Shoe Press Use on Graphic Paper Machines Grows as Mills Push for Higher Efficiencies

Faster machine speeds, increased minerals in the furnish, rising production costs, quality demands place growing pressures on shoe press fabric and belt performance.

— By Ken Patrick, Editorial Director

About a decade ago the first shoe press started up on a newsprint machine in Sweden. Prior to this pioneer machine, almost all shoe press installations had been on brown paper grades. Today, more than 100 of these presses are operating on new or rebuilt printing and writing paper machines around the world.

According to Eric Arseneault, application specialist, Graphics Business Development Team, Voith Fabrics, 23-plus graphic papers machine in North America are currently equipped with shoe presses This number is increasing at a constant rate, he adds.

Arseneault explains that the press geometry in which these shoe presses are used varies. But in general (North America), the dominant press arrangement is a tri-nip cluster configuration with the shoe system in the third press position.

"Regardless of the press configuration or the paper grade produced, shoe press systems are used to increase production."

– Eric Arseneault, Application Specialist, Graphics Business Development Team, Voith Fabrics

"We can expect the number of shoe press to double during the next three to five years as all new and rebuilt graphic machines will likely include a shoe press system," Arseneault points out, adding that "this growth will be driven by higher quality and productivity demands. It is also important to note that the increasing energy cost will have a large influence on new shoe press installation around the world."

North America vs Europe, Asia

Daniel Hedou, product business leader-Press, AstenJohnson, says that shoe presses producing printing and writing papers in North America represent less than 10% of all machines currently operating in these grades, "but this number is climbing every year, as retrofitting third and fourth presses to a shoe press remains one of the most economical ways to increase machine productivity."

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– Daniel Hedou, Product Business Leader-Press, AstenJohnson

Hedou says that North America pioneered the use of shoe presses in packaging grades since 1980, but Europe was more aggressive in adapting this technology to printing grades in the 1990s. "North America has been catching-up of late and several paper companies are planning to upgrade our best machines in 2004 and 2005," he says.

Albany International's Peter Slater, global sales and application director, Process Belts, says that although the percentage of publication grade machines utilizing shoe presses in North America today is less than 10%, more than 40% of all shoe presses installed per year in North America are on publication grades.

"Using price as a determinant misses the fact that there are more significant, 'hidden' aspects to the use of belt and fabric designs in terms of machine economy and efficiency,"

– Peter Slater, Global Sales and Application Director, Process Belts, Albany International

In comparison with North America, Slater explains, the Asian market is more difficult to assess due to the size and pace of growing markets such as China. One big difference is that, "in Asia, investment tends to be new, state-of-the-art total

machine projects with old capacity then closed. The pace of European investment has been higher than in North America, with nearly 20% of publication grade machines in Europe being equipped with shoe presses, he points out.

According to Arseneault of Voith Fabrics, compared with the rest of the world North America stands relatively well with regard to shoe press installations for graphic papers. "We estimate that North America has 15% of all graphic paper shoe press systems worldwide. The majority of shoe presses in North America are machine rebuilds. Since 2000, Europe and Asia have had a higher number of new machine installations," he points out.

Shoe Press Driving Forces

As Billy Summer, senior designer-Press Fabrics, Weavexx, explains, the major drivers behind increased use of shoe presses on graphic paper grades in recent years have been the desire for higher production at lower cost and better control of sheet properties. "The addition of a shoe press to an existing press arrangement can improve press solids six to eight percentage points," he says.

"This facilitates higher machine speeds and improved efficiency because of reduced draws and better internal bonding of the sheet. The shoe press also gives better control of sheet properties such as bulk, printability, and smoothness without sacrificing dryness," Summer notes.

Slater of Albany International adds that these driving forces often vary, depending on whether the shoe press is part of a new project or a rebuild. Almost all new press sections today contain a shoe press, he notes. "For a rebuild project, increased machine speed and efficiency or paper quality issues are the key drivers."

Hedou of AstenJohnson adds that "the main reason for upgrading to shoe presses was, and remains, the increase in productivity through higher press solids. Arseneault of Voith Fabrics agrees, stating that "regardless of the press configuration or the paper grade produced, shoe press systems are used to increase productivity.

"The increase in dryness provided by the shoe press will generally yield higher machine speeds. Higher sheet solids out of the press section will play a key role in improving machine efficiency (lower draws, reduced sheet breaks, etc).

