Paper Making with Modern Felts and Fabrics Styles

NATH, A.D.M.*

SUMMARY

The paper reviews the present day situation of clothing in press section and drying section of paper machines, taking in view the fast changes in paper machine design for more and more production and incremental advances made in clothing.

INTRODUCTION

Paper making attracts the chemist in each of us to look at, may be a tree or an agricultural residue, of apparently no value except perhaps as fuel and make out of it a product of value. Making this task efficiently is the job of the physicist and engineer in us.

The engineering went ahead and gave machines that substantially remained same for several, several decades. This was so a generation ago. But then, changes started coming as the physics of dewatering became clearer around 1960.

Engineering has responded and paper machines are changing-changing radically.

This is fortunate for the new-comers. They can by-pass the slow and fumbling steps of the pre 1960's and make a jump to modern technology.

The flow nozzle and twin wire combinations promise better sheet formation at low capital and operating costs.

The transversal flow principle in pressing has been made a reality by the new clothing developments. Costs of energy and effluent disposal are forcing the pace of these new developments to get as dry sheet as possible to the drying zone.

To bring home these concepts, the paper reviews mainly the clothing situation in the press section and considers briefly the application experience in this and drying which, today is a major area of practical but incremental advances in clothing.

CLOTHING DEVELOPMENT FOR PRESS DEWATERING**

The conventional felts were originally all WOOL. One looked to fine WOOL for finish and coarse WOOL for dewatering; strong and a straight WOOL for standing up to machine direction stress (or, L-way stress) and crimpy resilient WOOL for cross machine direction (or, X-way stress) properties.

*M/s. Shree Dinesh Mills Ltd., Baroda-5.

Treatments were developed to protect WOOL during storage and use.

Synthetic fibres were added to increase life: nylone in CMD and polyester in MD yarns.

Wool's ability to felt was the basis of all developments at the period. Weaves could be selected to give various characteristics as shown in Table-I.

TABLE—I

CHARACTERISTICS OF SELECTED WEAVES FOR PRESS CLOTHING

Weave	Bulk	Stability	Finish	Drainage	Wear
Plain	6	1	6	6	1
Satin	5	3	1	3	5
Two-sided	2	5	4	2	4
Straight Twill	4	4	2	5	3
Broken Twill	3	2	5	4	2
Duplex	1	5	3	1	6

Key : 1 = Best
6 = Worst

Some of these still very useful and Table-II gives the styles currently used in our industry.

Around 1960, came a way of freeing felt making from this restriction when felt technology adopted needle punching. The year 1960 is generally accepted as the year of break-through under the stimulus of a new understanding of water removal in a press-nip (bor je Wahlstrom, 1960).

The press and clothing developments that followed these events of 1960 represent a major thrust towards increased press efficiency.

**The speed of the machine is limited by the moisture content of sheet entering the dryers.
A widely held rule of thumb is that one percent increase in sheet dryness will give five percent speed increase.

In the plain press, (Fig. 1), as the water fills the voids in felt, hydraulic pressure builds up and water pressed out flows laterally, opposed by the felt structure advancing through the nip.

The suction press is theoretically an improvement as a part of the forced out water flows out across the thickness (or, Z-way). The benefit from theory depends on the magnitude of press loading (limited by the sheet strength now, reduced by the holes) and the transverse path (given by the number and size of holes).

Grooved rolls represent a more efficient application of the theory where the pressure distribution and so finish possibility on sheet is improved. The grooves are dewatered by directing a purge shower against roll rotation.

In the first or earlier type, the grooves are cut into the roll surface. The other type has the cuts into the cover only, either rubber or stainless steel, allowing a cheaper core selection. Rolls with blind holes represent a variant of the theme.

The conventionals were the preferred style but there has been a major shift to the Batt-on-base types shown in Table-III.

