

# Fabric Cleaning-Conditioning Plays Key Role in Press Section Efficiency

*Press fabric design, mechanical elements, and chemical cleaning programs are key elements for reducing fabric filling, and need to be carefully maintained to combat changing conditions on a paper machine.*

— BY TONY FERGUSON

Periodically paper machines new and old require cleaning and conditioning audits. This is to ensure that the showering and vacuum systems are properly designed and maintained for optimum press section efficiency. An inadequate system can lead to rapid press fabric filling.

Common contaminants include wood fibers, wet strength resins, sizing agents, clays, calcium carbonate, and wood fibers. Press fabric performance will decrease as the contaminants fill the inner voids of the fabrics. There are several operating problems that can surface as a press fabric fills. However, this can be minimized through press fabric design, mechanical means, and chemical cleaning.

## Negative Impact of Press Fabric Filling

**Reduced Water Removal:** Maintaining sufficient void volume in a press fabric is important for allowing optimum dewatering throughout the life of the fabric. As the fabric ages and fills, it becomes more difficult for the fabric to accept and give up water. Indications of poor water removal are increased press breaks, higher sheet draws, increased steam consumption, and sheet runnability throughout the dryers and at the reel.

**Poor Sheet Profiles:** Wet streaks in the sheet occur when dewatering efficiency is reduced by localized filling in the machine direction (MD). The permeability of the press fabric decreases in the MD locations, preventing water from passing through it at the press nip or uhle box. Poor sheet profiles are usually related to non-uniform showering, chemical cleaning, and/or variations in press loads (see Figure 1).

**Sheet Stealing:** Filled press fabrics typically run with higher moisture levels, resulting in a wetter and smoother fabric surface. The sheet is then more difficult to transfer off the fabric. Cleaning the fabric with a high pressure shower or a chemical wash can remedy the situation.

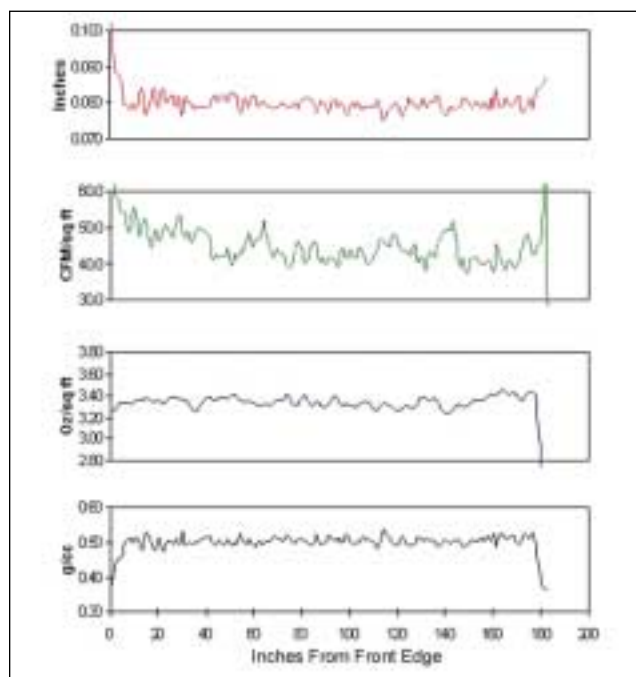


Figure 1. Returned cross machine press fabric sample showing caliper, permeability, weight, and density profiles.

**Sheet Drop Off:** This can occur on machines that have vacuum pickup rolls assisting with transferring the sheet from the forming section to the press section. If the press fabric permeability is reduced too much, the sheet will start to separate and fall away from the press fabric. Vacuum from the suction pick up roll cannot get through the press fabric to the sheet. This may also lead to an inability to pick the sheet off the forming fabric. Drop offs can occur anywhere between the suction pickup roll and first press roll.

**Crushing:** As a press fabric ages, it compacts and fills up, losing its void volume along the way. This may lead to a press fabric that can no longer accept water. If this condition is severe, it can create crush marks and holes in the sheet.

Solving fabric filling problems is a three-prong approach—*press fabric design, mechanical parameters of the paper machine, and chemical cleaning*. These are discussed below.

