Development and Selection of Machine Clothing for Improving Paper Quality, Productivity and Cost-Effectiveness – A Mill Experience

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ABSTRACT

Making high quality paper and controlling production costs requires selection of right machine clothing. Paper Machine clothing plays an important role in ensuring high productivity and efficiency of a paper machine. Proper selection of machine clothing ensures improved paper properties, better fiber retention and drainage, reliable and predictable life expectancy.

Introduction

The basic function of the Forming fabric is to give better sheet formation, free from any wire marking and to remove the water from paper web. Press fabrics help to optimize the water transfer from the sheet and dryer fabrics support for effective drying of the sheet. Modern fabric designs help in improvement in machine speed as well as operating efficiency. Clothing optimization by better conditioning & operation can provide significant savings in steam & power consumptions.

Paper makers consider following points while selecting fabrics.

(1) Fast start up without any operation issues.
(2) Good formation
(3) Good FPR and FPAR
(4) Good drainage
(5) Good life

Mill Experience

Case Study I (Paper Machine # 3)

Substantial cost savings by use of indigenous forming fabrics in top and bottom position in PM#3 without compromising quality and life expectancy.

Machine Details:

Type of M/C	:	Beloit Converflo head box with Bel-Baie IV Horizontal Gap Former having Tri-nip press & Soft nip calender
Product	:	News Print 45GSM Furnish: 100% DIP
Machine Speed	:	1120mpm
Deckle	:	3.6 Meter.
Production	:	250TPD

Emami Paper Mills Limited, Balgopalpur, Balasore - 756020 (Odisha)

It was possible to establish PM#3 of Emami Paper Mills to standard running conditions with the required quality parameters, at a machine speed up to 1120mpm from 100% recycled fiber at 45gsm Newsprint by specifying and correcting the selection of right quality of machine clothing's.

1) PM#3 was using imported forming fabrics in both top and bottom position after the commissioning and gradually increased machine speed unto 1120 mpm. The mill first tried an indigenous forming fabric in top position and then the bottom position also was changed over to indigenous fabric. Initially there were problems with drag load, drainage, wire slippage, elongation and life expectancy. But after detailed discussions between mill technical team and the suppliers, suitable changes in specifications in yarn diameter, Air permeability, Fibre support index etc. were made. After several trials the mill was able to achieve desired results in both the positions. Recently forming fabric supplied by indigenous supplier has achieved maximum productive life in both the positions and also the required quality of product Formation, Porosity, retention values etc.

Thus by using indigenous forming fabrics in top and bottom position, the mill has achieved substantial cost savings with equivalent quality and fabric life.
Table indicate the difference

2) Similarly use of indigenous press felt and dryer screens are being tried and established.

Case Study II (Paper Machine # 2)

Productivity & Quality improvement with less energy consumption by proper felt selection & improvement in nip width & drainage at wire part.

TABLE - 1

Particulars	Specifications of Imported fabric (TOP/BOTTOM)	Specifications of Indigenous fabric (Top/Bottom)
Type	24 shaft SSB	24 shaft SSB
Caliper mm	0.82/0.91	0.92/0.91
FSI	171/177	158/172
Air permeability	400/370	400/380
MD yarn diameter, mm	0.13/0.21	0.13/0,21
CD yarn diameter, mm	0.13/0.27,0.13	0.15/0.30,0.15

TABLE - 2

Particulars	Imported Fabric	Indigenous fabric
Drag Load	65-75%	65-75%
Wire slippage	No	No
Elongation	Normal	Normal
Life expectancy	12000 MT	12000-14000 MT
Cost factor	Imported Price is 30% higher	Normal

