Modifications in Paper Machine for Improved Efficiency in an Agro-based Paper Mill

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ABSTRACT

Operational profitability in any paper mill depends on the paper machine efficiency and productivity which in turn is controlled by a very significant factor that is machine uptime. Therefore, it becomes necessary to identify the factors that limit the machine runnability and accordingly incorporate modifications to maximize the efficiency of the paper machine. The present paper summarizes a case study describing a series of small modifications incorporated in a paper machine based on agro fibres. Benefits derived out of various modifications in terms of financial gains, quality improvement, resourse i.e. water and energy conservation have also been explained. Efforts towards other improvements and product development have also been included.

INTRODUCTION

In view of competitive paper market, the success of a paper mill is determined not only on the basis of quality and quantity of paper produced but at the same time on the productivity as well. Therefore, aim of modernization has been extended from improvement in quality to output of the paper making process. In this regard, efficiency of paper machine plays a very vital role in achieving the profitability in paper making process since the paper machine performs the most important function of converting the pulp to paper by performing water removal by a series of operations starting from drainage through suction followed by mechanical pressing and finally drying in steam cylinders. All these operations are controlled by a number of limiting factors which affect the efficiency and economics of each step. Since the agro fibres have comparatively low strength thereby affecting machine runnability and at the same time have caused low water drainage that consequently results in high energy consumption. Therefore, identification of limiting factors in paper machine process and subsequent application of inhouse innovations and modifications for removal of general and site -specific operating problems becomes extremely necessary to optimize the paper machine process for increased productivity without affecting the quality of finished paper.

EXPERIMENTAL

Modification of Paper Machine in ABC Paper

ABC Paper is an agro residue based paper mill using renewable agro waste such as wild grasses and straws for making high quality writing, printing and copier paper. ABC Paper has made a critical study to modify its paper machine to improve its efficiency in terms of quality and productivity.

Paper Machine Process in ABC Paper

Ready stock from the M/C chest is pumped to S.R. Box followed by transfer of required stock to fan pump through basis weight control valve. Fan pump takes white water from Silo for dilution of Stock and the diluted stock is fed into the centricleaners where cleaning of stock takes place due to centrifugal action. Accepted stock form the centricleaners goes to pressure screen for removal of over size particles and other impurities such as fibre bundles and the clean accepted stock is trnsferred to Headbox. The diluted fibre suspension is fed to the wire section where sheet is formed and water drainage takes place through wire with the help of drainage elements and the sheet moves forward with the aid of wire cloth and its drives. After Suction Couch Roll, sheet is picked up by Suction Pick Up Roll and transferred to press section where further dewatering takes place through press felts and press loads. Paper web from press section is fed to dryer section where drying takes place due to heat transfer with the help of steam. The steam condensate goes back to the boiler house. Dry sheet is fed into kuster calender where smoothness of paper improves and the caliper of the paper is controlled. From Calender, paper is fed to pope reel where the paper is wrapped over the parent roll. QCS Scanner has been installed between calender and Pope Reel, which sends feedback to QCS system and controls basis weight,

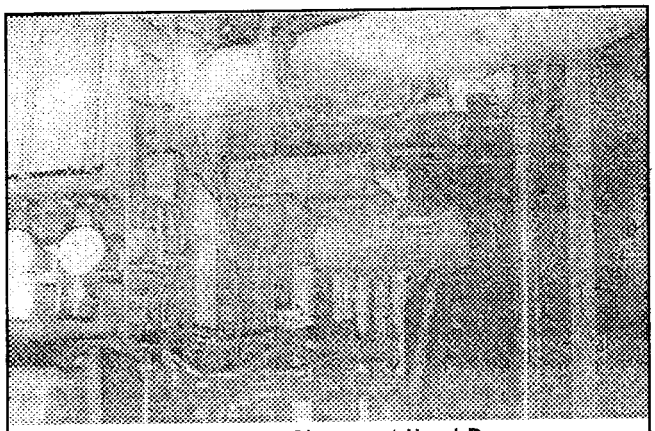

Fig. 1 Rotary Shower at Head Box

mosture and ash content in paper with the help of field instruments.

Modifications

ABC Paper has applied various modifications right from the head box to dryer part in paper machine. To list, few major ones are as follows

Head Box

Shower Modification

Originally Paper Machine had stationary shower, which has been replaced with more efficient rotary shower (Fig.1)..

Wire Section

Additional Roll in the wire Circuit

Wire circuit has been provided with an additional roll to improve the wrap on FDR (Fig. 2).

