A Guide to Spray Technology for the Pulp and Paper Industry
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Comprehensive Spray Technology
Solutions from a Single Source

Ensures spray system optimization

At the heart of all spray operations in your mill is the spray nozzle. It is the component that determines performance in moisturizing, cleaning, lubricating, edge trimming, bleaching, knock-off, gluing and dozens of other applications.

But, there are other aspects of your spray systems that can have a big impact on quality and efficiency. For example, shower design, nozzle placement, automation devices, accessories and more can help maximize the performance of your nozzles, reduce waste, speed installation, minimize maintenance time and lower operating costs.

Working with a single supplier that is an expert in all facets of spray technology is the best way to ensure optimal performance in all your spray operations. And, we’re uniquely qualified to be that supplier.

We offer:

• The most extensive selection of spray nozzles and accessories in the industry.

• A wide range of showers, headers and manifolds and the in-house design and fabrication capabilities to meet even the most stringent specifications.

• Spray controls and automated systems through our AutoJet® Technologies division to increase operational efficiency, decrease manual operation and ensure consistent performance.

• Spray research and testing services in our fully equipped spray laboratories to eliminate guesswork when predicting spray performance and facilitate problem solving in new and existing applications.

• Optimization, maintenance, on-site inspection and other educational programs at no cost to help customers improve efficiency.

• Sales engineers that specialize only in spray technology. They spend their time in mills like yours evaluating spray operations and engineering spray solutions.

Why not contact us today and learn more about how we can help ensure optimal performance in your spray operations?
Shower Solutions
for Cleaning, Coating, Moisturizing and More

We manufacture an extensive line of showers and have the experience to ensure optimal performance in your operations. If you don’t see exactly what you need below, be sure to contact us. We custom design showers and modify existing designs for customers daily.

**Brush-type showers eliminate nozzle clogging**

- An internal rotating brush assembly scrubs the interior wall of the shower and nozzle orifices to sweep debris away.
- Ideal for use with recirculating systems or white water.
- The brushes operate while showers are in use to maximize machine uptime.
- Brushes are staggered at 120° intervals to allow full system flow.
- Manual handwheel and automated motor-driven versions available. Existing manual brush-type showers can be easily retrofitted for automatic operation.

- No operator intervention is needed with automatic brush showers. Cleaning cycles occur regularly via a programmable timer. Dangerous climbing of paper machines is eliminated and personnel can be deployed to other tasks.
- Competitively priced. Manufactured in accordance with Good Manufacturing Practice (GMP).

Choose from various nozzle options depending on shower location and use: DiscJet®, NeedleJet or ShowerJet hydraulic nozzles. See Page 7

**Optimization idea:**

**Upgrade manual brush showers to automatic brush showers**

Removing the handwheel and replacing it with the brush drive motor will take less than 30 minutes and require no special tools.

**Plus:**

- Eliminate all manual operation – save time.
- Eliminate the need for workers to climb machines and improve safety.
- Reduce maintenance time – just lubricate the gears semi-annually.
Pipe-in-pipe showers offer added protection

- Ideal for use when the shower, feed tubes or nozzles require protection from the operating environment and accidental damage.
- Outer slotted tube encloses a conventional pipe manifold.
- Inside manifold slides in and out for quick maintenance.
- Economical alternative to other traditional box-style showers.
- Easily configure up to three zones for separate control of nozzle sections.
- Lightweight for easy installation.

Can be used with automatic air atomizing spray nozzles with integrated strainers. See Page 8

Brushless showers – basic and effective

- Designed for use with fresh water and operations where nozzle clogging is unlikely.
- Economical.

Can be used with hydraulic nozzles. See Page 10

Optimization idea:

Use a programmable timer to ensure cleaning cycles

- No manual intervention required – cleaning cycles occur automatically.
- Rely on pre-programmed cleaning cycles or set your own. Easily set the number of revolutions per cycle and the intervals between cycles.

Automatic Brush Shower used for lower wire cleaning on paper machine. The programmable timer is enclosed in the control unit.
Shower Solutions
for Cleaning, Coating, Moisturizing and More

Optimize the performance of showers with automatic nozzles and spray control

We have a variety of showers and manifolds that can be equipped with automatic hydraulic and air atomizing nozzles designed to deliver sprays of all types using a wide range of fluids with minimal clogging.

