EXPERTIP

Category	FORMING
Keywords	Forming fabric, forming fabric contamination, forming fabric cleaning, forming fabric conditioning, forming fabric contamination control, doctors, oscillating shower, high-pressure shower, fan shower

Tips for Cleaning and Conditioning your Forming Fabrics

Materials such as pitch and tar in the furnish can stick to forming fabrics. The risk of fabric contamination is higher when recycled fibers are used due to the coating binders and glues found in the raw materials. The polyester yarn in a forming fabric is susceptible to contaminant buildup. Buildup fills the fabric, leading to drainage and release problems. This makes forming fabric cleanliness an increasingly important issue.

Contamination Resistance

Over time, contamination build-up on your forming fabrics can have drastic effects on runnability. To prevent bonding between the fabric yarns and contaminants, yarns with contaminant-resistant finishes or coatings can be used. Coatings can be applied during manufacturing by the clothing supplier, or you can apply them on your paper machine using a passivation shower.

Fabric coatings can also be employed to prevent mechanical "locking" of the contaminants at the yarn crossovers. However, this type of fabric coating requires some capital investment and environmental issues may also be a concern.

If your furnish is recovered fiber, the use of higher mesh forming fabrics to increase the fiber support and improve retention for the shorter recycled fibers can be important. The fabric should have a surface that is easy to bridge with short fibers and is easy to clean with the machine's shower system. Lower caliper fabrics, in general, are easier to clean.

Cleaning Systems

Most important is that your mill has a solid, repeatable regimen for cleaning and conditioning forming fabrics in place. There are a variety of cleaning and conditioning systems:

CHEMICAL CLEANING. You may clean your forming fabrics with most solvents and cleaning agents used in the paper industry. Cleaning agents and their usage vary from mill to mill, so there is no standard cleaning method. Please consider the following points when chemically cleaning your fabrics:

- Avoid concentrated acids and alkalis, phenolic compounds, and strong bleaching solutions.
- Due to their toxicity and flammability, exercise caution when handling organic solvents.
- Do NOT use a metal wire brush or stiff bristle brush to scrub the fabric. A soft bristle brush or rag should be used. Select a brush that the solvent does not react with.
- Only use high-pressure showers to rinse off cleaning solutions if the fabric is rotated and not stationary.
- Do NOT use high-pressure steam to clean forming fabrics.

The question of chemical resistance of forming fabrics is of critical importance and must be evaluated on an individual basis. Chemical resistance decreases with higher temperatures. The concentration of chemicals is important. Often, there is only a short-term influence of a certain chemical or temperature on the monofilament.

SHOWER CLEANING. The most widely used cleaning systems today utilize some form of a shower. The higher the open area and straight-through drainage of the fabric design, the more readily a forming fabric can be cleaned with showers. Due to the pressures involved with some showers, fabric stability and seam strength are important considerations. No matter which shower system you use, it is critical to ensure that it maintains uniform coverage and that all the nozzles are clear/unplugged.

Figures 1 and 2 show typical shower positions on a Fourdrinier and on a Twin Wire former. Table 1 summarizes the forming section showers with recommended pressures and volumes used.

