VOITH

Cleaning forming fabrics

Cleaning methods

Forming is the most critical phase in the paper production process. Fabric cleanliness throughout the entire operating life is essential to ensure that paper quality is maintained on a high level. Cleaning methods may be classified as chemical and mechanical. While chemical cleaning is becoming less common, it is still required under certain conditions. Mechanical cleaning on the other hand, is the most widely used method as the forming section would not function correctly without some sort of high pressure showering.

	Function	Shower type	Nozzle size mm	Angle	Pressure bar	Distance mm
Inside HP shower	Single-layer cleaning	Oscillating needle	1.0	90° to fabric	20 to 30	200 to 300
Sheet side HP shower	Multi-layer cleaning	Oscillating needle	1.0	0 to 20° with or against fabric	20 to 30	100 to 300
Knock-off shower	Sheet knock-off for single-layer fabrics	Stationary fan type	3.0	90° to fabric	15 to 30	300 to 400
Flooded nip shower	Sheet knock-off and cleaning multi-layer fabrics	Stationary fan type	3.0		7 to 10	300 to 400
Lubrication shower	Cleaning rolls and doctors	Stationary fan type	3.0		2 to 3	150 to 200

1 Water is essential for the paper production process, both for sheet formation as well as fabric cleaning.

Mechanical cleaning

High pressure needle shower

The oscillating high pressure (HP) shower is the best and most widely used method of cleaning forming fabrics. For modern multi-layer designs, outside or paperside needle showers are the most effective way for removing pitch and stickies. In general, these should be angled at up to 20 degrees to the fabric run direction, the objective being to „chisel“ the contaminant off the fabric surface. Angling the shower against the fabric run direction generates the highest impact energy for cleaning, but also increases misting.

On modern, high-speed machines, including gap formers, suction boxes are normally located directly opposite the HP showers on the inside of the fabric. The distance between the nozzles and fabric should be between 100 and 300 mm.

At short distances, the jet is laminar with the outer periphery remaining intact. As the distance increases, the jet begins to disintegrate into smaller droplets producing a higher cleaning effect but the risk of yarn fibrillation also increases. A suitable water pressure is 20 to 30 bar. Higher pressures will also increase the risk of yarn damage. HP showers should never be operated with the fabric stationary.

An inside shower operating at 30 bar and angled at 0–20° with the run of the fabric is very effective for cleaning single-layer fabrics as still commonly used on tissue machines.

Water flow rate and therefore consumption varies for different nozzle diameters. In practice, diameters range from 0.7 mm to 1.5 mm with 1.0 mm being the most common size. The use of small diameter nozzles will have a greater risk of clogging and there may be a higher risk of fabric damage. Conversely, with larger diameter nozzles, water consumption will increase without a noticeable improvement in cleaning.

The following formula may be used to determine oscillation speed:
R = (MS/L) x D
where
R = oscillation rate (mm/min)
S = fabric speed (m/min)
L = fabric length (m)
D = diameter of jet contacting the fabric (mm)

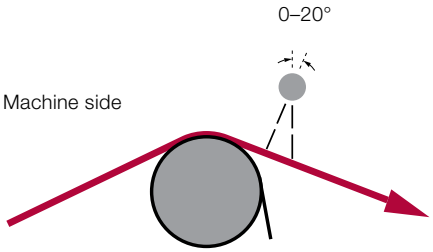
Note that for a 1 mm nozzle, the diameter of jet contacting the fabric will typically be 2 mm. The oscillator speed should be linear with minimal pause at the end of the stroke and should be synchronized with the fabric speed. The stroke should be double the nozzle spacing to ensure complete coverage.

Nozzle spacing may vary from 75 to 150 mm: more nozzles means more intensive cleaning but higher water consumption. Machines with poor quality furnish use shorter nozzle distances.

Shower nozzle materials vary from stainless steel, oxide ceramics and Pyrex glass. The preferred materials nowadays are ruby or sapphire due to their exceptional wear resistance.