TABLE - II

CONVENTIONAL WET FELTS (35% SYNTHETIC CONTENT)

Felt description				Application
Style	Group	Gsm	CFM	
A62901–14	E	750–850	100–150	Pickup/top position on
A62908–12	E	,,	,,	cy. mould machine.
XA62500–13	E	950	70	suct. press
XA64008–14	E	750	150	Plain/reverse press
XA64003	E	700	150	press felt for fine papers
MGR–1–2055	M	1075	20	Lickup & MG Glazing (ribbed)
MGR–1001	M	1075	10–15	–do–
A63502	H	1025	25	–do– plain
A63502/10/12	H	1100–2300	6–10	M.G. Glazing positions.

TABLE–III

NEEDLED FELTS – BATT–ON–BASE (35% OR 50% SYNTHETIC CONTENTS)

Felt description				Application
Style	Group	Gsm	CFM	
XYA62908–13	NE	800	100	Pickup/top for cy. mould
XYA62503–12	,,	750–1000	70–120	suct/plain press
XYA62500–11	,,	750–1000	–do–	–do–
XYA82500–15	,,	1000–1300	40–70	suction-fabric press
XYA62605–16	,,	800–1100	50–100	Plain-suction press
XYAN62605–13	WNE	800–1000	60–80	Plain-suction press
XYAN82605–16	,,	950–1100	60–70	suction-plain-high speed
XYA64406	NG	1000	50	Lickup
XYA64405–10	,,	1000–1400	20-45	Lickup/NG position
XYA84405-15	,,	1400–2000	15-20	M.G. Position
XYAN64105	WNG	1000	50	Lickup
XYA62306	NE	1300	125	Pulp M/c.
XYA62306-10	,,	1800	80	-do-

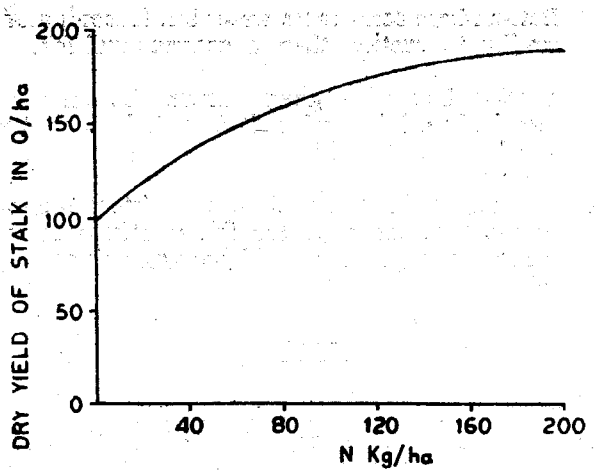

Fig.1

TABLE—IV

DISTRIBUTION OF FILLING MATERIALS

	Web	Machine direction yarns	Cross-Machine direction yarns
Caustic soluble	0	0	2.9
Paper stock	0	0.4	2.2
Ash	0.03	0.06	0.1
Extractables	0.6	2.2	3.6
TOTAL :	0.63	2.66	8.8
Per cent	6	22	72

The tendency of plugging in use is less with these than the conventionals. In 1973, Fabricious cited the role of CMD yarns in plugging (Table-IV).

These findings aroused a good deal of interest and a demand arose for felts without X-way yarns and, as a logical conclusion to the 100 % non-woven felts.

Further studies of pressing have called attention to the need to provide for a place in felt structure for the expressed water to stay till the felt comes away from the nip, and to reduce the 'water-film re-wetting'. Development of several types of Batt-on-mesh and combination felts have followed.

The combination fabric is not the only way by which a felt can help in the conversion of plain press into a transversal press, action; the other, and perhaps simpler ways are provided by the inner fabric or alternately by a shrink-sleeve.

The inner belt is an open monofilament or multi-filament/monofilament fabric that goes through the press nip inside of the felt. This configuation, known as a fabric press, provides a large void volume for expressed water due to its open, double-layered construction. The void area of an inner belt is approximately 62% as compared to a 16% open area with a grooved roll press and a 19% open area with a suction press. Operation of the inner belt requires hardware similar to a regular felt run, such as guide rolls, stretch rolls, showers, and suction pipes for dewatering.

