New developments in press fabric designs

DANIEL PERRON*, JAMES FULFORD*

INTRODUCTION

Press fabric development always follows the Pulp and Paper industry's evolution. This paper is meant to explain the interrelationship between the two as well as to emphasize recent new developments in press fabrics for the paper industry.

The P&P industry has greatly advanced in recent years. Considerable amounts of money were invested in order to increase production capacity, improve paper quality and to minimize manufacturing costs.

New technologies introduced either in the processes or in paper machine design, have forced the press fabric clothing industry to redefine the physical characteristics of press fabrics in order to comply with the needs of the industry.

A new family of press fabrics including multiple and complex base fabrics construction, as well as revolutionary processes such as our Fibernetics Process, are among the most recent developments that have contributed to the rise of this industry.

EVOLUTION OF THE PAPER INDUSTRY

In the 1980's, the Pulp and Paper industry went through a rapid and steady evolution. Many new technologies have been introduced to the machines and press sections as well as to the products and processes.

Twin wire formers, high machine speeds, increased amount of fillers, closed white water systems.....are among the most important changes that have revolutionized the machines.

The press sections also went through major modifications: higher loadings, harder roll covers, steam boxes, the advent of Tri-Nip and Trivent press sections and the addition of a fourth press, are among the most important developments that have occurred in the 1980's.

The increasing amount of chemi and thermomechanical pulp, peroxide bleaching, the higher utilization of fillers and recycled fibres, the conversion to alkaline papermaking, the trend for lower Newsprint basis weight, the increased chemical and mechanical cleaning of press felts, are major changes introduced to the products and processes.

The above changes and new technologies have contributed to the evolution of the Pulp and Paper industry and they had a strong impact on the evolution of press fabrics.

EVOLUTION OF THE PRESS FABRICS

In the last three (3) decades, press fabrics (which were previously called "wet felts)", also went through a rapid and steady evolution. The woollen felts have gradually been replaced by synthetic press fabrics and complex multi-layer base fabrics.

In the last seven (7) decades, six generations of press fabrics succeeded one another (refer to Table 1).

TABLE 1 : PRESS FABRIC EVOLUTION

1ST GENERATION (1920+)	—CONVENTIONAL FELTS
2ND GENERATION (1960+)	—NEEDLED BATT-ON-BASE FELTS (SINGLE LAYER 50-75% SYNTHETIC)
3RD GENERATION (1970+)	—NEEDLED BATT-ON-MESH FELTS (SINGLE LAYER 100% SYNTHETIC)

*Albany International
CANADA

4TH GENERATION (1975+)	—DOUBLE LAYER PRESS FABRICS
5TH GENERATION (1980+)	—TRIPLE LAYER PRESS FABRICS
	—LAMINATED DOUBLE LAYER PRESS FABRICS
	—SEAMED PRESS FABRICS (DOUBLE LAYER)
6TH GENERATION (1988+)	—FOUR LAYER PRESS FABRICS (INTEGRALLY WOVEN)
	—STRATIFIED PRESS FABRICS (DOUBLE & TRIPLE).
	—LAMINATED TRIPLE LAYER AND FOUR LAYER FABRICS.
	—SEAMED PRESS FABRICS (TRIPLE LAYER).

Each generation did contribute to the evolution of the Pulp and Paper industry. The woollen felts which had been used for forty years are no longer being run today. The batt-on-base which belongs to the second generation are still manufactured today but they represent a very low percentage of the total volume of fabrics. The third to the sixth generation are still currently being used on a regular basis. The shift in technology that has occurred in the 1980's was a major factor in the development of the fifth and sixth generation and has forced the press fabric manufacturers to re-evaluate the physical properties of press fabrics and to better adapt their products to the different types of machines.

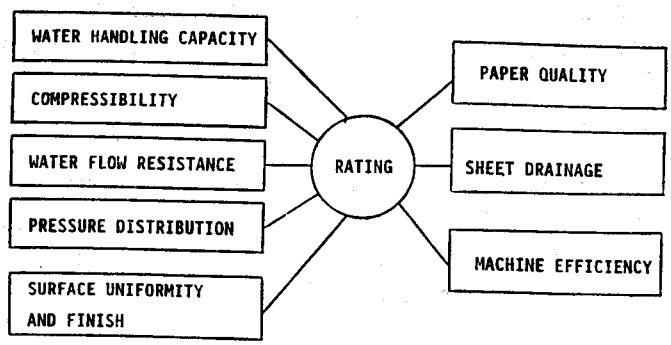
PRESS FABRIC DESIGN

Press fabric design is not an art, it is a science. It requires not only a good understanding of the different equipment, materials and process available to fabric suppliers, but it also demands a good understanding of the paper machines and their different components. The paper type and weight, the stock type and composition, the sheet consistency before the press, the type of press roll covers with the diameters and hardness, the conditioning, the press geometry as well as the special requirements of the customers, are all important factors that have to be taken into consideration when designing a press felt. It is a better understanding of the above factors that has helped press fabric manufacturers to better adapt their products to the different types of machines.