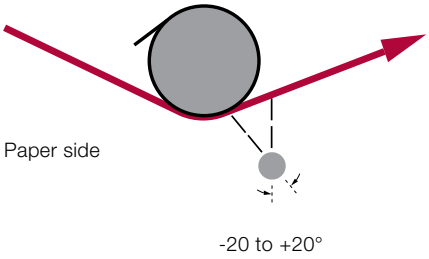
The setup of high pressure showers is strongly dependent on machine condition, equipment and contamination level. Therefore, it is especially important to check the conditioning system setup. Inspection of the distance between the nozzles, distance between the nozzles and the forming fabric, oscillation time and stroke, pressure as well as the angle are fundamental in order to guarantee a trouble-free performance of the high pressure showers.

Inside needle shower



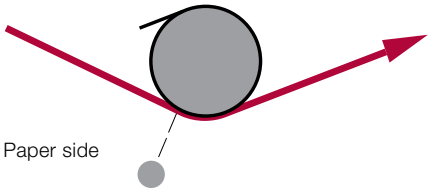
Outside needle shower

against and with fabric direction



Outside needle shower

against roll



Knock-off shower
This is located immediately after the couch or forward drive roll and is directed at 90° to the inside of the fabric. Its function is the release of the sheet at sheet breaks. A fan-type nozzle is preferable since large quantities of water are required to achieve a satisfactory result.

Flooded nip shower
This is sometimes used in addition to or even as a replacement for a knock-off shower on slower machines. It should be located on the inside of the fabric and directed at the in-going nip of the fabric turning roll. Its function is to flush contaminants from the fabric under hydraulic pressure created between the fabric and the roll.

On more modern high-speed gap formers, the flooded nip shower acts as both an internal cleaning shower and a knock-off shower. In this case, it should be located 300 to 400 mm from the in-going nip and operated at pressures between 7 and 10 bar.

High water flow rate is necessary to achieve a satisfactory effect. This may be calculated using the following formula:
RVV = S x W x C x V x 0.052
where
RVV = running void volume (l/min)
S = fabric speed (m/min)
W = fabric width (m)
T = fabric caliper (mm)
V = fabric void fraction
V = 0.6 is generally used for all fabric designs.

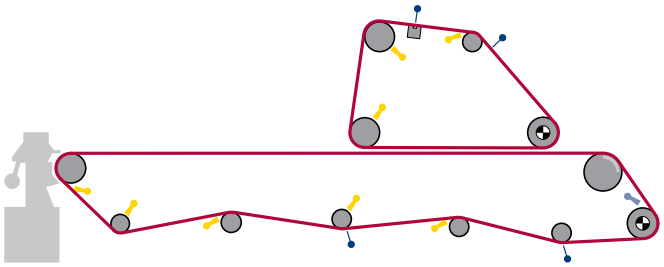
The RVV is the volume of water required to completely fill the fabric assuming it is dry but is not auto-matically the water volume of the Flooded Nip Shower. As fabrics usually carry some water and are not dry, it should be possible to operate with less than 100% of RVV. On faster machines with high degrees of wrap on the roll being used for the Flooded Nip, 80–100% of RVV is sufficient. Also at higher speeds, the centrifugal force generated around the roll gives the Flooded Nip water volume extra energy to flush fiber from fabric. For slower machines, where little centrifugal force is generated, it is typical to see 100–110% of RVV being run in the Flooded Nip. The extra volume ensures sufficient force to fully flush the sheet from the fabric.

