

## Machine clothing trends

JOHN C. EDWARDS

*The materials that clothe modern paper machines are sophisticated engineered fabrics, and suppliers have differing views on how to best support their customers' needs with these fabrics.*

Machine clothing is essentially the conveyor system that transports the papermaking material from the forming section to the press area and finally through the dryer section. What begins as liquid-rich furnish goes through a rapid transformation to become paper at the reel. In the process, it demands different clothing properties at each stage.

Forming fabrics are one of the tools the papermaker can use to obtain varying drainage rates, total drainage, and release properties. Therefore, the forming fabric must be designed for particular applications to meet specific papermaking objectives. Some of the major variables of the sheet-forming process include the headbox, furnish, paper grade, machine type, machine speed, and forming fabric. Since the fabric is only one element of the formation process, its design must be compatible with other elements in the forming section.

Press fabrics, or felts, carry the water-laden fibers through the paper machine press section. The felts must resist compaction that accompanies the substantial loads placed on the fibers to remove water. Consequently, they must also facilitate water drainage while maintaining their structure and rigidity. Conventional press felts feature an interlocking, woven design, while nonwoven felts, which eliminate the knuckles inherent in woven designs, are also becoming popular.

Dryer fabrics, which carry the now-formed sheet around the dryer cylinders and through the dryer section to complete the drying process, must resist the high temperatures to which they are exposed. Many suppliers rely on flat-yarn fabrics in this section to increase surface contact area with the paper sheet for better heat transfer and to minimize energy usage. Dryer fabrics typically last longer than the forming or press fabrics.

In preparing this article outlining present and future machine clothing trends, *Tappi Journal* interviewed six clothing manufacturer representatives: **Ian Booth**, VP, Marketing, Tamfelt, Inc., Canton, MA; **Bob Buchanan**, divisional chief executive, Scapa Group North America, Raleigh, NC; **Francis**

**Davenport**, director, Papermaking Technology, Albany International Corp., Albany, NY; **Shelly Sybeldon Phillippi**, technical marketing coordinator, Appleton Mills, Appleton, WI; **David Pretty, Sr.**, director, Marketing, Weavexx Corp., Wake Forest, NC; and **Bob Ward**, VP, Marketing, Asten Group, Inc., Charleston, SC. We wish to thank each respondent for his or her time in preparing for and participating in the survey.

**TJ:** *What changes in the paper manufacturing process over the last five years have had the most significant impact on machine clothing performance and design?*

**BUCHANAN:** Alkaline papermaking has had the greatest impact, followed closely by the increased machine speeds and the advent of gap formers. Extended nip, or large roll, presses as well as the introduction of single-tier dryer sections have also had an impact on the clothing industry.

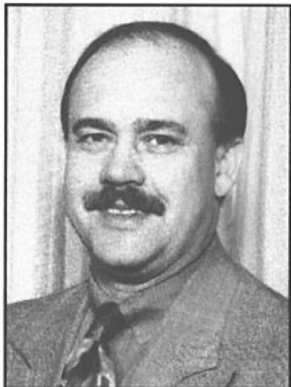
**DAVENPORT:** Two areas have impacted press fabrics: system chemistry and product value. The increased use of recycled paper and linerboard has introduced additives (e.g., ash) that would not normally be part of the process. Single-tier dryer systems now require fabrics with high-speed properties and additional features. Nonmarking seams in low-permeability monofilament designs were also developed.

**PHILLIPPI:** Recycling has led to more felt contaminants. Alkaline sizing and calcium carbonate are more abrasive to paper machine clothing, causing forming fabric and felt wear and the need for stronger fibers. Furthermore, nonchlorine (i.e., hydrogen peroxide) bleaching requires minor modifications to the various polymers and stabilizers.

**WARD:** Among the many changes occurring in the last five years, alkaline papermaking has had a significant impact. The shift to multi-wire formers, extended-nip presses, and single-tier dryers has also made an impact.

<sup>1</sup>Fliss, T., *TAPPI 1993 Wet End Operations Short Course Notes*, TAPPI PRESS, p. 221.