TABLE - 3

Particulars		Felt speed at 475mpm	Felt speed at 490mpm
Pick-up felt			
CD filaments (top/ bottom)	:	4 ply mono twisted	mono
MD filaments (top/bottom)	:	3/4 ply mono twisted	4ply mono
BATT:			
Paper side	:	300 g/m² -17 dtex 300 g/m² - 44 dtex	250 g/m² -17 dtex 300 g/m² -30 dtex
Roll side	:	150 g/m² -44 dtex	150 g/m² -30 dtex
Weight	:	1350 g/m²	1400 g/m²
Permeability	:	47cfm	40 cfm
Caliper	:	3.0 mm	2.7 mm
2nd press felt			
CD filaments	:	4 ply mono twisted	4 ply mono twisted
MD filaments	:	4 ply mono twisted	4 ply mono twisted
BATT:			
Paper side	:	150 g/m² -17 dtex 400 g/m² -44 dtex	150 g/m² -17 dtex 400 g/m² - 44 dtex
Roll side	:	200 g/m² - 44 dtex	200 g/m² - 44 dtex
Weight	:	1400 g/m²	1450 g/m²
Permeability	:	65 cfm	60 cfm
Caliper	:	2.8 mm	2.8 mm
Center press roll dia	:	825 mm	850 mm
Suction pick-up roll dia	;	650 mm	650 mm
Crowning	;	2.25 mm circumference	3 mm circumference
2nd press roll dia	:	570 mm	585 mm
Crowning	:	2.5 mm circumference	3 mm circumference
Nip load	:	52 kg at pick-up & 80 kg at 2nd press	56 kg at pick-up & 90 kg at 2nd press
Nip width	:	22 mm at pick-up & 18mm at 2nd press.	27 mm at pick-up & 21mm at 2nd press.
Dryness after press	:	42% to 43%	44% to 45%
Paper moisture	:	6%	7%
Steam consumption	:	1.7T/Ton of paper	1.6T/Ton of paper
Power consumption	:	450Kwh/Ton of paper	430Kwh/Ton of paper

TABLE NO. -4
Drainage element configuration for better drainage to speed up M/c.

At 490mpm.	**At 510mpm.**
Forming board followed by hydrofoils & Duo vac. & tri vac.	Introduced 0.5 deg foil after the forming board Ortho flow before the Duo vac.
High pressure shower -15kg/cm^2	**High pressure shower-25kg/cm^2**
Problems faced	**Results achieved**
❖ Dryness after the couch 17.8%	❖ Dryness after the couch 20%
❖ Moisture carry over	❖ No moisture carry over
❖ Moisture profile avg.	❖ Moisture profile better
❖ Roll condition at pope reel disturbed	❖ Roll condition at pope reel improved
❖ More sheet breaks	❖ Practically no sheet breaks
❖ Percentage Nil joint reel- 88-90%	❖ Percentage Nil joint reel- 95-97%
❖ Wire life 90-100 days	❖ Wire life 110-130 days
❖ FPR 56-60%	❖ FPR 60-65%
❖ Occasional fluff problems	❖ No fluff problem.
❖ Bendtsen 190/150	❖ Bendtsen 180/140
❖ Flocculent consumption-60gm/ton of paper	❖ Flocculent consumption-25gm/ton of paper
❖ Starch consumption 1.1kg/ton of paper	❖ Starch consumption 0.9kg/ton of paper

Machine Details:

Type of M/C : Fourdrinier
Quality : Newsprint, M/C installed in 1996 (old M/C from Portugal)
Head Box : Hydraulic
M/c configuration: Bi-nip press, size press, dryer group, kuster calendar.
Forming Fabric : 2.5 layer
Operating Speed: 510mpm
Basis weightr : 45 g/m^2

Capital investment:-

Cost of ortho flow unit & 0.5 deg foil box = 28 Lacs
Cost of center press rolls (2 nos.) = 20 Lacs
Cost of 2nd press groove rolls (2 nos.) = 12 Lacs
TOTAL = 60 Lacs

Cost benefit analysis

Cost of steam = Rs. 600/tonne
Previous steam consumption = 1.7 tonne/Mt of paper
Present steam consumption = 1.6 Tons/MT of paper

A) Cost saving on steam = 0.1MT x Rs. 600 = Rs. 60 = x 94.5MT = Rs. 5670/day
= 20 lacs/annum
Previous power consumption was 450 kW/tonne of paper
Cost of power = Rs. 5.0/- unit
Present power consumption = 430 kWh/tonne of paper