• Pipe-in-pipe for use with automatic air atomizing nozzles.
• Channel/angle style for applications needing a header for supporting and mounting nozzles and feed tubes. For use with hydraulic or air atomizing nozzles.
• Box-style for messy environments such as starch spraying that require a header to support, mount and protect nozzles and feed tubes. For use with automatic air atomizing nozzles.
• Modular air atomizing manifolds for applications that can benefit from organized tubing and fewer connections. Exposed or covered tube designs available and sized for use with up to 15 air atomizing nozzles.
• You’ll find dozens of nozzle types available for use with our showers and manifolds in hundreds of capacities, sizes, configurations, spray patterns and materials.

See page 8 for more details on automatic hydraulic and air atomizing nozzles.

Add spray control to enhance performance and simplify operation

An AutoJet® spray controller can be added to any of our showers to optimize spray nozzle performance, lower operating costs and automate operation. More critical operations such as coating and moisturizing tend to experience the greatest efficiency and performance gains resulting from precise control of our automatic spray nozzles.

Optimization idea:

Minimize waste, clogging and downtime with an automated solution for uniform wax application

• A spray controller automatically makes adjustments to the volume of wax applied based on line speed to ensure consistency.
• In addition, audible and visual alarms are activated when the controller detects clogged nozzles.

AutoJet spray controller used with showers to optimize nozzle performance.
Flat Spray Nozzles

for Showers

ShowerJet Nozzles

- Disc-type nozzles fit inside the shower so the internal brushes easily sweep debris away.
- Lock-ring holds the nozzles in place.
- Available in flat and solid stream spray patterns. Solid stream has a choice of ceramic, stainless steel or synthetic ruby orifice material for longer wear life.
- Groove on flat edges makes nozzle removal from headers fast and easy.

NeedleJet Nozzles

- Solid stream high impact performance – ideal for cleaning felts, fabrics, wire, suction rolls and more.
- Standard version features a tube on the back end that protrudes higher than competitive nozzles. This enables better quality water to be drawn into the nozzles and minimizes turbulence. Ruby orifice version is available for longer wear life.

DiscJet® Nozzles

- No better option when space is tight. Flush mount to shower pipe.
- Provides the cleaning efficiency of flat spray nozzles.
- Orifice designed to prevent clogging.
- Best used with fresh water.
- Threaded and threadless versions available.

Self-Cleaning Nozzles

- Available with low or high actuator pressures.
- Features a piston-type design. When line pressure is low, the nozzle’s piston retracts to purge debris from the nozzle orifice.
- Ideal for use in environments with suspended solids and showers with high solids content in the water.
- Compact design makes it ideal for use inside paper machines.

VeeJet® Nozzles

- Flat fan with tapered or even edges and high impact solid stream spray patterns.
- Spray angles from 0° to 110°.
- Wide range of material options; quick-connect versions also available.

Optimization idea:

Select nozzles in wear-resistant materials to extend time between maintenance/replacement intervals

- Choose shower nozzles with ruby orifices to extend wear life.
- Ruby orifice material provides superior spray precision and wear resistance.
- Stream remains steady in early stages of wear.
Air Atomizing Nozzles to Optimize Coating, Moisturizing and Marking

VMAU Air Atomizing Nozzles (Anti-bearding)

- Maximum flexibility – independent control of liquid, atomizing and fan air allow adjustment of spray capacity, drop size and spray pattern.
- Uniform spray distribution with minimal overspray.
- Modular design for quick and easy maintenance.
- Built-in clean-out/shut-off needle protects against clogging.
- A wide range of set-ups available including anti-bearding designs to significantly reduce bearding and clogging.
- Can be used on modular or custom headers.
- Optimized automatic performance when used with an AutoJet® spray controller.
- Add a heat jacket or band heater when spraying viscous liquids for use with a heated supply system.

J Series Air Atomizing Nozzles

- Finely atomized spray by mixing air and liquid.
- Wide range of options: pressure or siphon spray set-ups, external or internal mix, spray patterns, needle assemblies, capacities and materials.

JAU Automatic Spray Nozzles

- Precise on/off operation up to 180 cycles per minute via an internal air cylinder.
- Drip Free™ design ensures positive shut-off.
- Optimized automatic performance when used with an AutoJet spray controller.
- Wide range of configurations and set-ups.
- Modular and plate mount styles available.

PulsaJet® Automatic Spray Nozzles

- Accurate spray placement and excellent spray pattern integrity.
- Speeds up to 10,000 cycles per minute.
- Operates at low flow rates using larger clog-resistant hydraulic or air atomizing spray tips.
- Faster pulsing reduces amount of fluid used without compromising spray pattern.
- Electrically controlled.
- Can be set to adjust to changes in product width and changes in conveyor speed.
- Optimized, automatic performance via Pulse Width Modulation (PWM) when used with an AutoJet spray controller.