### Press Fabric Design Parameters



Figure 2. Press section schematic cross section.

The two components in press fabric design that impact the rate of filling are the web and base fabric, as shown in Figure 2.

The first component—web structure—utilizes various size fibers to assist in achieving optimum performance. A wide range of batt fiber sizes from very fine to coarse can be used. The type of fiber selected depends on the paper grade, speed of the machine, position in the press section, press loading, and fabric life expectations.

Typically the press fabric designer will stratify the web, having the finer layers on the surface contacting the sheet and the coarser fiber on the interior and backside. If a filling issue is occurring, the designer can consider selecting a coarser interior fiber while maintaining the finer web on the surface without sacrificing sheet smoothness.

There are also instances when the surface web will need to be changed. Before this is done, however, there are a few things to consider—will sheet smoothness be disrupted?... are there any sheet handling problems (sheet pick-up, or sheet threading issues for example) that would worsen with a coarser fiber? Opening up the fabric too much, however, can result in a loss of sheet dryness.

The second component that impacts fabric filling is the base fabric. Base fabrics can range from incompressible to very compressible. Filling and poor performance can result from base fabric compaction. Base fabrics also have a wide range of permeabilities. A fabric with low permeability may be more prone to filling. There are many different yarns that can be used in each fabric design. There are three classifications of base yarns—multifilaments, plied monofilaments, and single monofilaments. Single monofilaments are the least compressible.

These yarns are woven together to produce single, double layers, triple layers, four layers, and sometimes five layer fabrics. When filling is a problem, a change from single to double, double to triple, etc., may improve compaction and decrease filling. However, the application of

the press fabrics needs to be reviewed prior to making a change to the base fabric as it could change the felt characteristics dramatically.

Changing either the cross machine or the machine direction yarn can also reduce press fabric filling. If the filling is severe, the entire base fabric may need to be altered (see Figure 3). Press fabric suppliers over the years have developed designs that directly address the need for a fabric to stay open throughout its running life. The industry has progressed from woven bases, laminated, and now to multiaxial designs. More recently, polymeric non-woven materials are also being applied to achieve consistent press fabric performance.

### Mechanical Parameters

Although press fabric design is very critical in reducing fabric filling, certain mechanical parameters are equally important. A properly installed showering and uhle box vacuum system, for example, can greatly reduce filling.



Figure 3. Filler material (yellow) trapped within the base fabric

Many problems can be resolved through press fabric modifications. However, a good showering set up will optimize the press section efficiencies. This is accomplished by providing the desired press fabric for sheet transfer and dewatering while allowing the conditioning equipment to mechanically clean the fabric (see Table 1 and Figure 4 below).

**High Pressure Needle Shower:** The HP shower is located prior to the first uhle box on the sheet side. Contaminants are loosened by the needle jet spray and removed by the uhle box. Monitoring of the water pressure is critical in preventing damage to the press fabric.

If the HP shower pressure is too high, the surface of the press fabric can become mechanically damaged. This results in a rough surface and loss of batt fiber, contributing to poor sheet quality and press fabric performance problems. The following oscillating speed calculation will assist in achieving 100% press fabric coverage for maximum cleaning effectiveness:

$$\text{Oscillating Speed Calculation} = \frac{(\text{Machine Speed fpm} \times \text{Nozzle width inches})}{\text{Fabric length (ft)}}$$

