Present and Future Trend of Paper Making, Machine Clothing and Related Mill Experience

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ABSTRACT

Papermaking will move even more towards being science and engineering rather than art and science. This paper will provide some insight into present and future trends of papermaking, paper machines, paper products and requirement of m/c clothing in future. This paper will also deal with mill experience with different machine clothings of high-speed machines and developments made to improve quality, productivity, runnability of machine and on cost benefit.

INTRODUCTION

With the current speed in change of technology, it is hardly possible to predict the future of paper machines. Nevertheless, some attempt is made in this presentation to predict some of the future trends in paper making and expect accordingly the machine clothing industry to gear up. In the 1800, a paper machine was producing a sheet of 150cm width at a speed of 30m/min. Today, paper machines are close to 1250cm width and the speed is upto 2000 m/min. Some pilot paper machines are running at even higher speed. It is expected that the machine speed will reach up to 3500 m/min in a decade or so. Parallel to th improvement in paper m/c technology, paper m/c clothing manufacturing also made rapid progress within the last few decades. In 1995, the forest, wood and paper industry executives released the Agenda 2020 to set the future goal for these industries. The Agenda identifies six priority areas for research, viz sustainable forest management, environmental performance, energy performance, improved capital effectiveness, recycling and sensors & control. The search has to be continued for new fabrics and processes to improve paper quality and increase paper machine productivity. Paper machine manufacturers, paper makers, paper machine builders and universities need to continue working together to take the Paper making to new heights. Development of paper machine clothing with the input from paper manufactures will be more successful with good technical services.

EXPERIMENTAL

Paper Machines and Paper Making

Environmental issues will continue to be of concern that will affect the future direction in paper making and paper machines. More rational use of energy and water will become necessary. New concepts for forming, pressing and drying are expected to be developed in the future.

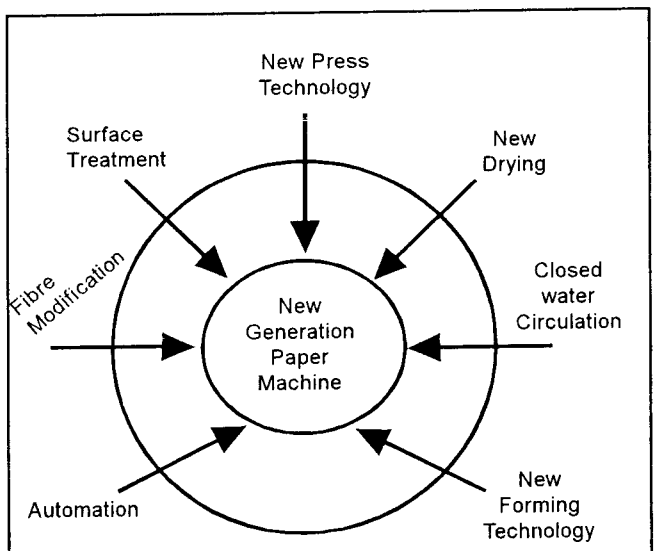

Fig. 1 Factors that will affect the development of future paper machine

More automation including fuzzy logic controls will be implemented.

Future expected change in machine features

Layered Head Box designs that will allow furnish layering will increase. Machine speeds and widths will continue to increase. More hydraulic Head Boxes will be used in future. Dilution control of basis weight rather than slice control allows for fine adjustments in basis weight profile without affecting fibre orientation. Use of single fourdriniers will decline. Gap forming and Twin wire machines will dominate the market for tissue and many paper grades. Adjustable blades are used in the latest generation of gap and blade formers. More multiple former will be used for board grades. Former types will continue to evolve to meet the requirements of most of the paper grade. High consistency forming will get more attention. Papermaking will move even more towards being science and engineering rather than an art and science.

Expected Future Paper Products

Ever continuing progress of technology and life style will necessitate new products with more demanding properties. More engineered paper including compsite paper structures will be developed for high performance application. Use of paper and board products in industrial aplications such as architecture and construction, medical technology, safety and protection etc. will increase. This will close the gap between nonwoven textile and paper even further. More two-sided coated grades will be made in bleached board. Liquid packaging grades are growing rapidly. Demand for recycled fibre in non food packaging grade will incrase. Recycled fibre content will increase for Brown Paper.

Automation

Automation in manufacturing of paper and paper machine clothing will continue to increase. This will require new sensors and new control strategies. Computer aided design and computer aided manufacturing will be utilized further.

