporating improvements which may seem small but can contribute in big way towards increase in production and productivity. This process is to be on-going one and there is no end to such improvements in a running and vibrant organisation.

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