	1	2	3	4	5
Shower Type	H.P. Needle Jet	H.P.Fan	Lube	Flooded Nip	Chemical
Location	Sheet side	Sheet side	Sheet side	Non sheet side after press nip before inner roll.	After press nip before inner roll
Distance	100 - 300 mm 4 - 12 in	75 - 150 mm 3 - 6 in	100 - 300 mm 4 - 12 in	75 - 150 mm 3 - 6 in	150 - 300 mm 6 - 12 in
Nozzle Spacing	75 - 200 mm 3 - 8 in	150 - 200 mm 6 - 8 in	150 - 200 mm 6 - 8 in	200 - 300 mm 8 - 12 in	80 - 200 mm 3 - 8 in
Traverse Distance	Twice the spacing distance	Twice the spacing distance	Twice the spacing distance	Twice the spacing distance	Twice the spacing distance
Speed of Traverse	Width of nozzle per rev. of fabric	Width of nozzle per rev. of fabric			
Angle	90 degrees or with the fabric run	90 degree	Contact fabric and uhle box leading edge	90 degrees	90 degrees
Pressures	.7 - 1.5 Mpa 100 - 200 psi	1.0 - 1.72 Mpa 150-250 psi	.15 - .2 Mpa 20 - 30 psi	0.30 - 0.40 Mpa 40 - 60 psi	.15 - 0.4 Mpa 20 - 60 psi
Nozzle Size	.7 - 1.0 mm 0.02 - 0.04 in	.7 - 1.0 mm 0.02 - 0.04 in			
Oscillation	Yes	Yes	Optional	Optional	Optional
Water Temp.	Stock Temp.	Stock Temp.	Stock Temp.	Stock Temp.	

**High Pressure Fan Shower:** The HP fan shower cleans the sheet side of the press fabric while providing a uniform moisture profile. This type of shower distributes water evenly across the width of the fabric with less chance of streaking. Fan showers are also less abrasive to the press fabric than a HP needle shower. The shower is located prior to the lube shower and first uhle box.

**Lube Showers:** Lube showers also have a vital purpose in the press fabric operation. First, the lube shower lubricates the leading edge of the uhle box. If the leading edge of the uhle box strip and press fabric run too dry, heat is generated, causing wear not only to the press fabric batt fiber but also to the uhle box cover. The fan shower nozzles should be angled so that the spray lubricates the press fabric at the leading edge of the uhle box. The water also provides an adequate seal for maximum vacuum distribution across the width of the fabric.

**Flooded Nip Showers:** Flooded nip showers should be located as far away from the uhle box as possible and on the inside of the press fabric ahead of a roll. These showers have three potential uses.

First, the shower works as a wet-up aide during the startup of the press section. This provides even distribution of water across the width of the press fabric. Secondly, if run on a continuous basis, it will flush out contaminants from within the press fabric. Finally, the flooded nip shower can also act as a good location for applying cleaning chemicals for a batch or continuous chemical wash.

**Chemical Shower:** The chemical shower should be located either on the sheet side or inside, but as far away from the uhle box as possible and after the press nip. Maximum dwell time is a benefit to allow the chemical to penetrate the press fabric for optimum cleaning.

**Uhle Box Application:** The uhle box is another cleaning and conditioning device. It removes water and contaminants from the press fabric. There are a few key factors that contribute to uhle box operation, such as cover material, cover type, alignment, and dwell time.

Cover materials are generally polyurethane or ceramic. Both types of materials require periodic inspection for monitoring cover wear. Polyurethane covers will wear

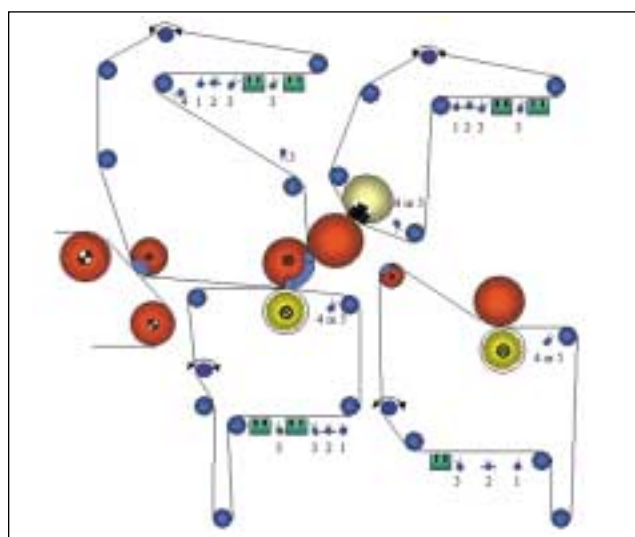


Figure 4. Standard four-nip press section shower locations.

quickly if not constantly lubricated by the lube shower. Excessive heat can develop at the contact points of the cover and press fabric. Ceramics provide a long lasting cover surface. This material also requires proper lubrication to minimize heat build up. If the surface is chipped, sharp edges develop and could quickly damage nylon press fabrics.