## Machine Clothing



**IAN BOOTH**  
VP, Marketing  
Tamfelt, Inc.  
Canton, MA



**BOB BUCHANAN**  
Divisional Chief Executive  
Scapa Group North  
America  
Raleigh, NC



**FRANCIS DAVENPORT**  
Director, Papermaking  
Technology  
Albany International Corp.  
Albany, NY

**TJ:** *Similarly, what changes in machine clothing design have most influenced paper manufacturing, and in what ways?*

**BUCHANAN:** We see multi-layer forming fabrics, allowing advances in papermaking equipment (e.g., gap formers), have most influenced paper manufacturing, because these fabrics can handle huge volumes of water very quickly while maintaining stability. Laminated press felts have enabled the papermaker to make the best use of extended nip presses, enhancing the sheet strength (especially of linerboard) without introducing detrimental sheet marking. Also, seamed press fabrics have enhanced water removal by allowing the use of more rigid, incompressible base fabrics while easing fabric installation and making the installation process safer. Low-caliper, low-CFM dryer fabrics permit uniron dryer setups and the single-tier-type dryer section.

**DAVENPORT:** Two product families have had a major impact on paper and board machines: on-machine seamed press fabrics and laminated press fabrics. Anti-contaminant polyester fabrics have been developed for all positions, but they have specific advantages in quick-to-fill, first-dryer section positions.

**PHILLIPPI:** In the forming section, the development of multi-layer designs, resulting in different drainage patterns, have had a large impact. Multi-layer and multi-base press felts have improved compaction resistance, sheet finish, and water removal. Seam felts have had a major effect, permitting new clothing designs for improved safety and reduced installation time. Higher-molecular-weight fibers

also help reduce press felt wear and shedding. In the dryer section, elongated warp designs improve sheet finish and handling, while yarn technology has led to hydrolysis- and contaminant-resistant designs.

**PRETTY:** The ability to design and produce high-mesh forming fabrics has had a large influence. The fabric must retain as much fiber as possible while minimizing linting. The expansion of laminated press felts to most presses and paper grades has had an impact on the industry, and the use of seam felts to minimize installation time has had an added effect. The low-profile, high-contact dryer fabrics have been the strong point in innovation.

**TJ:** *What aspects of the paper production process most influence clothing performance?*

**BOOTH:** Recycling and recycled paper content have greatly influenced performance, largely from a cleanliness/contamination point of view. Alkaline papermaking, although secondary to the recycling impact, has also had an impact on clothing performance.

**PHILLIPPI:** In the forming section, furnish, paper quality, and machine speeds have had the most influence. Machine speed, paper grade, furnish, press loading and geometry, and cleaning/conditioning most influence press clothing performance. In the dryer section, the most influential parameters include steam pressure, the moisture of the sheet entering the dryer, machine speed, dryer section geometry, and the type of enclosed hood system.

**PRETTY:** Recycling of paper fibers has put a great demand on our company to develop machine clothing that provides good life while running clean, with minimal or no showering. Forming fabrics, especially on high-speed machines, must also be able to handle large amounts of water with increasing quantities of abrasive additives. Well-maintained machines normally achieve exceptional clothing performance.

**WARD:** Among other operating conditions, overall machine speed, temperatures (especially in the dryer section), the type of furnish, and the chemical environment influence clothing performance.

**TJ:** *What characteristics are associated with nylon vs. polyester vs. other polymers and materials in clothing applications? Which materials or blends are best suited for what applications?*

**BOOTH:** Polyester is the yarn of choice in forming and dryer fabrics. The press section, featuring some type of nylon, is an area subject to chemical degradation such as that seen in alkaline papermaking and chlorine applications. In the dryer section, hydrolysis-resisting polymers are being developed, while some nylon content is added to forming fabrics to improve wearability.

**BUCHANAN:** Polyamide (nylon) is the polymer of choice in the press section, and polyester is broadly the fabric used in the forming and dryer sections. Polyester is more stable in wet conditions than polyamide, while nylon is more resilient and therefore finds application in the press section. Although more exotic blends of polyester may be used in the dryer section to extend life, they are not necessarily cost effective unless the fabric reaches its intended life without being damaged.

**DAVENPORT:** Modern press fabric yarns and batt fiber are almost all 100% polyamide. Polyester's stability, strength, and availability in various shapes and sizes make it ideal for dryer fabrics.

**PRETTY:** Polyester is primarily used in the forming area because of its stability. Nylon is used in the press section; it features elasticity and abrasion resistance. Polyester and its alloys are seen in the dryer section due to their heat resistance properties.

**TJ:** *Yarns are manufactured in a variety of shapes—round, rectangular, and hollow. How do those shapes each influence performance?*

**BOOTH:** The forming fabrics generally feature flat yarns. We have seen little difference in any of these shapes in the press felt section. While flat fabrics may also be used in the dryer section, we rely on a machine-direction, oval-shaped solid yarn, primarily for better sheet contact.

**BUCHANAN:** Rectangular, monofilament yarns in dryer fabrics give more surface area per unit weight, providing a smoother contact with the paper sheet. Because the rectangular, or flat, yarns can only be used in the machine direction, we use the round configuration in our cross-direction filling yarns.