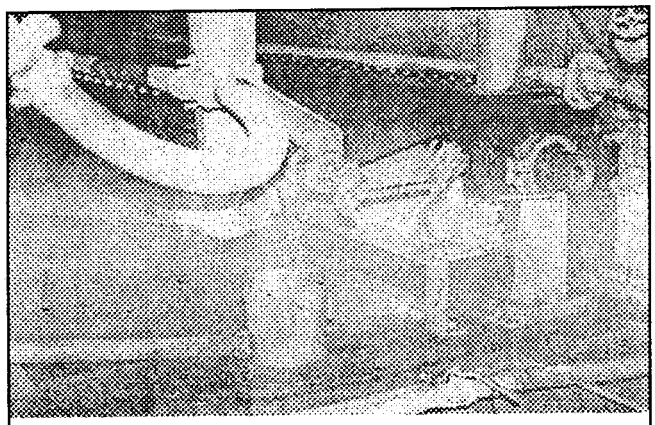

Fig. 2 Additional Roll in the Wire Circuit

Removal of Motor from Wire Return Roll

Earlier, the W.R. Roll was driven by a separate motor causing unequal tension leading to creasing of the fabric. To avoid this repeated phenomenon, this motor was removed.

Replacement of Dandy Roll

Dandy Roll plays an important roll in the formation of paper. Earlier in ABC Paper, the speed of the paper machine was restricted due to 700 mm dia of the dandy, which in turn has limited production capacity. To enhance the production capacity and also for clear water-marks, 700 mm dia dandy was replaced by dandy roll with 1200 mm dia.

Installation of Ceramic Tops

The HDPE tops in paper machine were replaced with ceramic tops (Fig. 3).

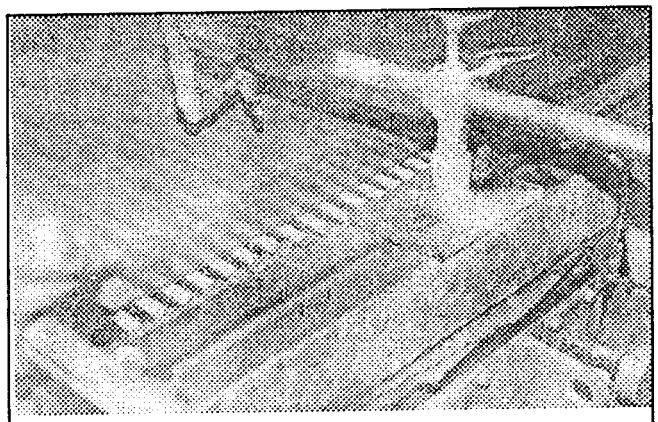

Fig. 3 Ceramic Tops in Paper Machine

Press Part

Shadow Marking

ABC Paper had a perennial problem of shadow marking in finished paper.

To remove the problem permanently following alterations have been done:

- Suction Pick-up roll has been modified to suction cum BDR to avoid the shadow marking and also better sheet dryness. After modification, suction pick-up roll hole dia is 2.8 mm with 23.4% open area with BDR hole dia of 1.8 mm with 19.34% blind drilled area in comparison to the previous suction pick up roll, hole dia of 3mm with 40% open area. The speed difference between Wire and Pick up roll was reduced

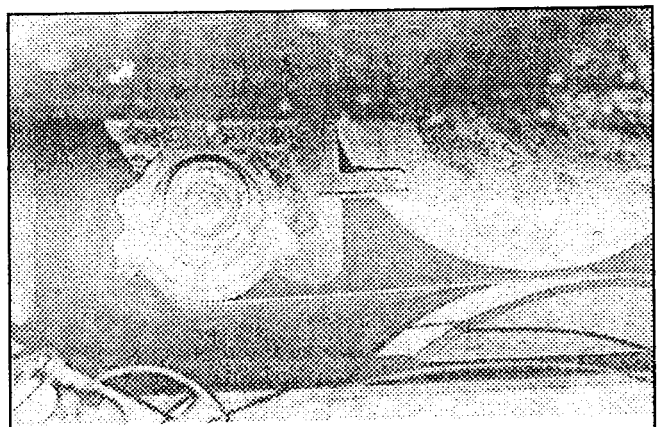

Fig. 4 Plain Rubber Covered Roll

which has resulted in the improvement in the pick-up felt life.

- The blind drill roll has been changed to the plain rubber covered roll at the 3rd press bottom location to avoid shadow marking completely (Fig. 4).