Over the years, several cover types have been introduced to the industry to optimize press fabric conditioning. The introduction of seamed press fabrics has prompted many of these changes. The various cover styles have helped reduce wear to the fabric but, more importantly, to the seam area. As seamed technology has improved, the need for all different types of covers has diminished. Within the industry today, slotted covers are very common, with herringbone styles next. Herringbone covers are typically supplied to applications running seamed fabrics.

There are a few items to consider when aligning the uhle box. Common setups align the uhle box cover approximately 6 mm or 0.25 in. below the press fabric. The vacuum from the box pulls the fabric tight against the box cover during operation. A tight seal develops between the box cover and press fabric once the vacuum is applied. Aligning the cover to push into the fabric will cause excessive wear to both the box cover and press fabric. Signs of misalignment include worn areas on the box cover and loss of batt fiber on the press fabric.

For proper uhle box conditioning, sufficient dwell time is required. This refers to the time in milliseconds that the fabric is exposed to vacuum at the uhle box slot openings. Typical dwell times are anywhere from 3-5 milliseconds. The current machine speed will determine the slot width required to maintain optimum dwell time. To reduce the potential for fabric wear, the use of several narrow slots is better than fewer wide slots. A slot width of more than 1 in. under certain vacuum levels can pull the fabric too far into the slot, causing the leading edges of the uhle box cover strips to wear the fabric surface. The following shows dwell time calculation:

$$\text{Dwell Time (ms)} = \frac{\text{Slot width (in.)} \times 5000}{\text{Machine Speed (fpm)}}$$

### Chemical Cleaning Parameters

Chemical cleaning is required in many situations to penetrate and loosen filler material that has migrated deep

within the press fabric. Increasing shower pressures alone can lead to premature wear. Therefore, using a less abrasive means such as a chemical solution is recommended.

Paper machines operate under acid or alkaline based wet end systems. There are many different types of filler materials that can lead to press fabric filling (pitch, calcium carbonate, wet strength additives, slime, starch, rosin size, latex, oil, grease, wax, talc, clay, etc.). Due to the variety of species, the removal may require the use of an alkaline or acid based chemical wash. In many cases, the chemical program will utilize both wash types for increased cleaning efficiencies.

The chemical can be applied through a fan shower located after the press nip and before the uhle box. These showers are also placed on either the sheet side or roll side of the press fabric. The actual press section configuration will determine the optimal placement.

Batch and continuous washing are the two methods commonly used for chemical application. Batch washes can be applied either while the machine is running or as the machine is being shut down. The continuous wash is applied and used while the machine is operating.

Most press fabrics are made of polyamide material (nylon). Nylon dissolves in concentrated acid and is weakened by high levels of chlorine and bromine. It is recommended that chlorine residuals be maintained below 0.5 ppm, and for bromine, less than 0.3 ppm. Low pH (<4.5) and high temperatures >52° C (125° F) will accelerate damage to the polyamide material

(see Figure 5 below). It is also recommended that the local chemical supplier be contacted to formulate a chemical cleaning program that is suited for the machine's particular requirements.

*About the Author:*

**Tony Ferguson** is press fabric design engineer, Fine Paper, Albany International Corp., Albany, New York.

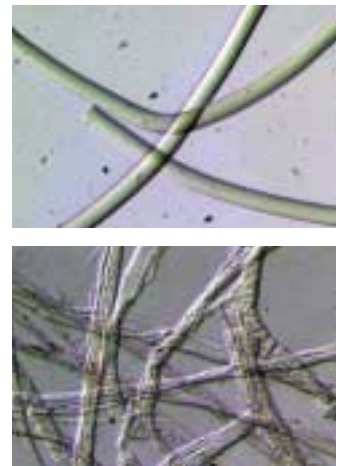


Figure 5. New batt fibers (top) and chemically damaged batt fibers (bottom).