**PRETTY:** Weavexx uses round yarn material in its weaving process, although some flat yarn is used in our dryer fabric production. Fabrics woven from round yarns dissipate water more quickly and evenly than other yarns.

**WARD:** Flat strands or yarns are used in forming fabrics to enhance sheet support. Round, hollow yarns are used in press fabrics to help resist compaction. With dryer fabrics, flat yarns can also be used to provide a smooth, knuckle-free surface to increase surface contact and to help reduce air-carrying characteristics.

**TJ:** *What is the average life expectancy of forming fabric, press felts, and dryer fabric? How does it vary with types of use and weave patterns?*

**DAVENPORT:** Press fabric life varies dramatically from as low as 14 days to over 100 days. Through various material and engineering improvements, we have seen a 10% to 50% increase in our average press felt life over the last two years. Dryer

fabric typically lives from six to 12 months. Abrasion, extreme thermal conditions, and extreme filling limit fabric life in this section. The choice of polymer size and type determines abrasion and overall degradation resistance.

**PHILLIPPI:** Although clothing fabric lives depend on variables such as the type of machine, the machine speed, and press loadings, we expect the following average fabric lives: forming fabric—60 to 90 days, press felts—2 months, and dryer fabric—9 months.

**PRETTY:** Forming fabrics run an average of 100 days, press felts usually last about 40 days, and dryer fabrics can last up to a year. Construction material and weave pattern, which offer high volumes of material on the wear side of the cloth, are the keys to improved life.

**WARD:** We see 90 to 100 days of forming fabric life, 40 days of life in the press felts, and about 270 days of use for dryer fabrics. Fabric life is determined primarily by machine speed, chemical environment, and machine temperatures.

**TJ:** *What are the most common problems mills have with machine clothing?*

**BOOTH:** Cleanliness, the ability to keep the pores of the product open, can be a problem. Also, fabrics in all press sections now run longer than they used to, partly because the industry as a whole has improved clothing quality. Unfortunately, this can cause a mill to run a fabric too long, past its intended life.

**BUCHANAN:** Paper mills tend to physically damage the clothing. Most clothing does not run



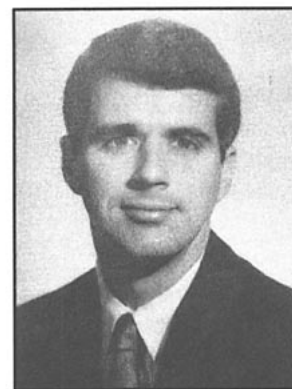
**SHELLY SYBELDON  
PHILLIPPI**

Technical Marketing  
Coordinator  
Appleton Mills  
Appleton, WI



**DAVID PRETTY, SR.**

Director, Marketing  
Weavexx Corp.  
Wake Forest, NC



**BOB WARD**

VP, Marketing  
Astens Group, Inc.  
Charleston, SC

## *Machine Clothing*

its full life cycle either because it is scheduled off or damaged by the papermaker. In addition, with continued use, the clothing begins to mark the paper sheet, even though it may still perform acceptably from a water-removing and drying standpoint, for example.

**DAVENPORT:** Water handling problems in press fabrics are common. These appear as slow startups, poor profiles, streaks, and low sheet solids. Contamination, or filling, also plagues these fabrics. Damage caused by wads or abnormal abrasion, particularly in the seam area, often determines dryer fabric life. Without strong, damage-resistant seams that do not mark the sheet, full life and value of these fabrics are not achieved.

**PHILLIPPI:** The most common problems with clothing are chemical and mechanical damage that occur at the paper mill.

**TJ:** *What are some signs that clothing needs to be replaced (vs. a problem of machine adjustment)?*

**BOOTH:** Moisture profile problems, where wet streaks are seen in the reel, begin to appear. Also, the dewatering ability of the press felt will begin to decline. Because of the heat in the dryer section, fabrics here begin to physically deteriorate and holes become visible.

**BUCHANAN:** An unacceptable sheet quality, typified by clothing fabric marks, is one indication that clothing should be replaced. The loss of drying capability is a second indicator.

**DAVENPORT:** The use of statistical process control techniques, trending fabric caliper and moisture content, suction box vacuum levels, and machine speed, gives the papermaker hard data indicating the need for press fabric replacement. Dirty dryer fabrics, as measured by portable air permeability meters, indicate potential loss of drying capability. However, evaluating the seam strength of these fabrics is most important, since failures most likely occur at the seam. Seam deterioration, indicated by abrasion, hydrolysis, and pintle condition, should be evaluated at every machine outage.