Over the years, the primary functions of press fabrics, which are to support and to dewater the sheet, have not changed. However, the new technologies introduced in the 1980's as well as the increasing demand to improve sheet quality and to optimize the press section efficiency have put strain on the press section clothing.

There are five (5) physical properties that can influence the press fabric behaviour on the paper machine (figure 1). With the equipment available in the laboratory today, it is possible to measure these physical properties and to predict to some extent, their effect on paper machine performance.

FIGURE 1 - PHYSICAL PROPERTIES OF PRESS FABRICS



The importance of each one of these properties varies with the application. The stock composition and freeness, the paper type and weight, the amount of water to remove, the press nip intensity are all very important parameters to consider when evaluating the physical properties. As an example, a press fabric manufactured for a Pulp machine requires a very high water handling capacity and a very low flow resistance.

The pressure uniformity and the sheet finish are almost negligible factors. However, on a machine producing a light and critical sheet (ex-coated base), these two properties have a higher impact and can be more important than the water handling capacity and the flow resistance.

The press fabric designer has the responsibility to well define the physical properties required for each application and to understand the interrelation between the physical properties and their influence on the paper machine.

The technological evolution of the Pulp and Paper industry has forced the press fabric manufacturers to develop new products that better fulfil industry requirements. New families of complex multi-layer designs, as well as revolutionary Fibernetics process have been introduced in the recent years and this will be reviewed individually in this paper.

LAMINATED DESIGNS

Laminated press fabrics are made of two or more base fabrics with separate yarn systems laminated during manufacturing (figure 2). Due to the stratification of two or more individually woven base fabrics, laminated press fabrics give the press fabric designer more flexibility in the selection of yarn, yarn density and weave patterns. The backing base usually assures the water handling capacity and imparts compaction resistance to the press fabric, while the top base fabric-which can be machine or cross machine oriented - increases the base fabric uniformity. Increased base fabric uniformity is necessary to optimize the pressure distribution and improve the sheet finish.

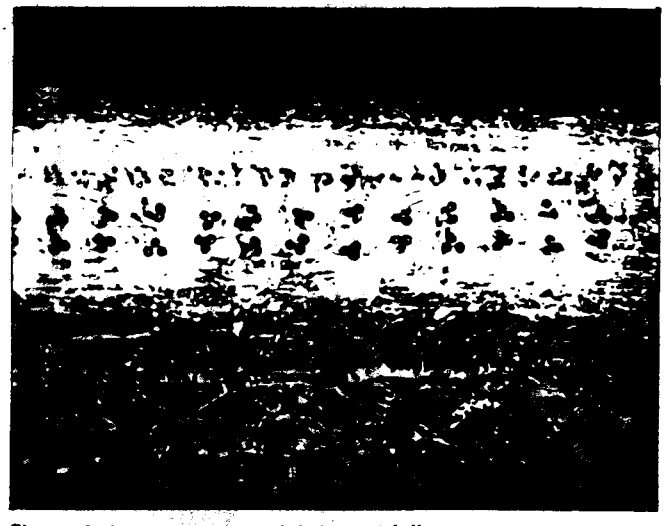


Figure 2: Laminated base fabric and felt

Laminated press fabrics represent a big step forward in the development of multi-layer designs. In the past, this concept was used on highly loaded press positions where a large amount of water had to be handled Today, the concept is being used more and more on high speed publication grades as well as on Board and Kraft machines where sheet quality and machine runnability are more critical.

The laminated designs show the following advantages over integrally woven designs :

- Higher water handling capacity (figure 3)
- Better resistance to compaction (figure 4)