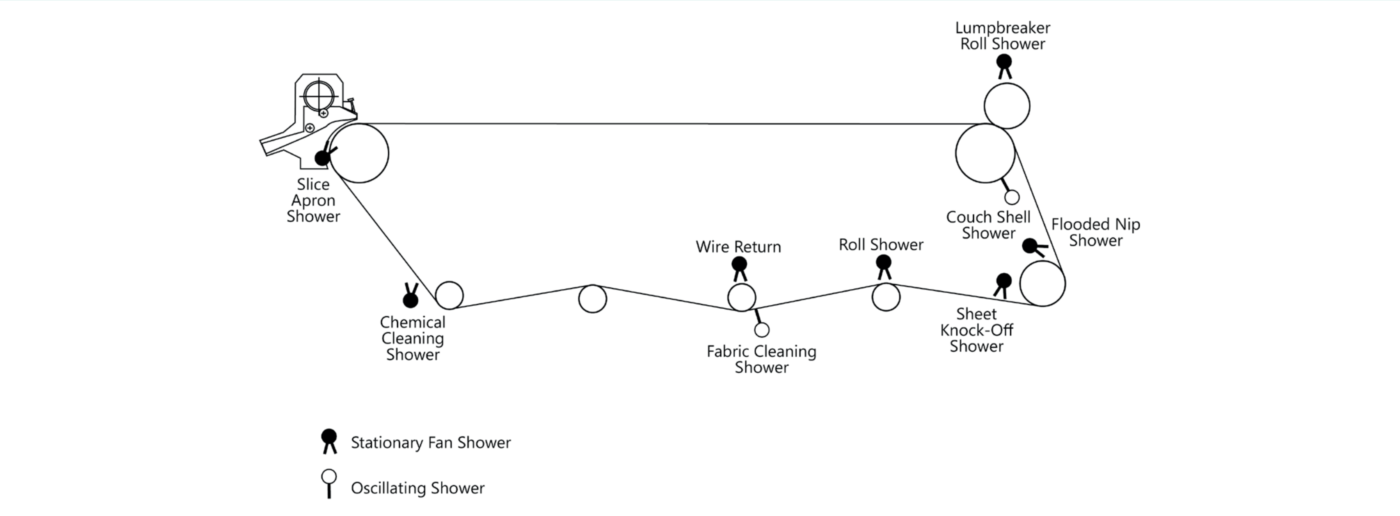

Figure 1. Fourdrinier showers

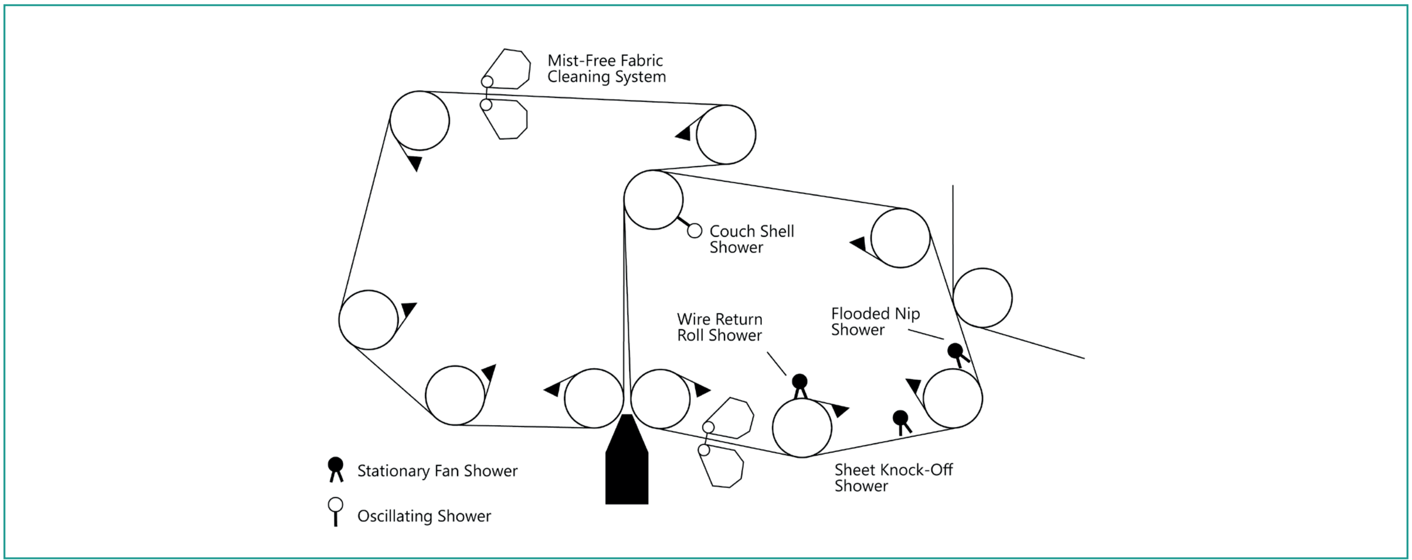

Figure 2. Gap forming showers

Table 1. Forming shower recommendations.