The basic rationale of the shrink sleeve was to reduce the free running inner belt of the fabric press to a cover on the press roll itself. To meet these requirements, a shrinkable sleeve maintaining the desirable characteristics of the two-layer inner belt construction was developed. This offers the papermaker the main advantages of the fabric press principle in a form that is simple and less expensive.

As we now go to increased speeds by efficient use of press nips, problem shifts to wet-end breaks as a result of reduce sheet dryness at the couch. In Europe, and now in U.S. and India as well, installation of a couch press is offered as a solution. The couch press is an application of double sided dewatering in a new form.

Papermaker's will find that we have come a full circle with this. Double dewatering is nearly as old a concept as machine made paper and has in the past been known for its rather inefficient dewatering sheet rewetting on both sides and marking. In the new press configurations, the idea brings in improved double-sided dewatering.

APPLICATION

(1) DRYER CLOTHING

While there is much awareness of the potential of open mesh fabrics there is not much field experience as yet in our country.

In dryer felt application, the seam rather than the felt has often been the problem. The metal hooks tend to corrode. Their properties do not match those of the felt and the seam is relatively impermeable.

Now, non-metallic seams are available. The woven multi-filament loop seam and a plastic spiral seam are both better than the clipper seam. The loop seam has the additional advantage of great strength (this is much greater than the clipper seam).

For open-mesh fabrics, the loop seam can be applied. A pin seam is available for the mono-filament fabrics. Which has practically the same grammage and openness as the rest of the fabric.

(2) PRESS SECTION CLOTHING

The field experience, while plentiful, have in general a distinct local flaver. The properties of felt are

affected greatly by the nature of plugging material a function very local in character.

The lessons from this experience is that paper makers could use other's experience as a first crude guide. If they desire then through the Sales Engineers they can get the customers service laboratory to help them in overcoming the plugging problem.

At our R & D Centre, treatments have been developed to resist specific plugging materials. Treatments are rather complex chemical reactions which can introduce, as desired, significant modifications to felt structure. For specific customer positions, treatments have been developed to resist fibre shedding, abrasive wear and to resist compaction.

The felt or fabric compacts or looses thickens (caliper) as it passes repeatedly through the press nip. We have developed simple formulae for calculating the effect of this on water handling ability.

Then, an attempt has been made in theoretical calculation to separate the effect of plugging by writing resistance to flow as given by the reciprocal of air permeability.

This work require testing used samples before and after washing and comparing with original (unused) samples as made and as compressed to the level of used sample.

The result of these and study of pressing behaviour show the importance of cleaning the felt, and before it goes to nip dewatering at the suction boxes.

General results can be stated:

1. A Batt on mesh Fabric is similar to Batt on treated base in water handling ability and loose water more easily to a suction box than a batt-on-base.
2. Batt-on-base carry more water but looses it more readily to suction than a conventional felt.
3. Suction box of a given vacuum becomes increasingly efficient when it is split into smaller width.
4. Plugging studies do not show a consistent pattern, except that the need for felt conditioning increases as we go on to the higher synthetic content felts.

CONCLUSION

Mathematically speaking, the highest output of a paper machine together with the limitations responsible for it, constitute the papermakers boundary layer problem. Every change of a felt or a fabric provides him an opportunity to review the problems with the felt makers.

A modern felt or fabric is not a latest development advertised. It is a clothing that could even be designed like the felt of an earlier decade provided it is made with todays' understanding of its proper function in the paper mill and further, it is made with todays' state of art in textile technology. In this sense, a well designed conventional wet felt is as modern as the latest Batt-on-mesh.

New and wider machines are being added to our industry to meet the rising needs of paper & board. Partial re-builds are being considered for increasing the output rate at the existing machine width. Several small mills are coming up to utilize agricultural residues or to exploit local opportunity for business.

In this pursuit, the paper makers' best friend is the Sales Engineer-who has behind him, the customer service laboratory, the R & D services and the architect of the felt, the designer himself.