ENGINEERING THE EVOLUTION: LAMINATED PRESS FABRICS

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LAMINATED PRESS FABRICS EVOLVE INTO MULTIAXIAL AND APERTURED INNOVATIONS TO ADAPT TO EVER-CHANGING PAPER MACHINE TYPES AND CONDITIONS.

ADVANCEMENTS IN PAPERMAKING TECHNOLOGY have led press fabric manufacturers to develop new products. Spurred by the papermaker's demand for press fabrics that will prevail over faster machine speeds and increased productivity, the design engineer is shouldering greater responsibility for improved sheet quality and production efficiencies. Challenges come not only from paper machine modifications but also from advances in printing technology. More stringent printing requirements oblige press fabric designers to place even greater emphasis on improving sheet quality not only for the publication grades but also for kraft papers.

PRESS FABRIC CONSTRUCTION

Conventional fabrics are "integrally" woven, i.e., the machine direction (MD) yarns are connected with cross-machine direction (CD) yarns. The press fabric is made up of a woven component and a nonwoven component—batt— mechanically attached during the needling process.

Laminated press fabrics consist of two or more separate bases, which are joined by the needling process. The bottom base can be an integrally woven single-, double-, or triple layer or even a four-layer construction; the top base is typically a single layer. This provides us with an almost infinite number of possibilities for the design of press fabrics. **Figures 1 and 2** compare integrally woven and laminated double-layer bases.

HISTORY OF PRESS FABRICS

Originally press fabrics or *felts* consisted of only a woven component of woolen yarns, which was *fulled* to achieve proper size and finish characteristics. As press loads and speeds increased there was a need to mask the base fabric weave and create a more durable product; thus the press fabrics of today began to evolve.

Needling technology allowed the nonwoven component, or batt, to be needled onto the base structure. This product initially had a larger percentage of batt relative to base but eventually the base fraction exceeded the web fraction once again to accommodate higher loads, longer dwell times, and nip contacts from increased speeds. The lower batt-to-base ratio creates a fabric that is more resistant to these conditions and less compressible over time, leading to increased life.

Laminated fabrics further increase the base ratio. One of the first attempts at a laminated construction was to create a fabric that was *vented* on the backside. This was done by using a bottom base with large MD yarns or extruding plastic onto the backside of the fabric.

Another development was *integrally woven* laminates in which a small binder yarn in the MD or CD was used to hold two planar structures together. The binder yarn could also be water soluble and removed during the washing process. This would eliminate knuckles, which can cause marking.

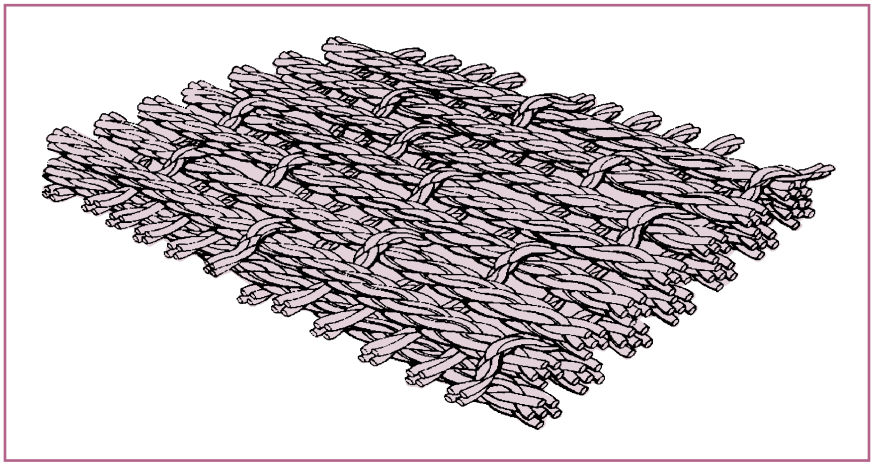
One of the initial difficulties with laminated bases was matching the woven sizes and dimensional changes during the needling procedures. After carefully engineering the sizes of the two separate bases and developing needling techniques to join them, press fabric manufacturers began to make laminated fabrics with two independent CD and MD yarn systems.