Forming

Most forming fabric development efforts during 1870's and 1980's focused on increasing drainage capacity and structural integrity including stability and life. These areas are of lesser concern today because of improvement made in these areas. In future we expect followings from forming fabric suppliers looking to fast changes taking place in paper making and paper machines. Increasing machine speeds and widths will require even more stable and uniform fabrics. Further stability in both MD and CD will be achieved in coming years with new fabric design. Increased use of abrasive calcium carbonate in alkaline sizing will continue to demand excellent life potential and retention. In general, fabrics with higher quality, longer life and lower cost are to be developed. Increased demand from the printing and converting industries for smoother, stronger sheets with better printing surfaces will affect the forming fabric design and structure. Improved consistency will result in repeatable and more dependable product. Forming fabric will need to offer greater level of fibre support without sacrificing drainage or structural integrity. The paper industry will have to produce these higher quality sheets from lower grade and less expensive furnishes. Therefore fabrics will have to be finer, giving more sheet support while improving their mechanical properties with regard to dimensional stability, wear resistance and ease of cleaning.

We hope that these conflicting requirements may be met by improved designs of triple layer fabrics. Paper machine speeds will continue to increase. The very short dewatering time then necessitates forming fabrics with good drainage and high fibre support. The increased speed will require an ever increasing need for fabric stability and resistance to stretching due to higher tensions. Easy fabric installation for less down time will require development of pin and thin line coil seamed forming fabrics. Paper weights will continue to decrease especially for finer paper while maintaining or improving current standards for opacity, smoothness, strength and printability. Other grades while maintaining sheet weight, will need improvements in printability. All these demands require finer forming fabrics to enable the paper makers to obtain smoother sheet properties and more uniform and fine distribution while achieving excellent formation.

Pressing

It is well known that better dewatering in presses requires less energy on overall basis and produces a superior product. Use of synthetic fibres in place of wool fibres in press felts and new needling technologies increased the life drastically and revolutionized fabric designs. Double and triple layer fabrics, twisted mono filament and stratified batt structures resulted in superior press felt performance. More stable base structures and low batt to base ratio fabrics that will provide more uniform sheet profiles will be developed. Needling technique will improve. Use of laminated press fabric structures will continue. Seamed fabrics utilizing with lamination are already in operation. Alkaline paper making for fine paper requires good water handling capacity which will require higher void volume structure. Couch consistency will be important. Felt filling due to carbonate and aluminum hydroxide will require coarse batt fibres with more open structures. Mechanical and chemical felt wear and

shedding require higher molecular weight batt and better chemical treatments. Machine speed and press loads will increase. Dwell time will be longer. Multiple shoe press sections and new long press LNP section will be utilized. Therefore felt manufactures will have to develop new fabric of single monofilament CD fabric constructions. Multilayer, Multiple base fabric and pin seam construction will be in increased usage. Chemical and wear resistant fibre content will increase. New and improved chemical treatment and wear resistant fibre to be developed. To control vibration and bounce in the last press, high caliper structures with improved mass uniformity are required. To improve sheet properties, pressure uniformity will have to be improved. Smoother surface finish needling techniques will be developed. Speed will increase for bleached board pressing. There will be less double felted pressing. High void volume design will be used in first press position. Multinip presses will be used for printing and writing paper grades. Suction press rolls may be phased out and open draw between press and dryer section may be eliminated.

Drying

Since the most difficult and expensive water removal takes place at the dryer section of paper machine, there is great scope to make advancement in the dryer section. Future dryer fabrics should maximize the mass transfer and drying rate. Use of high velocity, high temperature air impingement for more efficient drying will increase. With increasing use of recycled fibre, there is need to develop still better contaminant resistant dryer fabric. Residual adhesives pitch and ink from recycled fibre, coating and size press solids can fill the dryer fabrics prematurely and affect the drying efficiency, dryer fabric performance and fabric life. Better contaminant resistant fabrics will increase steam saving and fabric life, reduce down time for cleaning and improve sheet quality. Higher temperature, wear resistance dryer fabrics with good hydrolysis resistant will be developed. Improvement in surface contact area will improve dryer efficiency. Minimal seam marking is required. Fabric with less carrying properties needs to be developed. Use of single run and single tier dryer configuration has increased in recent years. These configurations support the sheet continuously without open draws. In these machines, speed variation may occur between top and bottom cylinders, which may cause sheet-stretching slippage and break. The dryer fabric plays an important role to reduce the speed difference. There is still room for better dryer fabric stability and resistance to distortion and damage. The current move of single tier dryer system will continue. Steam heated cast iron cylinders will continue to be used. Closed sheet transfer will become standard and fabric driven dryers with no ropes will be used.