Optimization idea:

Automate defect marking with PulsaJet nozzles and an AutoJet Spray Controller

- Input from a light bar defect sensor sends a signal to the AutoJet controller.
- The controller then sends a signal to high-speed PulsaJet nozzles to accurately mark flaws.

PulsaJet nozzles used to mark paper defects after the calendar stack.
Web Trimming Nozzles
To Improve Precision, Speed Set-Up Time

UltraStream® Nozzles

- Precise, sharp, crisp edge trimming.
- Single orifice version can be used with most paper grades.
- Dual orifice version provides twin parallel solid stream sprays – ideal for use with specialty or fine papers. Dual orifice version eliminates the need to use two nozzles in tandem, reduces backsplash and simplifies spray alignment.
- High impact performance enables the nozzles to be placed further away from the target which reduces build-up on the nozzles and downtime for maintenance.
- Choice of orifice materials including synthetic ruby for long-lasting, precise performance.

72020 UltraStream Alignment Device

- Simplifies the mounting and adjustment of UltraStream nozzles. Calibration scales and handles facilitate precise positioning of nozzles to ensure crisp, clean paper edges.
- Returning to those exact positions when conditions change requires resetting the calibration devices – a task that takes just minutes.
- Waste due to paper tears and breaking is minimized and downtime for nozzle set-up is significantly reduced.
- All calibration scales and handles are located away from the nozzle. Operators no longer have to work over the moving web to adjust the trimming nozzle.

Optimization idea:

Speed positioning of trimming nozzles and minimize waste with UltraStream Alignment Device

- Calibration gauges on the 72020 Alignment Device allow quick and easy adjustment of edge-trimming nozzles.
- Once the ideal position is finalized, locations can be recorded to facilitate repositioning of nozzles after a change in paper grade or sheet size.

Alignment device used to quickly position edge-trimming nozzles on wet end of paper machine.
Stock Chest Cleaning Nozzles

When it comes to general purpose nozzles for use in head boxes, we have the broadest selection available. You’ll find a wide range of capacities, spray patterns, spray angles, materials and connection options. Nozzles commonly used for cleaning include:

<table>
<thead>
<tr>
<th>VeeJet® Nozzles</th>
<th>FlatJet® Nozzles</th>
<th>WhirlJet® Nozzles</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Flat fan with tapered or even edges and high impact solid stream spray patterns.</td>
<td>• High-impact flat spray pattern with a narrow spray angle.</td>
<td>• Hollow cone spray pattern.</td>
</tr>
<tr>
<td>• Spray angles from 0° to 110°.</td>
<td>• Large flow passage minimizes clogging.</td>
<td>• Good atomization of liquid at lower pressures.</td>
</tr>
<tr>
<td>• Material options include stainless steel, brass, mild iron and PVC. Special materials such as titanium are available upon request.</td>
<td>• Material options include stainless steel, brass and steel. Special materials are available upon request.</td>
<td>• Material options include stainless steel, brass, polypropylene and PVC. Special materials are available upon request.</td>
</tr>
<tr>
<td>• Quick-connect options include UniJet® nozzles in brass and stainless steel and QuickJet® nozzles in ProMax®, brass and stainless steel.</td>
<td>• Quick-connect QuickJet option available.</td>
<td>• Quick-connect options include UniJet nozzles in brass, stainless steel and hardened stainless steel and QuickJet nozzles in ProMax, brass and stainless steel.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Unobstructed flow passages minimize clogging.</td>
</tr>
</tbody>
</table>

FloodJet® Nozzles

• Wide-angle flat fan spray pattern with minimal atomization.
• Large, round orifice design minimizes clogging.
• Material options include stainless steel, brass and PVC. Special materials are available upon request.
• Quick-connect options include UniJet and QuickJet versions.

Optimization idea:

Choose nozzle materials carefully to ensure long wear life

Materials with harder surfaces generally provide longer wear life. Check the chart for standard abrasion resistance ratios for different materials for nozzles, orifice inserts and/or spray tips.