ADVANTAGES OF LAMINATED STRUCTURES

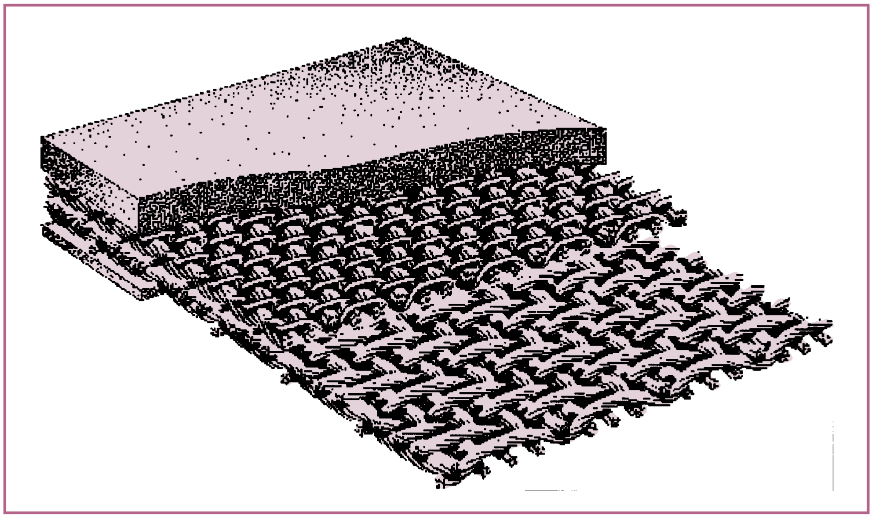
The laminated fabric produces characteristics not attainable with an integrally woven fabric. Since the CD and MD yarn systems are separate, they will not collapse as readily over time. This translates into increased fabric life and more consistent performance throughout life. We refer to this performance as *steady state pressing.*

Steady state pressing

While the fabric runs on the paper machine, certain performance parameters can be measured vs. time. This



1. Integrally woven two-layer base



2. Laminated two-layer base

could be fabric caliper; uhle box vacuum; nip or uhle box dewatering, or both; moisture content; and draws, etc. Upper and lower control limits exist for each parameter. The performance parameter remains within these limits when a laminated fabric is used vs. a two-layer batt-on mesh as illustrated in **Figs. 3 and 4**.

Void volume

The use of laminated base fabrics produces a felt with increased void volume and therefore increased water handling ability. In this application 1 + 1 > 2! For example, a new two-layer batt-on-mesh fabric would have a void volume of 610 cc/m^2 vs. a double-layer laminate with a void volume of 700 cc/m^2 of equal weight. The same used fabrics have void volumes of 200 cc/m^2 and 450 cc/m^2 respectively. There is not only an increase in void volume but also much improved retention of this characteristic after use.

Improved sheet finish

Typical laminates consist of a bottom base for void volume and load bearing properties with a finer top sleeve to create more uniform pressure and drainage distribution in the nip. This means improved sheet finish for the papermaker. If we picture a bed of nails, the traditional fabric would have perhaps a distribution of only 10/in.^{2} vs. the laminated fabric, which may have 3–10 times the amount of contact points per inch thus producing more uniform contact with the sheet. The drainage will be more uniform comparable to a fine-mesh forming fabric relative to a coarse one.

Reduced batt-to-base ratio

Because of the use of a fine top sleeve, less batt is required to mask the mark of the bottom base. The batt portion of the fabric is more compressible and more easily filled over time. With less batt the fabric will have less compaction and filling resulting in longer life and improved productivity on the paper machine. The base dominated structure is easier to keep clean and could result in decreased cleaning chemical usage—an added savings.