"In addition to productivity, a shoe press system will often influence sheet quality parameters. On wood-free grades, for example, sheet bulk versus sheet dryness diagrams reveal that for equal dryness values, shoe pressing will yield a higher bulk index than traditional roll pressing.

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> *— Billy Summer, senior designer-Press Fabrics, Weavexx*

"In addition to quality and productivity, shoe press systems have an indispensable role when integrated into newer modern press sections. These single and tandem nip press sections have been designed to eliminate the bottle necks associated with traditional press sections. They are capable of attaining speeds above 1,900 m/min using no-draw configurations and relatively linear sheet travel direction," Arseneault explains.

Designing Fabrics for Shoe Presses

Slater explains that modern press fabric designs generally can be manufactured with adequate capacity to handle the water removed in a shoe press. "As more grooved shoe press belts are used (more than 85% of all belts on publication grade shoe presses are grooved today), what has become more important is the rate at which that water is removed," he says.

"At the same time," Slater adds, "sheet quality requirements are still paramount, and so fabric designs tend to use novel base structures to allow water flow and handling with finer surfaces to ensure good sheet properties."

Because of the lower peak pressures of a shoe press compared with a conventional roll press, Summer says the design of press fabrics has been less challenging. Compaction rates, he adds, are less and the preservation of a press fabric's properties is improved. "With a conventional shoe press, the failures have had less to do with product but rather with application. Over-designing (too heavy, too coarse) were some of the earlier pitfalls.

"With the introduction of the newer, closed-draw, shoe-press arrangements," Summer continues, "the challenges have increased. These arrangements are double-felted and either single or a two-nip press. Minimizing rewet, maintaining consistent water removal perform-

ance, and achieving desired sheet quality parameters have been the challenges with these press arrangements."

Hedou points out that some shoe press applications really brought out the need for increased press fabric uniformity. This prompted the introduction of multi-axial constructions and some innovative surface technologies such as flat fiber and thermally fused fabric surfaces, he explains. In some cases, anti-rewet technology has been absolutely necessary to the success of the shoe press operation due to new supported fabric runs.

"The application of seamed fabrics on shoe presses also presents additional challenges due to the propensity for the seam to mark in the long dwell time press. This has generally been addressed through further incremental refinements of the seam area, which diminishes the magnitude of the seam opening. Again, multi-axial technology has helped us meet these challenges," Hedou emphasizes.

Arseneault says that press fabric requirements will vary significantly depending on the paper grade produced and the geometry of the press section (more specifically the location of the shoe press). As it is the case for roll pressing, he notes, the main objectives for the press fabric design in shoe pressing revolve around:

Rapid startup

- Optimum dewatering efficiency
- Positive influence on sheet quality (including CD sheet moisture profiles)
- Maintaining steady state conditions
- Optimum operating life.

The high press impulse from the shoe press (longer nip residence time) increases the influence (negative and positive) the press fabric has on the sheet, Arseneault explains. "Issues related to sheet smoothness and sheet moisture profile induced by the press fabric are common. This is not to say that these challenges are not present with traditional roll pressing, but they simply become more pronounced and often problematic in shoe pressing applications. Press fabric design engineers therefore have to find a precise balance between total system void volume, system resilience, and press fabric surface pressure uniformity.

"Too often the press sleeve (or belt) design characteristics are not accurately considered during the press fabric design process. The press sleeve has characteristics that can change from one manufacturer to the other. The sleeve characteristics can also change over the course of its life (surface wear, groove deformation, etc) and will have an effect on the efficiency of the press fabric.

"This clearly underlines the importance of evaluating the shoe press as an assembly that contains interdependent elements (press fabric, sleeve, and the shoe system) that need to be optimized using a well organized approach," Arseneault says, adding that "it has become common practice for some press fabrics manufacturing companies (the ones that have press sleeve manufacturing capabilities) to assure joint design activities with the press fabric sleeve team to assure optimum results on key shoe press optimization projects."

Latest Fabric Technologies

Arseneault points out that the PrintFlex P, stage two of Voith Fabrics' Four-Stage Platform for shoe pressing was developed in conjunction with Voith Paper using their research & development facilities and Voith pilot machines.

One of the main elements influencing sheet dewatering and sheet quality in shoe pressing is micro pressure uniformity, Arseneault says. The PrintFlex P press fabric offers a very high micro uniformity index, he explains. The surface is engineered to contain a blend of fiber and resin carefully distributed in the fabric's z-direction. The high uniformity index of the press fabric is essential for controlling micro-rewet taking place in the press nip known for affecting dryness and causing moisture profile issues.