<table>
<thead>
<tr>
<th>Material</th>
<th>Resistance Ratio</th>
<th>Material</th>
<th>Resistance Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aluminum</td>
<td>1</td>
<td>Hardened Stainless Steel</td>
<td>10 – 15</td>
</tr>
<tr>
<td>Brass</td>
<td>1</td>
<td>Stellite®</td>
<td>10 – 15</td>
</tr>
<tr>
<td>Polypropylene</td>
<td>1 – 2</td>
<td>Silicon Carbide (Nitride Bonded)</td>
<td>90 – 130</td>
</tr>
<tr>
<td>Steel</td>
<td>1.5 – 2</td>
<td>Ceramics</td>
<td>90 – 200</td>
</tr>
<tr>
<td>MONEL®</td>
<td>2 – 3</td>
<td>Carbides</td>
<td>180 – 250</td>
</tr>
<tr>
<td>Stainless Steel</td>
<td>4 – 6</td>
<td>Synthetic Ruby or Sapphire</td>
<td>600 – 2000</td>
</tr>
<tr>
<td>HASTELLOY®</td>
<td>4 – 6</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Materials with harder surfaces generally provide longer wear life. Check the chart for standard abrasion resistance ratios for different materials for nozzles, orifice inserts and/or spray tips.
Tank wash nozzles – ideal for cleaning

Eliminate contamination concerns, increase production time and reduce labor costs for manual cleaning by using automated tank wash nozzles.

Additional benefits include:

- Thorough and consistent cleaning.
- Chemical and water use is controlled.
- Workers are kept away from hazardous chemicals and dangerous operations.

Choose from high-pressure motor-driven units, fluid-driven reactionary force, fluid-driven constant speed and fixed tank wash nozzles. A turnkey Fluid Delivery System is also available for complete automation and to enhance tank wash nozzle performance.

Most commonly used tank wash products in mills include:

6353 Fixed Tank Wash Nozzles
High-capacity stationary tank washing nozzles are simple, reliable and provide 360° coverage.

AA090, AA190 and AA290 Motorized Tank Washers
provide high-impact cleaning. Lightweight and portable, choose from a wide range of shaft lengths and air or electric explosion-proof motors.

27500 Fluid-Driven Tank Wash Nozzles
are ideal for low-pressure cleaning and rinsing operations. Well-suited for clean-in-place (CIP) since the reactionary force of the cleaning liquid rotates the spray head.

Optimization idea:

Automate cleaning with portable, motorized tank washers to improve cleaning and save time

- Motorized tank washers can be lowered into chests through openings in the ceiling.
- The units are easily removed after cleaning.
- High-impact sprays ensure quick, thorough cleaning with little manual labor.

AA290 tank washer, powered by an air motor, used to clean broke storage chests.
Air Control Products
for Drying and Blow-Off Operations

727 and 707
WindJet® Nozzles

- Using compressed air, WindJet nozzles create an air barrier to prevent contaminants from entering defined areas.
- Also used for drying and blow-off applications.
- Ideal for use on sides of machines and prior to NIP showers.
- Wide range of flow rates, spray patterns and material options.

WindJet Low Flow
Air Knives

- Low flow air knives also deliver a high-velocity air stream but use less compressed air for cost savings compared to conventional air nozzles.
- A uniform air flow is provided across the entire length of the knife for fast drying and blow-off.
- Maintenance-free.
- Lower noise levels.
- Ideal for applications requiring one or two knives.

WindJet Air Knife and Blower Packages

- Complete packages customized to meet your blow-off requirements are a Spraying Systems Co. exclusive.
- Packages include WindJet air knives or cannons, a low maintenance direct drive blower and all the accessories needed for mounting and package installation.
- Using clean heated air, our blowers are energy efficient, quiet and easy to use.
- Low operating noise.
- Outstanding performance — uniform, constant, controlled air stream that eliminates spotting and blotching in drying operations. Ideal for use in areas with tough build-up that requires a concentrated stream of high-velocity air.
- Yields tremendous operating cost savings compared to compressed air.

Optimization idea:

Reduce air consumption by using regenerative blowers and WindJet Air Knives

- Unlike other blower options, regenerative blowers require minimal maintenance and operate with greater efficiencies.
- When WindJet Air Knives are used with regenerative blowers, a uniform, high-volume, constant air stream is produced.
- Operating costs are quite low since compressed air is not required.

See page 18 for more information.

Air knives used to dry raw paper stock as it comes off the unwind stand.
Additional Nozzle Solutions
for Plant Clean Up, Black Liquor and Humidification

**GunJet® Spray Guns**
- Widely used for general clean up throughout the mill.
- Many versions available – ergonomic designs to reduce operator fatigue, low, medium and high-pressure models.
- High flow rates and various extensions available to spray hard-to-reach areas.