**WARD:** Premature fabric wear can appear or result in loss of paper production in several ways. As fabrics run longer, they tend to fill and allow less air to flow through them. Abrasive machine conditions can also prematurely wear the fabrics, causing a reduction in strength. Sheet marking manifests itself in many ways and is the result of several operating conditions or poor fabric quality.

**TJ:** *How will machine clothing most change in the next five years? What impact might that have on paper manufacturing?*

**BOOTH:** We will continue to be pushed by the paper companies to help them improve sheet quality while they strive for yet higher machine speeds to increase productivity.

**DAVENPORT:** Machine speed, productivity, and quality will continue to influence press fabric applications. Higher operating temperatures, above water's boiling point, will also require special materials and structures. When total sheet support (no-draw) press section-to-dryer section transfer becomes a reality, new products, unlike current press or dryer fabrics, will be necessary to facilitate this transfer.

**PHILLIPPI:** We expect to see finer, multi-layer fabrics in the forming section, more seamed wet felts, and changes in raw materials. We will also need to develop low-cost products and processes to maintain profits in today's price-depressed market. Better cleaning methods are expected to provide increased fiber support, and nontraditional materials may be developed to overcome the limitations of current technology.

**PRETTY:** We will be challenged to maintain or improve clothing performance (i.e., life, stability, and cleanliness) as paper machine speeds continually increase and recycling becomes more prominent.

**TJ:** *What do you consider to be the most significant or innovative changes in the design and manufacture of machine clothing within the last five years?*

**BOOTH:** We have a new, patented, proven product, called SuperAquaduct, which is a nylon-based nonwoven used in the press section. This, our "secret weapon," features no woven knuckles, providing a smoother fabric that is able to outperform our competitors' woven clothing; it makes up close to 50% of our product mix. Our exclusive Equalizer dryer fabric, reducing sheet speed differentials in this section, is being used successfully in some of the fastest machines in Scandinavia.

**DAVENPORT:** Global product research has led to two recent developments: extremely fine woven structures with no needed batt and multi-axial press fabrics for optimum compaction resistance. Albany's patented Thermonetics dryer fabric is an economical alternative for hydrolysis-prone positions. Since its introduction in 1990, the percentage of multi-filament fabrics has dramatically decreased.

**PRETTY:** The most significant change in forming fabrics is the ability to weave high-mesh, multi-layer products; the ability of yarn manufacturers to produce finer filaments; and the ability of loom manufacturers to produce equipment that yields higher meshes and a multitude of weave patterns. In the press section, laminated felts (e.g., double-base, triple-base, or multi-layer combinations) offer designers the ability to cloth virtually any modern machine. We also expect the seam felts to be applied to paper grades for which they were previously not used. Furthermore, the development of 100% manmade yarns offers more flexibility in designing and increasing clothing life.

**WARD:** In the forming section, it has been the development of superfine-mesh, multi-layer forming fabrics. Among Asten products, our new HCB™ base fabric technology for press fabrics has shown better water removal, compaction resistance, and flexibility for easier felt installation. For the dryer section, our Monotier™ fabric has proven to be successful on single-tier and other critical applications to improve sheet support and reduce air carrying.

**TJ:** *There has been a significant consolidation of machine clothing companies over the last five or ten years. What impact has that had on how your company approaches customer service, research, and business in general?*

**BOOTH:** We in Canton were originally the Draper Felt Co., dealing only in press section clothing. In 1986, we were purchased by Tamfelt Oy of Finland, and have since been a stand-alone manufacturer of machine clothing for all paper machine sections.

We are a small company in terms of our competitors, which can hinder our success. As a result, we market quality service as opposed to the quantity service that some of our competitors offer. Overall, we believe our company's ability to be especially innovative allows us to market our product where some of our competitors cannot.

**BUCHANAN:** We acquired Scandia Felt in 1992 and have purchased several other companies over the years. I don't believe the pure act of acquiring other companies has influenced our approach to service or research; that approach is customer- and market-driven. Our aim in acquiring companies is to gain market share and to enhance our influence in certain markets.

**PHILLIPPI:** We have been part of the consolidation process in both the domestic and international markets. It has allowed us to provide expanded service to our customers and improved our research and development efforts. The consolidation has led to an overall strengthening of relationships with our customers.

**WARD:** Asten Group remains a privately held company, as it has been for more than 100 years. Our objective to meet and exceed our customers' needs and expectations, through the delivery of top-quality products and services, also continues and strengthens as our business grows. ■

*Edwards is a freelance technical writer based in Uniontown, OH.*