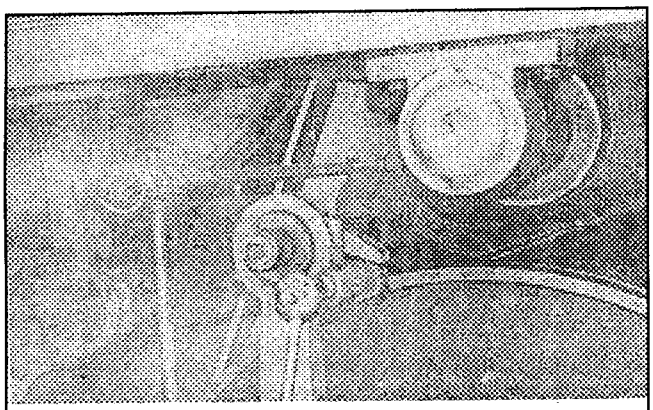

Fig. 5 Photo Cell and Hooter in Dryer part

Dryer Part

Replacement of SLDF Screen

SLDF screen has been replaced with woven screen for better sheet flatness and also to avoid screen marking.

Dryer Break Detector

A Photo Cell and Hooter/enunciator has been installed as dryer break detector to avoid paper - jamming in dryer (Fig. 5).

Static Current Remover

Static current remover has been installed by way of incorporating multiwire terminals on the dry paper in between calender and pope reel (Fig. 6).

Quality Control System

A spectacular development has been achieved by the successfully commissioning the Quality control System (QCS) controlling grammage (GSM), ash percentage and moisture (Fig. 7). This system has proved to be economically beneficial to the Company in various ways.

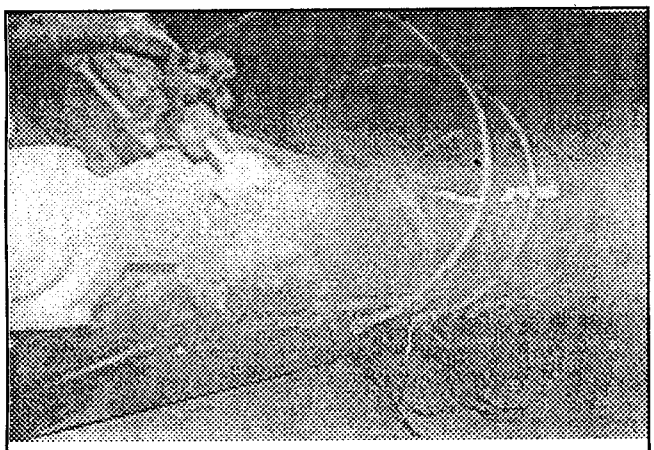

Fig. 6 Static Current Remover

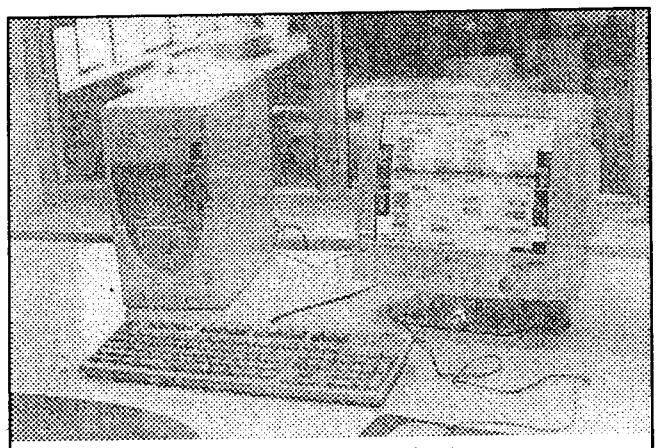

Fig. 7 Quality Control System

Wate Conservation

Mark Saveall

A RCC, tile lined, stationery mark Save-all System with a capacity of 400 m based on gravity settling technology has been installed to replace the Krofta super-cell (Fig. 8).

Wate Conservation Methodology

Knock Down Pump

Knock down pump is running only with startup and shut and in case of sheet breakages.

Recycling of Back Water

Complete recycling of paper machine back water either in paper machine itself or in bleach plant of pulp mill. Backwater recirculation plan has been shown in Fig 9.

Other Improvements

To keep the paper machine hall free from birds, a special bird repellant gel has been applied on all paper machine roof structure and hence the quality of paper has been improved such as free from holes with reduction in the unnecessary paper breakages.