**Black Liquor Nozzles**
- Excellent heat and corrosion resistance.
- Splash plate design is cast from 309 stainless steel and has a large exit orifice for maximum flow passage.
- VeeJet® design is constructed of 310 stainless steel and provides a flat fan spray pattern.

**DripSafe™ AirJet® Fogger**
- Add moisture without wetting to prevent static and shocks.
- Provides high volume, high efficiency atomization to produce an adjustable high-quality fog.
- Ideal for open storage areas, pre-shipping areas and more.
- Uses normal water pressure – no need for high-pressure hydraulic pumps.
- Internal diaphragm allows for quick drip-free shut-off.
- Use with our 45400 humidification/anti-static unit. It is lightweight and easy to install on a wall or for use in non-ducted applications.

**Optimization idea:**

**Maximize wear life in black liquor applications**
- Use nozzles constructed of heat and corrosion-resistant materials such as 309 and 310 stainless steel.
- Also, choose nozzles with open passages and large exit orifices to ensure maximum flow.
Strainers
Minimize Clogging

Liquid Strainers

- Protect your nozzles from damaging debris and reduce clogging.
- Dozens of T-style options – choose from low-, medium- and high-pressure versions in a wide range of materials and various cleaning options to simplify and minimize maintenance.

Self-Cleaning Strainers for high flow applications

- Allows the use of poor quality water with minimal risk of nozzle clogging.
- Choice of models and styles – flow rates up to 1760 gpm (6662 l/min).
- Large filter area captures most debris extending time between flush cycles.
- Minimal water used for flushing – downstream water supply is not interrupted.
- Easy to use and maintain.
- Special design available for white water applications.

Optimization idea:

End nozzle clogging with Self-Cleaning Strainers

- Suitable for use with poor quality water.
- A large filter traps contaminants and a unique suction scanner removes the debris.
- Only filtered water moves upstream to the nozzles significantly reducing downtime due to clogging.

A spiraling motion sweeps suction scanner nozzles across the screen to remove debris in Self-Cleaning Strainers.
Ways to Optimize Spray Performance and Lower Operating Costs

Preventive Maintenance

Spray nozzles are designed for long-lasting, trouble-free performance. However, like all precision components, spray nozzles do wear over time. Spray performance can suffer and costs can rise. How quickly wear occurs is dependent on a variety of application-specific factors.

Other factors that can negatively impact spray nozzle performance are plugging, corrosion, scale build-up, slime/odor, thermal attack and caking. These are common problems in pulp and papermaking largely due to the chemicals and water supplies being used. Establishing and implementing a nozzle maintenance program is the most effective way to prevent and minimize costly spray nozzle problems.

Common problems and prevention/troubleshooting tips

Plugging
- Very common with use of reclaimed or white water.
- Nozzles, lines and showers can plug due to debris and long fibers in the water.
- Use proper water clarification devices.
- Use strainers.
- Be sure to specify nozzles with adequate free passage.
- Conduct maintenance on a regular basis.
- Use automated self-cleaning showers.

Corrosion
- Many chemicals are extremely corrosive.
- Specify nozzles in the appropriate materials: 316 or 304 stainless steel depending on chemical concentration. Avoid iron and mild steel.

Scale build-up
- Control hardness level of the water.
- Use chemical additives as needed.
- Conduct maintenance on a regular basis.

Slime and odor
- Implement an effective biocide program to control biological growth.
- Use chemical additives as needed.
- Eliminate areas with stagnant water.
- Conduct frequent wash-ups.

Caking
- Build-up can occur inside the nozzle or on the exterior.
- Conduct maintenance on a regular basis.

Maintenance tips

- Determine the optimal maintenance schedule based on the specifics of your operations.
- Examine spray patterns and watch for changes in spray angles, distribution and heavy edges.
- Wear may be hard to detect so go beyond visually inspecting nozzles. Check flow rate and spray pressure at a system level.
- The nozzle orifice is precision engineered so be careful to avoid damage or replacement will be necessary.
- Cleaning tools should be significantly softer than the construction material of the nozzles, such as a toothbrush, toothpick or brushes in the showers. Never clean the orifice with metal objects.
- Soak in mild solvent to loosen debris for easier removal with proper equipment.
Ways to Optimize Spray Performance and Lower Operating Costs

Preventive Maintenance

Neglect your nozzles and watch energy, water and chemical costs increase

Even slight wear can cost tens of thousands of dollars annually in increased operating expenses. Here are just a couple of examples to help illustrate how quickly costs can rise.