Doctors
Contaminants tend to transfer from the rougher surface of forming fabrics to the relatively smoother surface of a roll. Doc-

Comparison of a standard HP shower and a DuoCleaner

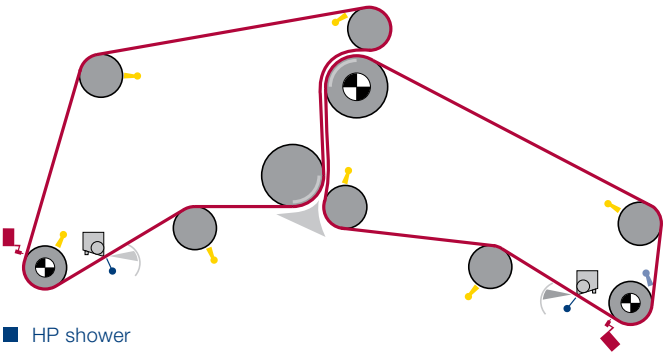
	HP Shower	DuoCleaner
Distance from wire	100 to 300 mm	~ 50 mm
Impingement angle	15° to 20°	0° to 45°
Nozzle diameter	n x 1.0 mm	up to 30 x 0.2 mm
Material	stainless steel, ruby	sapphire, ruby
Water consumption	30 l/min/m	up to 10 l/min
Pressure	20 to 30 bar	100 to 275 bar
Stroke	100 to 200 mm oscillating	machine-wide variable

Voith DuoFormer D



- HP shower
- Flooded nip/knock-off shower
- Lubrication shower

Voith DuoFormer TQv



- HP shower
- Flooded nip/knock-off shower
- Lubrication shower
- DuoCleaner
- JetCleaner

tors made from polymers or fiberglass are essential to prevent build-up on the rolls. Generally, wet-end doctors do not oscillate unlike press section doctors but this may be an option.

Lubrication showers

These are directed at rolls with the purpose of keeping the rolls clean and to reduce friction between the roll and its doctor blade. Best results are obtained using a 30 to 60° fan-type nozzle operated at 2 to 3 bar and at a distance of 150 to 200 mm.

The following points should also be observed with respect to showers:

- The shower water should be at the same pH and temperature as the stock in order to avoid shock precipitation of salts which would increase contamination.
- Oscillating showers should not overlap one another.
- Roll doctor oscillators should be working effectively.
- The equipment should be regularly inspected and maintained to ensure that all nozzles are delivering a uniform jet and have not been affected by wear.

Mechanical devices

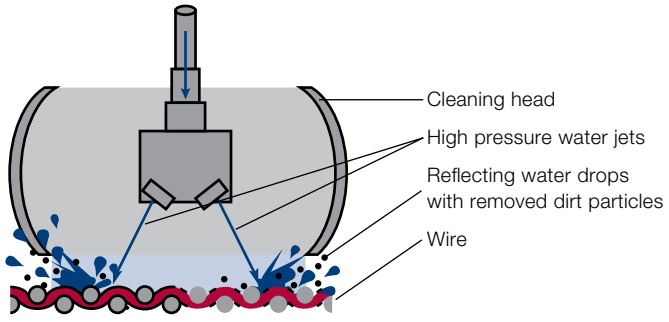
Specially designed mechanical devices such as Voith JetCleaner™ and DuoCleaner™ are particularly successful at maintaining fabric cleanliness. With the JetCleaner, the fabric is humidified with water just prior to an air doctor. The jet of air blows through the fabric carrying away dirt particles and fibres on the paper side. The DuoCleaner has been introduced for high-speed machines. It uses the principle of inclined high pressure water jets to remove dirt particles.

Continuous fabric cleaning with the DuoCleaner:

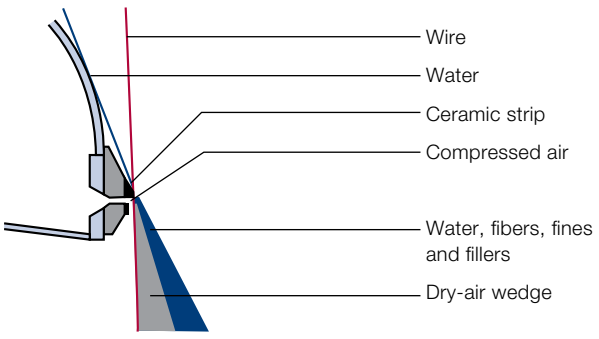
- Maintains clothing performance
- Keeps high permeability value
- Ensures even retention
- Gives even drainage
- Improves CD profiles
- Reduces pinholes
- Reduces wet end related breaks
- Reduces sheet marking

DuoCleaner is easy to retrofit, uses significantly less water than conventional HP showers and offers a fast return on investment.