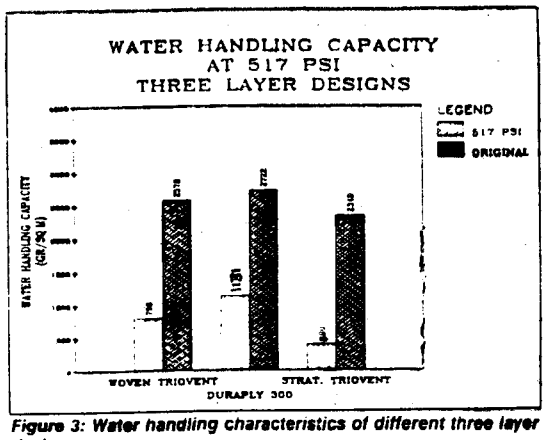


Figure 3: Water handling characteristics of different three layer designs

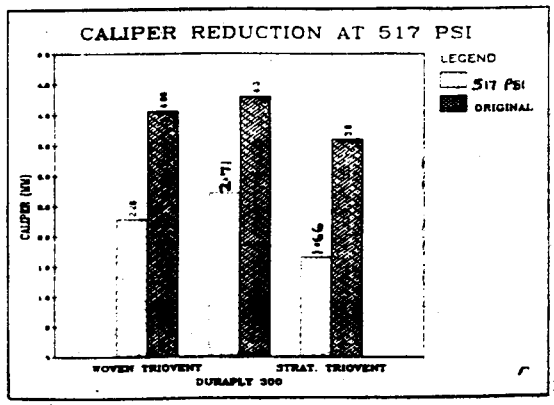


Figure 4: Caliper reduction of different three layer designs

— Improved sheet finish (base, groove, shadow marking)

— Potential improvement in sheet smoothness

— Vibration free operation

The above advantages have contributed to the rapid growth in the last two years of laminated designs.

The Duraply laminated design is thus now a major contributor to high sheet quality standards in the paper industry.

STRATIFIED DESIGNS

The stratified base fabrics are manufactured from a special weaving process which results in a single base with a double density of fine machine direction yarns on the surface and a single density of coarser M.D. yarns on the back side. The stratified base fabrics can be manufactured in two, three and four layer constructions (see figure 5).

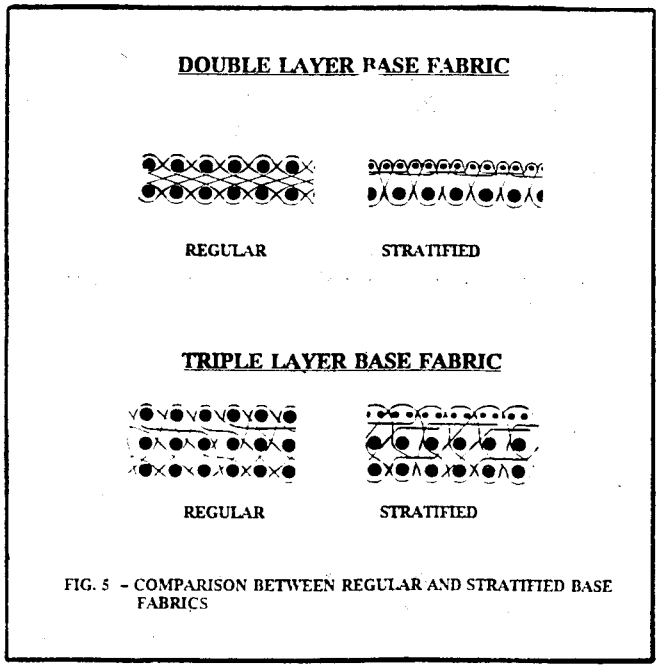


FIG. 5 - COMPARISON BETWEEN REGULAR AND STRATIFIED BASE FABRICS

The density and type of machine direction yarns as well as the weave pattern are selected as a function of specific physical properties and requirements of paper machines.

The dense and uniform structure of stratified base fabrics help to optimize the pressure distribution in the nip and if the proper web blends are used on the surface, the sheet finish can be considerably improved. While the pressure distribution and the compaction resistance of a stratified design are slightly inferior to a laminated design, the stratified design has the advantage of producing a higher specific pressure and a wider nip than a laminated design.

The stratified base fabrics are used on different types of machines. The third and fourth presses of machines producing pressure control grades (Newsprint, groundwood specialties, L.W.C...) are ideal positions for the utilization of the above designs. However, it is imporatant to be certain that the specific nip pressure generated doesn't exceed the maximum limit of the physical capacity of the press fabric. Ideally, these fabrics are run on polyurethane roll covers or stainless steel covers loaded at 110 kn/m or less. The higher loaded stainless steel presses normally require the utilization of laminated or four layer designs.

The stratified designs are also utilized on Board machines requiring a good sheet finish. Excellent results are achieved on the last presses.

FOUR LAYER DESIGN

Four layer base fabrics are made from a unique weaving process (figure 6). The optimization of the physical properties is made though the proper selection of machine direction yarns as well as in the uniqueness of the weaving process. While easy to weave, the four layer designs require special components on the weaving looms and they are not accessible to all press fabric manufacturers.

FIG. 6 - FOUR LAYER BASE AND FELT

While very compressible, four layer base fabrics have the unique advantage of being very resistant to compaction and they retain a high water handling capacity in mid-nip. A study made by the Albany International Research Centre has shown that the four layer produces a wider nip and a lower specific pressure than laminated or stratified designs. These two parameters are very important in the resolution of compacion and vibration problems at high press loadings.

TABLE-II COMPRESSION TESTS
(NIP SIMULATOR AT 90 KN/M)

	*P Max (kPa)	Nip Width (MM)
Stratified Designs	6 68	45.71
Laminated Designs	6.29	48.39
Four Layer Designs	6·27	52.67

***Maximum Pressure in the Nip**

The following advantages can be expected from the 4 layer.