Example #1: Dryer Section Shower – One shower with 70 nozzles spraying a release agent on dryer felt

Operating conditions:
System sprays 5 gpm (19 l/min) of a 1:20 aqueous solution of chemical at 40 psi (2.76 bar)
Chemical consumption: .25 gpm (.95 l/min); $0.50 per gallon
Operation: Three shifts, five days per week = 120 hours per week

15% nozzle wear = 15% increase in operating costs

<table>
<thead>
<tr>
<th>Expense</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water expense</td>
<td>$6,135</td>
</tr>
<tr>
<td>Chemical expense</td>
<td>$53,820</td>
</tr>
<tr>
<td>Electricity expense</td>
<td>$3,118</td>
</tr>
</tbody>
</table>

15% wear (increase in nozzle capacity): $63,073

Note: Does not include water filtration and recovery costs.

The cost to operate this one shower increases from $54,803 to $63,073.
If you have six showers in the dry end, your costs increase by $49,620 annually.
Be sure to take a minute and calculate the potential waste based on the actual number of showers in your mill.

Example #2: Knock-Off Shower – One shower with 72 nozzles in the dry end of a press section

Operating conditions:
Nozzle size: 2.34 gpm (8.8 l/min) at 350 psi (24.1 bar)
System operated 60 hours per week, 48 weeks per year

Wasted water and wasted electricity costs alone can be staggering

<table>
<thead>
<tr>
<th>Expense</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increased water consumption daily due to increased capacity:</td>
<td>137,117 gallons</td>
</tr>
<tr>
<td>Increased annual cost of water and electricity for pump operation: (assumes water cost of $3.00 per 1000 gallons; electricity at $0.08 KWh)</td>
<td>$65,156</td>
</tr>
</tbody>
</table>

Again, do the math for yourself. This is the increase in water and electricity for a single knock-off shower. You’ll see how quickly $65,156 can become $651,560 or more.

Our online Spray Optimization Calculator may help expedite your calculations.
Visit www.spray.com/save
No-obligation optimization and maintenance programs

We offer two complimentary programs to achieve efficient, trouble-free spraying.

Visual inspections
- Occur while machine is running.
- Include visual inspection of all showers and nozzles on the machine for obvious spray problems.
- Include documentation of nozzle and shower locations.
- Include a written report of inspection results along with recommendations for operational enhancements if appropriate.

Nozzle audits
- Occur during shut-down.
- Include an inspection of all nozzles on the machine; size and condition of nozzles are noted.
- Include identification of nozzles that need replacement.
- Can be completed in one to four hours depending on machine.
- Include a written report with optimization tips, documentation on every nozzle and shower by location and maintenance recommendations.
Ways to Optimize Spray Performance and Lower Operating Costs

Air Management

Many mills use pipes with drilled holes or slits for drying or blow-off. This approach is extremely inefficient and consumes high volumes of costly compressed air.

Two ways to reduce air consumption

Compressed air nozzles
Air control nozzles that use compressed air convert low-pressure volumes of air into a targeted, high-velocity stream or flat fan air pattern and provide many benefits:

• Significant improvements in drying or blow-off by increasing impact on the target.
• A significant decrease in air consumption compared to open holes or slits in pipes.
• Reduced noise level.

An added benefit: lower noise

<table>
<thead>
<tr>
<th>Air Pressure</th>
<th>Noise Level</th>
<th>Noise Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>psig (bar)</td>
<td>open pipe</td>
<td>air nozzle</td>
</tr>
<tr>
<td></td>
<td>dB(A)</td>
<td>dB(A)</td>
</tr>
<tr>
<td></td>
<td>Perceived %</td>
<td></td>
</tr>
<tr>
<td>15 (1)</td>
<td>70</td>
<td>63</td>
</tr>
<tr>
<td>45 (3)</td>
<td>84</td>
<td>74</td>
</tr>
<tr>
<td>60 (4)</td>
<td>88</td>
<td>76</td>
</tr>
<tr>
<td>100 (7)</td>
<td>98</td>
<td>85</td>
</tr>
</tbody>
</table>

Air knife packages with blower air
There are several types of blowers available. Regenerative blowers offer several performance advantages:

• Lower noise.
• Lower maintenance.
• Longer life.
• Lower operating costs.
• Warm air can improve drying.
• Fully customized solution.

Using an air knife in conjunction with blower air produces a uniform, high-volume, constant air stream along the entire knife length. Using an air cannon is another option to consider when high velocity air needs to be directed into holes and crevices to ensure complete drying or blow-off. Plus, the operating costs associated with an air knife package are quite low – even lower than the cost of using air control nozzles with compressed air.