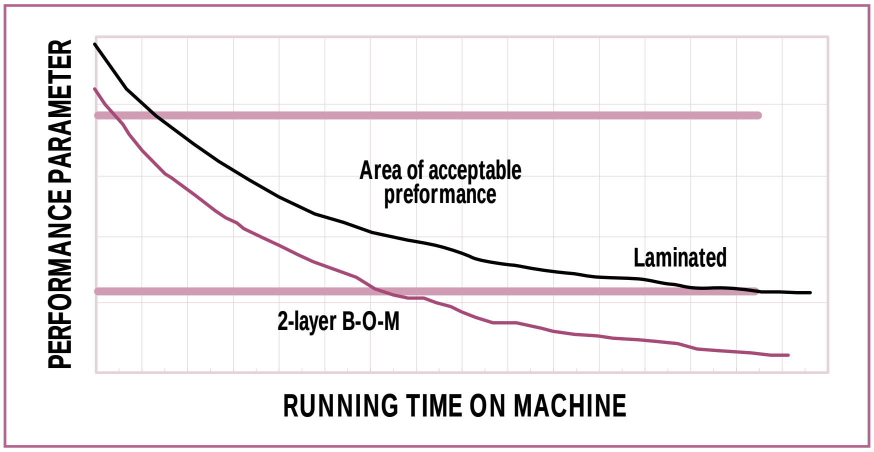
MULTIAXIAL PRESS FABRICS

Increased demands for sheet quality and compaction resistance have led press fabric technology one step further—a unique construction with base fabric yarns in at least four directions.

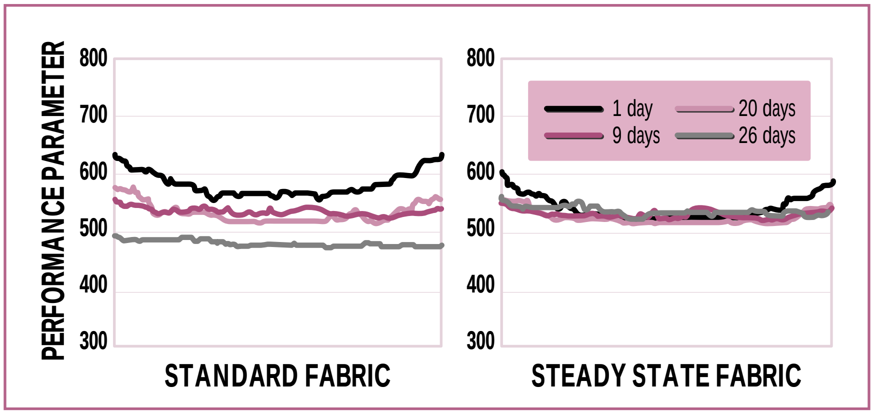
The manufacturing techniques for forming fabrics produce high quality from flat weaving as opposed to endless weaving used for press fabrics. Unfortunately polyamide does not lend itself to splicing as easily as polyester used in forming fabrics. Therefore, a new manufacturing technique has been developed. A flat woven fabric is spiraled and bonded-spiraled in one direction for the bottom fabric and the opposite direction for the top fabric.

Figure 5 shows this process. A MD yarn for each base has been highlighted in red. They are slightly offset, which means we not only have two separate MD and CD yarns (four directions) systems; but these systems are also at an angle. Thus the MD yarns of one base will not nest into the MD yarns of the second base. This produces better compaction resistance and less caliper reduction over time, leading to longer life. The fabric design is more open under load, which will facilitate cleaning. An additional benefit is stability in long unsupported areas of the fabric run since the MD yarn systems will not allow typical elongation, which can occur with other fabrics.

As previously mentioned, flat weaving is capable of producing very high quality and extremely uniform surface topography for improved sheet finish. In endless weaving there are two loom edges that may exhibit slight nonuniformity. In press sections prone to vibration, this nonuniformity may cause a "bounce." The multiaxial fabric has no loom edges, which will eliminate this as a cause for vibration.