APPLICATION	TYPE	NOZZLE SPACING/PITCH Inches (cm)	DISTANCE Inches (cm)	PRESSURE psi (kPa)	FLOW RATE GPM/in (LPM/cm)	SPEED in/min (mm/min)	ORIFICE Inches (mm)
Headbox	Rotary Fan Spiral set-up 60^0	10-20″ (25–50cm)	8″ (20cm)	20-40 (140-280)	0.075-0.204 (0.111-0.303)		0.1″ (2.5mm)
Headbox apron (bottom of apron)	Stationary Fan $45\text{-}55^0$	6-8″ (15-20cm)	16″ (40cm)	30-40 (200-280)	0.120-0.133 (0.178-0.198)		0.080″ (2.0mm)
Dandy	Oscillating Needle	1-1.5″ (2.5-4cm)	2-4″ (5-10cm)	100-200 (700-1,400)	0.130-0.290 (0.19-0.433)	See Equation	0.031 (0.8mm)
Lump Breaker	Stationary Fan $70\text{-}90^0$	6-8″ (15–20cm)	12″ (30cm)	20-30 (140-200)	0.028-0.043 (0.042-0.064)		0.060″ (1.5mm)
Non-sheet Side, HP	Oscillating Needle	3″ (7.5cm)	3-4″ (7.5–10cm)	100-250 (700-1,700)	0.130-0.238 (0.19-0.355)	See Equation	0.031-0.040″ (0.8–1.0mm)
Sheet Side, HP	Oscillating Needle	3″ (7.5cm)	3-6″ (7.5-15cm)	200-450 (1,400-3,100)	0.135-0.238 (0.20-0.355)	See Equation	0.031-0.040″ (0.8–1.0mm)
Multi-Head Cleaner, HP (wide range depending on design)	Traversing Head	0.080″ (0.2cm)	0.6-2″ (1.5–5.0cm)	1595-2540 (11,000-17,500)	0.008-0.014 (0.012-0.021)	See Equation	0.008″ (0.2mm)
Sheet Knock-off [Slow machines post WTR: <1,300fpm (400mpm)]	Stationary Fan 40^0	3″ (7.5cm)	4-7″ (10–18cm)	150 (1,030) (For continuous cleaning 80psi (550kPa)	0.75-1.77 (1.12-2.678)		0.12-0.16″ (3-4mm)
Flooded Nip knock off	Stationary Fan 40^0	3″ (7.5cm)	11-14″ (28-36cm)	80-200 (550-1,400) (For continuous cleaning 40-80 psi (280-550kPa)	Fill Fabric Running Void Volume	See Equation	0.16-0.24″ (4-6mm)
Wash Roll/Sheet wetting and separation at 1st outside return roll over Couch Pit	Stationary Fan 40^0	3″ (7.5cm)	4-7″ (10–18cm)	80-120 (550-830 kPa) (For continuous cleaning 40- 80 psi (280-550kPa)	0.75-1.77 (1.12-2.678)		0.12-0.16″ (3-4mm)
Doctor Lube	Stationary Fan $60\text{-}80^0$	6-8″ (15–20cm)	8″ (20cm)	30-40 (200-280)	0.150-0.163 (.223-0.242)		0.1″ (2.5mm)
Suction Rolls and drilled shell rolls Cleaning: (Couch roll, Suction Breast roll, Suction forming roll, Combining roll)	Oscillating Needle	3-6″ (7.5-15cm)	4″ (10cm)	350-500 (2,400-3,500)	0.18-0.250 (0.27-0.373)	See Equation	0.031-0.040″ (0.8-1.0mm)

Shower Oscillation Speed (in/min) = [Fabric Speed (fpm) / Fabric Length (ft)] x Nozzle Orifice (in)
Shower Oscillation Speed (mm/min) = [Fabric Speed (mpm) / Fabric Length (m)] x Nozzle Orifice (mm)

Running Void Volume (GPM) = [Fabric Caliper (in) x Fabric Width (in) x Fabric Speed (fpm) x 0.6] / 19.25
Running Void Volume (LPM) = Fabric Void Volume (L/m^2) x Fabric Width (m) x Fabric Speed (m/min)

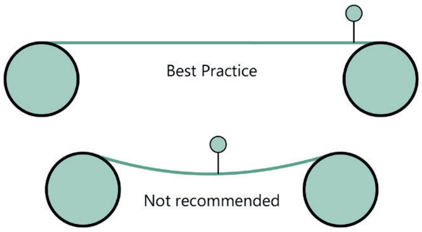

Figure 3. Shower location.