See Page 12 for more information

Optimized air consumption

A single operation in a mill using a 4’ (1.2 m) pipe with slits can cost $350,000+ annually.

Different approaches to drying and blow-off can cost just $30,500 annually.

A possible savings of more than $300,000 per year.

The cost of a new drying or blowing system is quickly offset by the tremendous savings in operating expenses.
**Guidelines:**

*Use compressed air and air control nozzles:*
- If your application needs maximum impact.
- If the nozzles need to be more than 4" (10.2 cm) from the target surface.

*Use blower air and air knives:*
- If your application needs velocity instead of impact.
- If the air knives can be placed less than 4" (10.2 cm) from the target surface.
- If the oil in compressed air causes quality control problems.

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**Comparing the options**

<table>
<thead>
<tr>
<th></th>
<th>Slit Pipe</th>
<th>Nozzle Manifold</th>
<th>Air Knife</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length</td>
<td>4' (1.2 m)</td>
<td>4' (1.2 m)</td>
<td>4' (1.2 m)</td>
</tr>
<tr>
<td>Pipe gap/air knife slot</td>
<td>1/8&quot; (3.2 mm)</td>
<td>—</td>
<td>.040&quot; (1 mm)</td>
</tr>
<tr>
<td>No. of pipes/nozzles/knives</td>
<td>1</td>
<td>24</td>
<td>1</td>
</tr>
<tr>
<td>Operating pressure</td>
<td>60 psi (4 bar)</td>
<td>60 psi* (4 bar)</td>
<td>—</td>
</tr>
<tr>
<td>Blower Hp</td>
<td>—</td>
<td>—</td>
<td>15 Hp</td>
</tr>
<tr>
<td>Total CFM (Nm³/hr)</td>
<td>6200 (10,535)</td>
<td>532 (903.6)</td>
<td>—</td>
</tr>
<tr>
<td>Hours of operation</td>
<td>4160</td>
<td>4160</td>
<td>4160</td>
</tr>
<tr>
<td>Electric costs</td>
<td>$.07 KWh</td>
<td>$.07 KWh</td>
<td>$.07 KWh</td>
</tr>
<tr>
<td>Annual Cost of Operation</td>
<td><strong>$356,281</strong></td>
<td><strong>$30,564</strong></td>
<td><strong>$3,620</strong></td>
</tr>
</tbody>
</table>

*Operating pressure of 45 psi (3 bar) can be used to achieve comparable impact using air control nozzles. This reduces the total CFM required for operation to 425 (721.8 Nm³/hr) and yields a total annual cost of operation of $24,427 or a savings of $331,854. All costs are in USD.*
Ways to Optimize Spray Performance and Lower Operating Costs

Spray Control

In many operations such as coating and moisturizing, spray precision is a necessity. Often, the best way to achieve optimal spray performance is by adding automatic spray control. The benefits are numerous and the payback period is often short.

- **Quality is improved through precise and even coating or wetting.**
- **Overspray is minimized** – chemical and coating consumption is reduced, worker safety improved and better transfer efficiency is achieved.
- **Manual intervention is minimized** – the controller can receive a signal to detect moisture content, volume of solution being sprayed, line speed or other conditions to automatically make adjustments based on operating conditions.
- **Inspection and maintenance costs can be decreased** – integrated devices can send signals to the controller when flaws are detected, so the marking process can be initiated or clean-out cycles activated and more.
- **Regulatory compliance and emission control can be improved** with automated spray systems designed specifically for pollution control.

Automatic spray control can be achieved by tying into an existing control system, adding a PLC or adding an AutoJet® spray controller. AutoJet controllers are designed specifically to optimize the performance of our automatic spray nozzles. Our controller manages spraying operations exclusively and can yield better performance than other types of controllers. In addition, AutoJet controllers offer “plug and spray” performance for easy set-up and operation.