- Minimal vibration at high press loads & machine speeds.
- Very high life potential on stainless steel presses (100 kn/m+)
- Easy to manufacture consistently
- Endless base fabric which requires no lamination

This new generation design was developed especially for high machine speeds sensitive to vibration. Newsprint as well as light weight coated grade machines equipped with highly loaded stainless steel presses (105 kn/m +) are all potential positions for the utilization of four layer designs.

J-88 FIBERNETICS

The basic polyamide fibre which makes up the batt is a key factor in press fabric performance. Compared to the tremendous change in base fabric design, batt fibre has undergone little change. It is however,the wearing away and or compaction (fatigue) of the batt that limits the useful service life of most press fabrics.

The J-88 Fibernetics is a new process which alters the basic polyamide sructure of the fibres to enhance both their physical properties and their chemical resistance (figure 7 & 8). This new process for the first time improves both the physical and chemical nature of polyamide fibres to resist fatigue in the degrading paper machine environment. The field results, which have been extremely positive, reveal the following benefits : substantial protection against chemical attack, superior impact resistance, increased wear resistance,

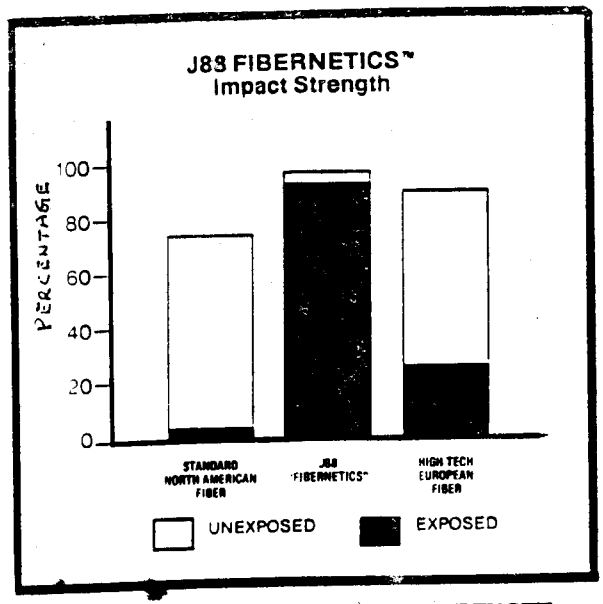


FIG. 7 - COMPARISON OF IMPACT STRENGTH

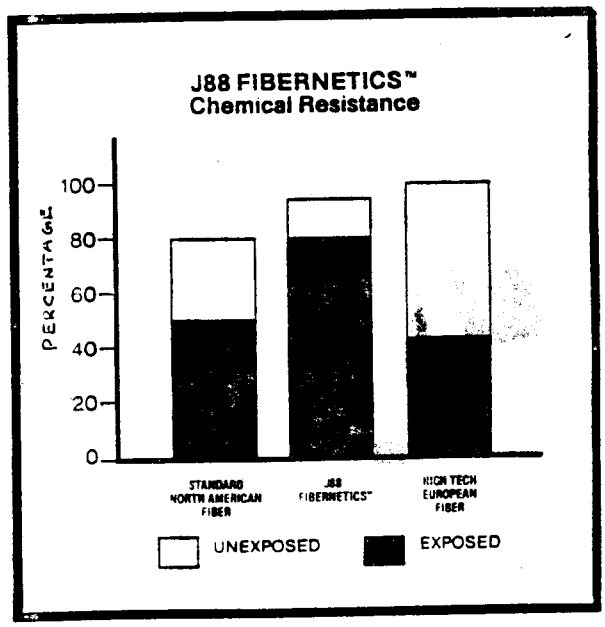


FIG.8 - COMPARISON OF CHEMICAL RESISTANCE

increased compaction resistance and better caliper and porosity retention. In many cases, press fabric life was increased substantially while on other machines, sheet quality standards were maintained for a longer period of time due to improved fibre bonding and less press fabric filling.

The Fibernetics process is used on different types of machines producing various grades. The best results have been achieved on Fine Paper machines using calcium carbonate as a filler. The J-88 has helped to minimize considerably wear and filling up problems which contribute to the reduction in press fabric lives on these machines. Excellent results are also achieved on Tissue and Newsprint machines sensitive chemical degradation and to high mechanical wear.

CONCLUSION

The modifications as well as the new technologies introduced to the Pulp and Paper industry in the last decade had strong impact on the press fabrics. The need for better sheet quality and higher machine efficiency have forced press fabric manufacturers to develop new products that better fulfil industry requirements. Their reply was the introduction of laminated and stratified designs, the J-88 Fibernetics process as well as the four layer integrally woven design.