High-pressure needle showers. High-pressure (HP) showers are very effective for contaminant removal on the wet end of the machine. HP showers should have an automatic interlock to shut off when the machine shuts down or the oscillator stops. There should also be safety logic that will not allow an HP shower to start until the machine is put into the run mode.

HP needle showers are required to penetrate the voids in the forming fabric. However, the high energy jet can cause fabric vibrations, resulting in premature failure if not positioned close to the ingoing nip of a support roll (Figure 3). It is critical that the roll has an adequate doctor blade.

There are several opinions on how far to place the shower nozzle from the fabric surface. The fabric structure and production requirements must be evaluated before making this decision. If you want the inside needle shower to clean out the internal fabric voids of contaminants then they need to be in the laminar flow range for better penetration. This is typically 3 – 4 in (7.5 - 10 cm). For face side showers that are primarily cleaning the fabric surface they may be moved further away in the 6 – 8 in (15 – 20 cm) range for more of a hammering effect on hard to dislodge stickies and surface contaminants. However, the risk of fabric damage also increases with distance so the lower end of the range is better for finer fabric designs. The same applies to pressure, as 450 – 500 psi (2700 – 3500 kPa) is fine with packaging grade designs but will often damage ultra fine tissue fabrics, especially on the inside as the knuckle wear pad becomes more exposed. As a general rule HP needle showers should be used at the lowest pressure possible to achieve the desired results.

Sheet side HP shower. This type of shower is most effective in removing fiber and other contaminants from the surface of the fabric. It is critical to have an oscillating needle jet-type shower with a recommended pressure from 200-500 psi (1400-3500 kPa) that is within +/- a few degrees perpendicular to the fabric surface. Angling against the run produces more kinetic energy and cleaning effectiveness. Angling with the fabric run reduces the amount of shower mist and helps with the overall cleanliness of the fabric run. The nozzle is generally installed at a distance of 3-6 in (7.5-15 cm) from the fabric.

Non-sheet side HP shower. This type of shower is very effective in cleaning contaminants from the internal voids of the fabric. However, many machines run successfully without a non-sheet side HP shower. It is critical to have an oscillating needle jet-type shower with a recommended operating pressure of 100-250 psi (700-1700 kPa). The nozzle is generally installed at a distance of 3 – 4 in (7.5 – 10 cm) from the fabric.

Shower Oscillators. Oscillating shower nozzles are typically spaced 3-4 in (7.5-10 cm) apart, with a stroke twice the nozzle spacing. It is best practice to synchronize the oscillation rate of the shower with the machine speed (one nozzle diameter per fabric revolution). If the rate cannot be automatically synchronized with the machine speed, it is recommended that oscillation be calculated for the slowest machine speed to allow the best coverage. A shower that oscillates too fast will miss areas of the fabric; if it oscillates too slowly it can permit contamination buildup to occur prior to the next pass. Most oscillating showers are configured double coverage (i.e., two nozzles pass over an area before the stroke stops and returns). However, if the stroke stops short, the cleaning intensity in a specific area could be compromised. This may be detected by light (over coverage) or dark (under coverage) MD streaks visible on the return run at approximately the same spacing as the nozzles. Individual streaks can identify plugged nozzles.

Traversing head shower. Newer shower technology using a multi nozzle traversing head has some unique advantages over traditional HP showers. The main advantages are: less water and less pump power, lower mist/overspray, and capability of programing to single zones.

The shower is located on the sheet side at an inside side return roll. Depending on the manufacture and design there is a wide range of pressures and nozzles utilized.

Suction roll and drilled shell roll showers. Examples would be couch roll, suction breast roll, suction forming roll, combining roll. The high-pressure oscillating needle shower is located perpendicular to the roll surface with nozzles spaced on 3 in (7.5 cm) centers, 4 in (10 cm) from the roll surface, at a pressure of 350-500 psi (2400-3500 kPa).

Stationary knock-off (fan) shower. The sheet knock-off shower, or fan shower, supplies fairly large quantities of water at a relatively low pressure across the full width of the forming fabric. The effectiveness of lower pressure fan showers is questionable when cleaning multi-layer fabric structures because the bottom surface of a multi-layer fabric shears the fan jet, creating MD flow before water passes through the plane of the fabric. Higher pressures significantly improve the efficiency of this type of shower. The effectiveness also declines as machines speeds are increased, and this type shower is not recommended above 1300 fpm (400 MPM).