Voith DuoCleaner



Voith JetCleaner



Chemical cleaning

Forming fabrics made up mainly of polyester yarns are susceptible to contaminant build-up such as pitch and tar. Recycled paper may also contain latex making this worse. In such cases, both chemical and mechanical cleaning may be used.

Common alkali-based cleaning agents are available with surfactants added to shorten the treatment time. The application temperature should be the same as stock temperature or preferably slightly higher. The cleaning agent concentration should not exceed 10%, any higher may damage.

Acid-based agents should be used with care. Hydrochloric acid is less aggressive to the yarn material and may be used. Sulfuric acid should be avoided since it degrades monofilament yarns even at low concentrations. Acids should be used with caution on fabrics containing nylon and if necessary only in a very dilute form. Concentrated acids and alkalis, phenolic compounds and strong bleaching solutions should be avoided. Similarly, caution should be exercised when handling organic solvents due to their toxicity and flammability.

Chemical cleaning may be carried out at either shut down or as a continuous operation. Shutdown cleaning requires an abundant supply of water after treatment to remove residual chemicals. The chemical shower should ideally be positioned on the paperside as soon as possible after the high pressure shower. Alternatively, it may be directed at an in-going nip on the machine side to flush the cleaner through the fabric. Nozzles should be typically 70 to 100° fan type with 150 mm centers and should be positioned about 150 mm from the fabric.

Always contact your chemical supplier for advice about the risks involved with chemical cleaning.

Contamination	Solution
Fibers	10% caustic at 70°C
Fillers (clay, chalk, kaolin, $CaCO^3$)	Nonionic active acid plus surfactant
Rosin from pulp	Caustic or solvent
Resin from adhesives	Caustic at 70°C
Paraffin wax, wax dispersions	Caustic
Neutral adhesives	Caustic
Aluminum salts	Caustic, acid or solvent
Calcium salts	Caustic + complexing agent or acid
Urea resin	Continuous treatment with acid or caustic
Polyamide resin, melamine resin	Continuous treatment with acid or caustic
Printing inks	Caustic and surfactants or aromatic hydrocarbons
Starch	Usually water soluble
Retention agents	Usually water soluble
Latex	Solvent
Stickies/Pitch	Caustic
Oil, Grease	Caustic or solvent

Summary

Careful consideration needs to be given to the cleaning of modern, multilayer forming fabrics. It is far easier to keep a fabric clean than to clean up a dirty fabric. A badly contaminated fabric will give poor drainage leading to sheet quality problems. The fabric should also be cleaned uniformly across the width to prevent uneven sheet profiles. It is therefore essential to integrate a good cleaning system into the continuous maintenance program.

Prolonged exposure to high concentrations of cleaning chemicals at elevated temperatures can damage fabrics. Cleaning methods have been continuously adapted to cope with the increasing demands of recycled fiber and complicated fabric structures. As a result, mechanical devices such as the JetCleaner and the DuoCleaner are taking fabric cleaning to a new level.

For further advice, please contact your Voith Paper representative.

frs_1010 | en | Content: vwit/bunzs | Design: vranak | Print: maurer | 2012-07-31

Headquarters
Voith Paper Holding GmbH & Co. KG
St. Poeltener Str. 43
89522 Heidenheim, Germany

paper@voith.com
www.voith.com/paper

Regional Contacts
Asia
Voith Paper in Kunshan, China
Tel: +86 512 577 61 858

Europe
Voith Paper in Heidenheim, Germany
Tel: +49 7321 37 7490

North America
Voith Paper in Wilson (NC), USA
Tel: +1 252 291 3800

South America
Voith Paper in São Paulo, Brazil
Tel: +55 11 3944 4089

VOITH
Engineered Reliability