3. Performance parameter



4. Steady state pressing

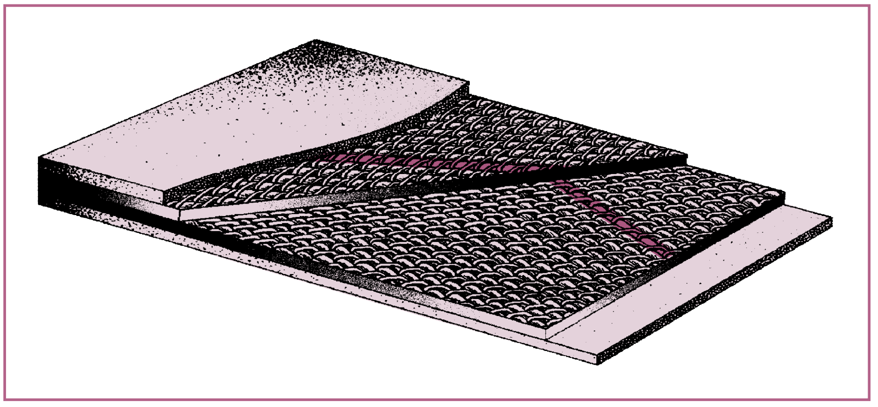
FIELD RESULTS—MULTIAXIAL PRESS FABRICS

In our experience of field testing several hundred Dynatex® fabrics, which have run on paper machines producing a variety of grades, we were able to document specific improvements in several areas.

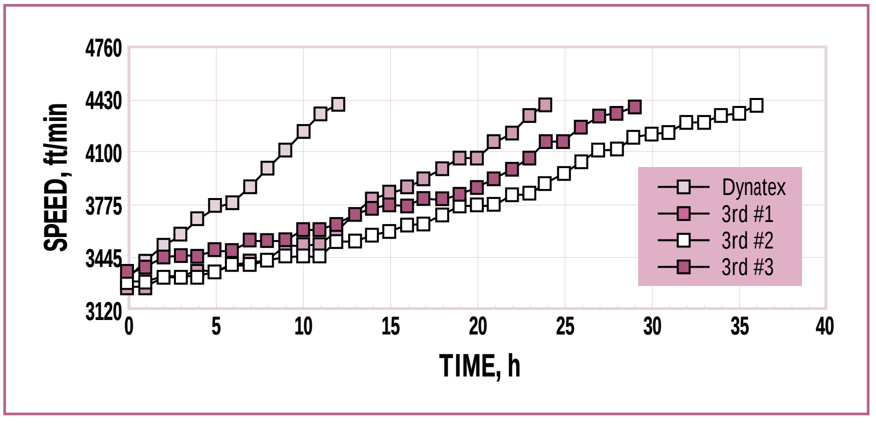
- A Valmet Sym-Press with a fourth press manufacturing magazine paper at 5100 ft/min used the fabric on the pickup and first bottom positions. The uhle box vacuum remained low throughout life and dropped 15% in response to cleaning late in life. This behavior is due to the monofilament structure of the base fabric, which is easier to keep clean. Since the fabric was easier to clean, moisture streaks in the fabric did not develop and sheet moisture profiles improved at the reel.

- We tested a Dynatex® fabric on a high-speed (4600 ft/min) newsprint trivent, which runs multiaxial fabrics on the pickup position. The machine typically experienced severe fabric rippling entering the first press. (Rippling or fingering may occur if the press fabric begins to stretch in the machine direction, thus becoming slack and wavy.) To combat the fingering, the fabrics were stretched out on the jack and we tracked the number of times this was done. The test indicated that the fabric only had to be stretched twice over the life of 22 days. The multiaxial fabric did not elongate over time; therefore no narrowing occurred, which contributed to improved machine runnability.

- In a study to cut start-up time, a Voith trinip making newsprint at 4600 ft/min used the multiaxial fabric on the first bottom and third presses. Achieving optimum speed was difficult for this machine. Use of laminated fabrics, although beneficial for compaction resistance, frequently takes longer to break in. The multiaxial fabric can be designed to be thin and dense throughout life and yet maintain caliper while on the machine. When the two multiaxial fabrics were installed, startup improved dramatically. It was reduced from 24–36 hours on average to 12 hours. **Figure 6** documents this experience.



5. Multiaxial press fabrics



6. Field results for multiaxial press fabric

"APERTURED" STRUCTURES

The press fabric manufacturer is continuously looking for ways to improve the operation of the press section and the quality of the sheet. The newest developments in this endeavor are apertured structures, which are nonwoven components that act as a "layer" in the laminated structure.

These "layers" will offer the ultimate in uniformity for pressure and drainage distribution contributing to improved sheet finish. Anti-rewet agents and anti-soil treatments can be incorporated into these materials to offer new improvements in press section performance.

These new designs as well as the laminated and multiaxial fabrics will continue to be fine tuned and developed to adapt to the ever-changing machine types and conditions. Engineering the evolution of press fabrics continues. **TJ**

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