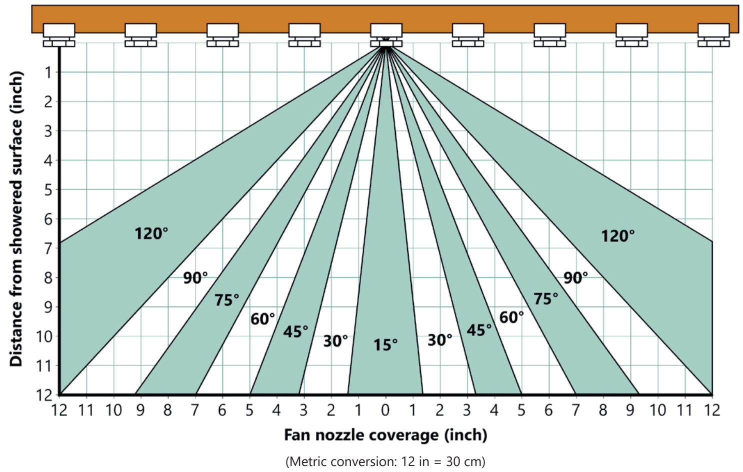

Figure 4. Fan angle and coverage.

The fan shower generally uses stationary 40-45° fan nozzles, spaced 3 in (7.5 cm) apart with a pressure of 200-400 psi (1400-2800 kPa). Since the distribution of water is uneven, a second pipe with offset nozzles is recommended. Maximum impact is obtained by placing the nozzle 4-7 in (10-18 cm) from the surface of the fabric. The actual effectiveness of a fan shower depends on the distribution of water across the face of the fabric, which is controlled by the fan angle chosen. Figure 4 shows the effect of changing fan angle and fabric distance on coverage.

Flooded nip shower. Recommended for speeds over 1300 fpm (400 MPM). Flooded nip showers have the dual purpose of internal fabric cleaning and sheet knock-off. This shower type is used with multi-layer fabrics when regular knock-off showers are ineffective. In many cases, the stationary knock-off shower is eliminated when a flooded nip shower is installed.

Located at the ingoing nip of the fabric turning roll, sheet knock-off volume should be 10% more than the calculated running void volume of the fabric (fabric caliper x width x speed x fabric void volume). The excess volume lifts the sheet away from the fabric allowing it to drop into the couch pit. At speeds above 3,100 ft/min (950 m/min) the volume per minute rate can be reduced to 75% of the fabric's total running void volume due to centrifugal forces which "throw" water through the fabric due to the wrap on the roll (Figure 5).

The key to a flooded nip shower is for the jet to hit the roll surface immediately before the nip and use the volume of water to fill the fabric void volume and separate the sheet from the fabric surface. If the shower jet hits the fabric first it is then relying on pressure rather than volume to knock the sheet off as the water volume will be insufficient by the time it reaches the ingoing nip. The shower should be located at a distance of 11 – 14 in (28 – 35 cm) from the ingoing fabric – roll nip. 25 - 400 fan nozzles spaced 3 in (7.5 cm) apart will provide double coverage of the fabric. The shower must be shielded (Figure 6) to capture the water and fiber.

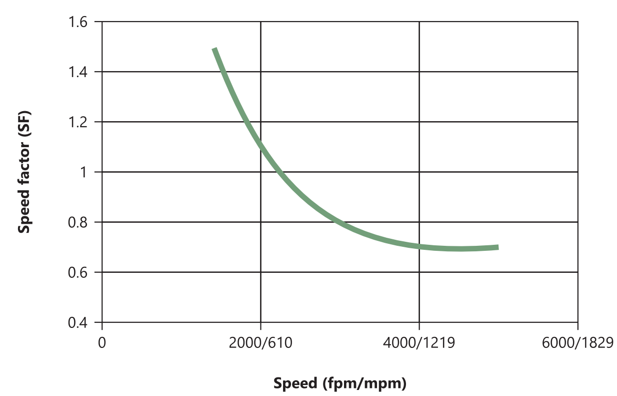

Figure 5. Speed factor for running void volume.