Mill experience (Paper Machine-3)

Make	Over Mechanical
Type	Twin wire former (Papriformer)
Operating speed	415-425 m/min
Quality	Writing & printing (Cream wove & MapDix)
M/c Limitation	Open press, drying to increase production & Quality development.
Quality problems	wire mark in paper, Less smoothness, Less air porosity, Lumpy sheet, poor texture, etc.
Rebuild	1993
Addition	New Tri Nip Press, Size press, Dryer group, New Calendar Stack.
Speed	550 m/min
Gsm range	54-80
Quality made	Map printing-SS, Base paper for coating & Soap industries, Cream wove & Map-DLX etc.
Sizing	Acid sizing upto 2000, Alkaline sizing since 2001 & running continuously.

Experience with single layer forming fabric

Poor retention-50-55%. More rippling of fabric. Weak seam and more distortion of seam. More fabric elongation and Slippage. Prominent wire marks with both 4 and 5 shaft fabric. Avg. fabric life-50-60 days.

Double layer forming fabric (1995-2002)

The retention was 60-65% with acid sizing and 75-80% with alkaline sizing with more fibres carry over problem. against which was care by better shower and pressure. There was severe problem of edge wear out resulting in lesser life in comparison with single layer fabric. Fabric life increased with the LS profile on edges of fabric and it was further improved after installation of better cleaning system and use of better quality of talcum as filler. Fabric elongation was reduced to some extent. Frequent choke of wire in AKD sizing resulting in less drainage was taken care by changing the fabric design.

Triple layer forming fabric (Trial is on)

More dimensional stability is found now, with practically no elongation. Retention has increased to 80-85%. Reduction in power consumption is under observation.

Faster drainage has been observed. Better life is expected compared to double layer fabric.

Experience of press felts on TRI NIP Press

Type of press- Tri Nip press

Top & bottom Kusters rolls 480 mm dia

Centre granite roll 1100 mm dia.

Suction press roll 1040 mm dia. Hole size-3 mm.

Loading	Design load	Running load
1st Nip	70 Kn/M	30 Kn/M
2nd Nip	90 Kn/M	40 Kn/M
3rd Nip	120 Kn/M	70 Kn/M

Limitation- Shadow marking due to 3mm hole size on suction roll rubber. Low bulk in paper due to higher loading. Types of Felts used are: 1993-1998 Double layer & Laminated felts.

1. Avg. felt life-70-75 days
2. No reduction in Shadow marking even with different gsm & type of felts used and with less Nip Loading.
3. Less sheet Dryness after press and more steam consumption.
4. Poor M/c run and more break on press.
5. More fines bleeding from double layer felts.

Double layer and Laminated felts. Suction press roll was provided with blind drilled holes in Nov. 1999. AKD sizing is being made since 2001.

Results & benefits derived are Shadow marking which totally vanished and Press loading increased to :

Loading	Design load (before)	Running load (After)
1st Nip	35 Kn/M	40 Kn/M
2nd Nip	40 Kn/M	45 Kn/M
3rd Nip	70 Kn/M	80 Kn/M

Dryness after the press increased from 42-43% to 43-44% even keeping higher retention due to AKD sizing. Better m/c runnability & better m/c. productivity. Steam consumption reduction by about 0.2 Mt/Tonne of paper. Felt GSM has already been reduced to reduce cost. Felt life has increased as follows.

	With Acid sizing		With Alkaline sizing
	Suction press (Without blind drill holes)	Suction press (Blind drilled holes)	Suction press (Blind drilled holes)
Double layer	80 days	85-90 days	90-95 days
Laminated	90 days	95-100 days	110-115 days

CONCLUSION

Machine clothing suppliers should gear up with the expected changes taking place in paper making in future for better productivity, quality of paper and cost reduction. We feel that inherent machine problem cannot be fully taken care just by changing m/c clothing designs. However it is possible to reduce the extent of problem by making suitable changes in machine clothing depending on individual cases. Machine clothing supplier needs to understand paper m/c throughly before recommending the Fabrics/ Felts. Better interaction between paper maker and machine clothing suppliers is needed for further improvement.

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