Ways to benefit from automated spray control

- Automatic activation of individual nozzles or a zone of nozzles based on paper width eliminates the need for downtime or manual intervention.
- Using a moisture sensor, nozzles are turned off and on as required to ensure proper wetting.
- Flow rate and pressure control based on line speed enables precise coating.
- Automatic defect marking based on input received from a vision system.
- Automatic application of fragrance at very low flow rates using our PulsaJet® nozzles with Pulse Width Modulation.
- Automatic verification of spraying activity with our SprayCheck™ monitoring system reduces inspection time. The AutoJet controller sends a “spray” signal. The SprayCheck sensor confirms the signal with a “spray present” signal. Unconfirmed spray cycles can activate alarms or stop production – especially valuable in applications such as starch spraying or web moisturizing where consistent spraying is a necessity.
- Automated cleaning of chests and other containers without tapping into the main pumping system or water lines using an AutoJet Fluid Delivery System.
- Automated gas conditioning system allows precise control of gas temperature, volume and humidity to minimize the creation of toxins, protect downstream equipment and increase plant productivity.
The value of spray control

In this example, a modular AutoJet® system is used in conjunction with a sensor to control when nozzles apply glue for labels. The controller also monitors line speed and adjusts the glue volume to ensure consistent application and minimize waste. No manual intervention is required. If a problem is detected that the controller cannot resolve automatically, alarms will be activated to alert workers.
Ways to Optimize Spray Performance and Lower Operating Costs

Spray Analysis and Research

**Predetermining performance with spray testing and research**

Many spray operations require high precision and there is little or no margin for error. That’s why we often recommend spray performance testing prior to nozzle and shower selection in new applications or in critical operations where there may be an opportunity to increase efficiency.

**For example:**

- **If you’re spraying glues or starches**, selecting correct nozzles and determining optimal nozzle spacing, height and position can be challenging. In addition, nozzle clogging and frequent process interruptions are unacceptable so it is important to select the best nozzle for spraying viscous liquids.

- **If you’re spraying brighteners and colorants**, even distribution is required or you’re faced with high scrap rates.

- **In remoisturizing applications**, drop size is critical to ensure proper water retention without excess wetting. In some operations, automated zone control of nozzles may be the most effective way to ensure even moisturizing and minimize scrap.

- **In most applications**, operating conditions and layout parameters such as nozzle spacing and spray height are crucial to reduce misting, overcoming boundary layer air and improving transfer efficiency.

- **When it comes to spray system optimization, we often suggest spray characterization studies.** In our state-of-the-art spray laboratories, we can simulate your operating conditions using your chemicals/liquids to determine how to achieve the exact performance you need.

**Testing capabilities include:**

- Spray pattern and spray overlap tests to determine the ideal nozzle height and overlap required to achieve the desired distribution.

- Evaluating different nozzles at various pressures and operating conditions.

- Evaluating nozzle positioning/orientation.

- Drop size, distribution and velocity studies using laser technology.

- Impact studies using a proprietary device that measures impingement force in three dimensions.

- Process simulation using your specific chemicals.

- On-site testing or Computational Fluid Dynamics (CFD) to predict spray performance in situations where we are unable to simulate your application in our labs.

*Once we understand your application needs, we can determine if testing is required and provide recommendations on how to proceed.*
The value of performance testing

This chart shows the difference in coverage based on nozzle spacing. The data was collected in our spray labs using a patternator that collects liquid in channels aligned perpendicular to the nozzles. Several nozzles can be tested at once to determine the proper spacing and height for a specific volumetric distribution.

Automated and manual patternators are just a few of the specialized instruments in our labs to help predict spray performance in a wide range of operating conditions.
Other Helpful Resources

Optimizing Your Spray System: Spray Nozzle Maintenance and Control for Improved Production Efficiency; Technical Manual 410
Explains how to maximize performance and quality in your spray application.

UltraStream® Nozzles; Bulletin 563A
Provides information on single orifice and dual ruby orifice UltraStream nozzles for precise, even trimming of a wide variety of paper grades.

72020 Alignment Device; Bulletin 611
Addresses a device to facilitate the mounting and adjustment of UltraStream nozzles for reduced maintenance downtime and costly paper tears.

Automatic Brush Shower; Bulletin 561
Eliminate manual brush operation in existing applications and/or eliminate manual cleaning entirely in new applications by installing our automatic brush showers.

Automatic Brush Retrofit; Bulletin 600
Provides details on the benefits of automation and explains how quick and easy it is to replace a manual handwheel with a motorized drive shaft and control unit.

AutoJet® Technologies Modular Spray System; Bulletin AT104B
Details the features, specifications and options of our most cost-effective spray system to incorporate advanced spray control. The fully integrated system consists of both electrical and pneumatic control panels and is fully portable.

Liquid Strainers and Self-Cleaning Strainers; Catalog 35B and Bulletin 596
Explains how to protect nozzles, valves and pumps from damaging debris by using strainers and self-cleaning strainers.

Industrial Spray Products; Catalog 70
Full-line catalog including spray nozzles and accessories, technical data and problem solving ideas.

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