B) Cost saving on power = 20kWh x Rs. 5 = Rs. 100 x 94.5T= Rs. 9450/- day
= Rs/ 33.0 lacs/ annum.
Total Cost saving in energy = 20lacs + 33lacs
= 53lacs/annum
Increase in production = 5.0T/day
Increase in production = 1750T/Year
(350 working days) = 87 lacs/ year
Total Saving = 87+53 = 140 lacs.
Capital investment = 60.0 lacs
Return on investment = 5months

TABLE NO - 5

Previous Conditions & problems associated with single layer forming fabrics	Present Conditions associated with 2.5 shaft layer forming fabrics
Experience with single layer fabric at the speed of 300m/min—In flat woven type fabric the work during weaving is composed of yarn which is referred as MD yarn in order to make endless loop. Fabrics are joined by connecting the warp at the end of each fabric. Initially 5-shaft 1up & 4 down single layer fabric was used. This design has more void volume & more drainage capacity.	**Advantage of 2.5 layer fabric at the speed of 330m/min-** 16-shed ex-weave-It is a improved 8-shed ex-type. It has a better abrasion resistance property. The shed side weft density is increased; the result is better sheet support that improves wire mark, retention & surface property of the paper. In addition the no. of weft yarn on the machine side are reduced so that the three dimensional space (void volume) is increased for enhance drainage capability.
1. Wire marks as the wefts form projections on the paper making surface.	1. No wire mark in paper & Formation improved.
2. Less abrasion resistance capability.	2. Roughness improved.
3. Due to inherently small water retaining capacity this fabric is unsusceptible with increasing speed more than 300mpm.	3. Due to inherently more water retaining capacity this fabric is unsusceptible with increasing speed up to 330mpm.
4. Wire elongation and slippage was more.	4. No wire elongation and less slippage.
5. More two sidednesses of paper and roughness.	5. No two sidednesses of paper and roughness.
6. Production 50T/Day	6. Production 52T/Day
7. Wire life 2 months.	7. Wire life increased to 3 months.
Properties with 5-shaft single layer fabric (S.S. Maplitho – 54 gsm) Smoothness, ml/min (Bendtsen) Top bottom 250 390 200 360	**Properties with 16-shed 2.5 layer fabric (S. S. Maplitho – 54 gsm)** Smoothness, ml/min (Bendtsen) Top bottom 170 280 140 250
Stiffness, mN : MD – 2.6 to 2.8 CD - 1.6 to 1.8	Stiffness, mN : MD – 3.0 to 3.2 CD - 1.8 to 2.0
FPR : 70 – 72%	FPR : 72 – 74%
Hence, address the problem and for further increasing the productivity it was discussed with wire manufacturers & finally decided to switch over from single layer to 2.5 layer fabric.	Speed increased to 330m/min & paper property improved with respect to the stiffness, smoothness etc.

Case Study III (Paper Machine # 1)

Machine Details:

TYPE OF M/C : Fourdrinier M/C installed in 1983 (Old Imported Machine from Sweden)
Product : Writing & Printing paper 52gsm to 150gsm, furnish 100% DIP
Machine Speed : 135 mpm to 330mpm
Deckle : 2.1meter
Production : 52MT
Head Box : Hydraulic
Machine Configuration : Fourdiner wire part having 1st press double felting & 2nd press open, size press & kuster calendar.

Conclusion

1) Proper selection of machine clothing & its design can improve the machine efficiency & significant savings on Energy consumption.

2) Right selection of indigenous forming fabrics has given substantial savings on PM#3.
3) Significant improvement in productivity & quality achieved by changing the felt design and drainage elements on PM#2 (increase in production 5MT/day).
4) Reduction in steam & power consumption from 1.7 MT to 1.6 MT & 450 Kwh to 430Kwh respectively on PM#2.
5) By switch over from single layer to 2.5 layer fabric at PM#1 helped to improve the formation, stiffness, smoothness & two sidedness.

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