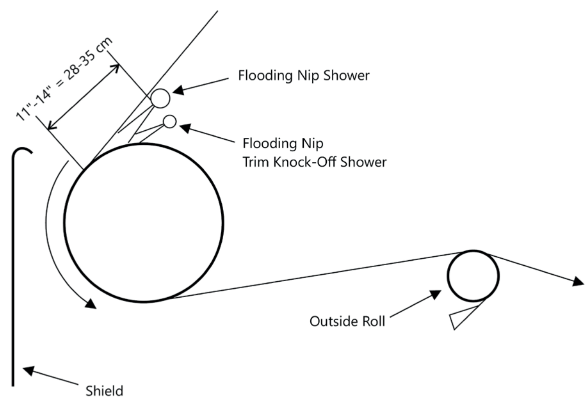

Figure 6. Flooding nip shower.

Conduct some trials to find the optimum pressure for both cleaning and sheet knock-off. With higher speeds and higher wrap, effective cleaning can be accomplished with lower volume of water. It is typical to see fabric cleaning at 40-80 psi (275-550 kPa) and sheet knock-off boosted up to 80-200 psi (550-1000 kPa) at a water volume available for efficient flooded nip showering. You can boost pressure for knock-off with a booster pump, a control valve, or variable frequency drive.

Wash roll/Sheet Wetting and Separation Shower.

Recommended when machine speeds are over 1300 fpm (400 MPM) and a flooded nip shower cannot be utilized. The 1st wire return roll must be positioned over the couch pit to utilize this shower. The shower is effective as a sheet knock off and on a continuous basis for cleaning fiber from the fabric. It is important not to use the conventional knock off shower at the same time, as the full sheet should be carried over the 1st wire return roll.

The shower is positioned over the 1st wire return roll at a slight angle with the fabric run and impinging at the exit nip of the roll (Fig 7), 40 degree fan nozzles at 0.12-0.16" (3-4mm) diameter with 3" spacing (additional nozzles on ends). 80-120 psi (550-830 kPa) is used for sheet separation and knock-off. 40-80 psi (280-550 kPa) can be used for continuous cleaning. Filling the fabric void is not required, the sheet is removed due to the vacuum pulse created at the diverging nip. Be sure to ensure adequate pressure and volume to avoid the sheet being sucked back and carried by the fabric. You can boost pressure for knock-off with a booster pump, a control valve, or variable frequency drive.

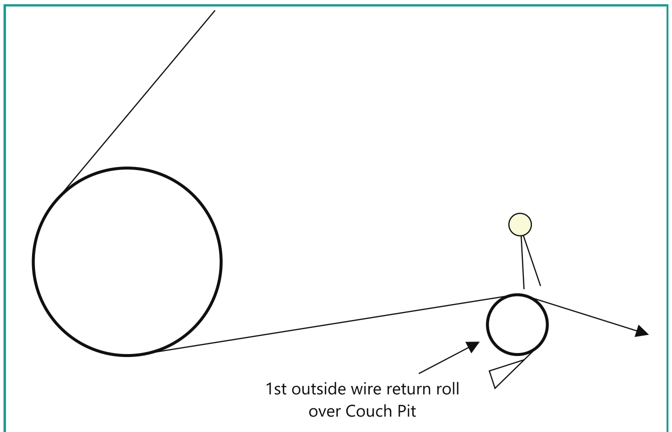

Figure 7. Wash roll/sheet wetting and separation shower.

Forming Section Doctors

Doctors are an integral part of cleaning and conditioning systems for forming fabrics. Contaminants naturally transfer to the smoother roll surface from the rougher forming fabric surface and must be doctored away from the roll, or they will build up and cause operational problems. Polyethylene, fiberglass, epoxy resin and carbon fiber are common materials used for roll doctors on the former. Forming section doctors should always oscillate and be lubricated by low volume fans showers to prevent uneven roll and eventually fabric wear. It is recommended that all rolls have a lubricating roll shower and doctor blade assembly.

Questions?

We are here to help. We distribute **ExperTips** to help you improve the performance of your paper machine. Not just fabric performance, but the overall efficiency, reliability, and productivity of your mill.

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