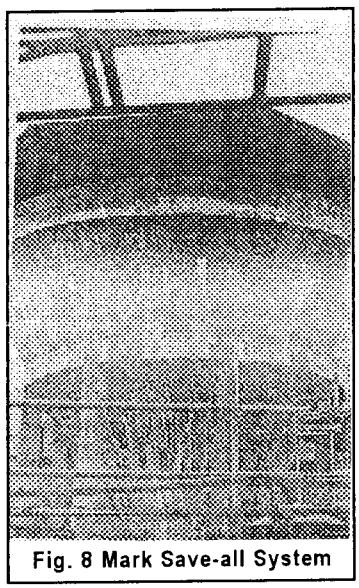

Fig. 8 Mark Save-all System

Product Development

Apart from the above modifications, continuous efforts have been made for product development. A high brightness paper based on agro based raw materials has been launched under the trade name "White Gold".

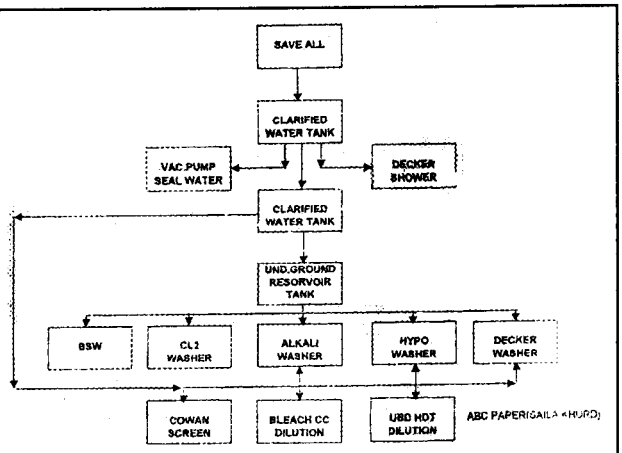

Fig. 9 Machine Back Water Recycling System

RESULTS AND DISCUSSION

Head Box

This Shower Modification in the head box has resulted in better foam killing and consequently reduced break due to foam lumps.

Wire Part

The incorporation of additional role has not only improved the wrap on the FDR but also avoided the wire slippage and consequent fabrik damage. The removal of motor from wire-return roll has eliminated the creasing problem. The replacement of dandy roll (700 mm dia) with a new dandy roll (1200 mm dia) has resulted in increase in speed to more than 350 m/min with 95 rpm of dandy roll from the previous 250 m/min with 115 rpm of dandy roll. Additionally, the water mark on the paper has become better and more prominent in comparison to the previous system.

The installation of ceramic top in place of HDPE tops has resulted in the following direct benefits:

- Reduction of drag load i.e forward drive roll from 260A to 200A D.C. and couch roll from 170A to 130A i.e reduction by 40 KW equivalent to a saving of Rs. 12 lacs p.a.
- Increased wire life from 4000 tonne/wire to 6000 tonne/wire with a saving of Rs. 10 lacs p.a. The last wire has operated from October 10, 2002 to January 6, 2003 and produced 6933 MT of paper.
- Increase in ash retention by over 1% resulting in a saving of Rs. 18 lacs p.a
- Increase in machine speed by 15 mtr/min due to reduction in moisture at couch with savings of Rs. 38 lacs p.a.
- Sheet dryness improved from 10.5% to 16% after suction box

In addition to above, the indirect benefits obtained out of this modification are improvement in quality by way of uniform formation and sheet flatness.

Press Part

Modifications in the Suction Pick-up roll i.e change to Suction cum BDR have resulted in removal of shadow marking and reduction in speed difference between the wire and Pick-up Roll with additional benefit of increased felt life.

Quality Control System

The incorporation of quality control system has resulted in tremendous improvement in terms of financial gain and quality as well, as follows:

- Consistency in grammage has resulted in the reduction in market complaints with a saving to the tune of Rs. 25 lacs p.a.
- Maintenance of constant ash level has benefited at the rate of Rs. 100b per tonne of paper i.e. Rs. 40 lacs p.a.
- Maintenance of constant moisture level at 4.5 ± 0.5% at the pope reel has resulted in better flatness, no cockling and no over drying of paper at the rate of 0.5% steady extra moisture maintenance has resulted in earning at the rate of Rs. 100 per tonne of paper i.e Rs. 40 lacs p.a.

Water Conservation

The improvement and benefits achieved by incorporating Mark Save-all System are as follows:

- Clarity of water from 200 ppm to 75 ppm have resulted in the utilization of clear overflow in various section of paper machine.
- Since there is no rotating part as in krofta, this has resulted in electrical energy saving.
- Flocculant application has become easier and effective.

CONCLUSION

It may be concluded that critical study, identification and analysis of various factors in paper machine process and incorporation of even small but proper modifications may not only lead to tremendous improvement in quality and efficiency at reduced cost but also play an important role in resourse conservation in terms of reduced water and energy consumption.

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