Sheet print quality (PPS, missing dots, etc.) is also improved with the PrintFlex P technology, Arseneault explains. "Its influence on printability surpasses fabrics having very fine surfaces, yet the PrintFlex P has a higher resistance to wear than traditional designs. Finally, the PrintFlex P press fabric is a very versatile product and can be designed to adapt to various paper grades and machine conditions," he says.

Hedou explains that basic technological platforms at AstenJohnson used to meet the challenges of printing grade shoe presses have been the PriZm-XF and Stratus/NexGen (seamed) technologies. Both of these base structures afford the best surface contact area while maintaining the center of the fabric open for flow control, he says. "We are able to customize these base struc-

tures to meet the higher void volume, uhle dewatering freesheet presses, as well as to provide the nip dewatering required for newsprint and supercalendered grades.

"Our AquaTrol anti-rewet technology and our Equator flat fiber are other staples of successful printing grade shoe press applications. Our NexGen thermally fusible fiber is also frequently used to maximize sheet-to-fabric contact quality," Hedou explains.

Summer says that "for all press configurations, our press fabric development is focused on exceeding desired paper quality parameters and providing efficient water removal performance throughout life. We have developed our Huyperpunch D and Huyperm products to meet sheet quality goals. These products combine specialized needling and finishing techniques that provide the smoothest press fabric surface in the industry. These processes can be incorporated on specialized base constructions that are engineered for maximizing macro-uniformity and controlling compressibility properties.

"Our family of Capillaris TX press fabrics," Summer continues, "were developed specifically for the shoe press market. These specialized base constructions combine unique weave patterns and yarn combinations that can be engineered to achieve the functional properties necessary for realizing the full potential of the shoe press arrangement. Our Dry Star products incorporate an anti-rewet barrier that preserves the sheet solids on the newer, closed-draw shoe press arrangements," Summer notes.

Slater explains that the Albany Laminated 2+1 and 1+1 designs with superfine top bases are the most widely used fabrics to maximize nip dewatering and optimize sheet quality. "Non woven bases have begun to grow in use because of their ability to give excellent pressure uniformity leading to improved dryness and sheet quality. The application of seamed press fabrics is growing strongly," he says.

Trends and Challenges

Hedou of AstenJohnson points out that a growing trend with all printing and writing papers is the continuous need to eliminate sheet two-sidedness and overall smoothness. Shoe press owners are no exception to this trend.

"Press fabric makers now offer a great variety of technologies to address this need. AstenJohnson's new AXiom technology encompasses all the necessary attributes to optimize sheet topography—optimized sheet contact area, fine mesh base to reduce yarn embossing, open base to control destructive hydraulic pressures, and new batt making techniques that ensure optimum press fabric formation uniformity," Hedou says.

According to Summer of Weavexx, one of the greatest impacts on felt design has been the advent of the single-nip shoe press concept for uncoated free sheets; and to a lesser degree two-nip shoe press arrangements. With regard to the single-nip shoe press configuration, he says, "providing a press-fabric design that will take sheet solids from 20% at the couch to 48-plus% out of one nip, while achieving the paper quality goals and performing consistently for the desired length of time, is quite a challenge. It still one that continues today.

"Neutral pH operations with high levels of mineral fillers can make this challenge with press design even greater. Proper conditioning and a biocide program that doesn't expose the press section clothing to chemical degradation is essential to being able to achieve success on these modern, high-speed machines," Summer points out.

Slater believes that the trends toward improved print quality and machine speed will continue to push shoe press utilization and fabric design in the near future. "This affects many different areas of paper machine operation from type of fiber through filler materials and efficiency of operation. Design work has focused on this and has lead to a new breed of fabrics with finer and finer surfaces, in some cases with a coated surface. The use of non-porous belts is now common in publication grades."

Arseneault of Voith Fabrics adds that "paper manufacturing is not a static process. Machine conditions and raw materials have evolved significantly over the years. Filler type, recycle fiber content, and machine speeds all are being optimized to improve productivity and quality.

"Such changes often have a negative impact on paper machine clothing. A high percentage of recycled fibers for example will require more intense cleaning and conditioning of the press fabric (more importantly on the shoe press position). In some cases, excessive cleaning shower pressures will negatively affect the fabric's properties and lead to runnability issues. Advanced press fabric technology (such as the PrintFlex P) is, however, available to help meet such challenges," Arseneault says. ■