

## Filtration Applications in the Pulp & Paper Manufacturing Industry — Efficient Water Filtration Protects Spraying Nozzles

### Introduction

The very competitive Pulp & Paper Industry is sensitive to global economic conditions. Tighter control of critical processes have reduced costs while increasing productivity and quality. Managers of paper mills, therefore, are driven to reduce operating costs in order to remain competitive.

The Pulp and Paper Industry uses a significant amount of water during the paper making process. The water comes from various sources (rivers, lakes, wells, municipalities). Water characteristics can vary, especially during seasonal changes or after storms. Because of increased quality requirements and larger volumes requested by end users, water quality has become an even greater concern. Solving water contamination problems is a challenge for every mill.

During the paper making process, spray nozzles are used at many locations in the manufacturing machine. Their functions are:

- **To wet the still fragile paper sheet** - Shower water streams must spray continuously to wet the paper to reduce the risk of paper breakage.
- **To adjust paper dimensions** - Water jet cutting is used to cut the paper to width on both sides of the paper sheet.
- **To wash the wire belts** - Continuous washing of the transport wire is necessary to maintain a clean wire surface for uniform paper forming.

The purpose of this Application Brief is to describe an effective water filtration system for the protection of spray nozzles in paper plants. Proper filtration protects the nozzles from plugging, which results in less downtime, reduced maintenance costs and the prevention of catastrophic failures.

### The Process

The paper manufacturing process (figure 1) starts with the mix of pulp and additives into water. As the slurry flows from the head box onto the wire, the water drains away through the mesh leaving a continuous tiny fibrous mat on the mesh. As the wire section is traveling in a loop, each section of the raw paper now traveling along the mat at 115 ft/s (35m/s) is being dewatered. By the time it reaches the end of the wire section, the sheet of paper is still quite moist and very delicate.

At this stage the paper is continuously trimmed with water jets to the required width and the trimmings are washed into the wire pit. (Refer to figures 2 and 3)

- Water is sprayed along the paper line via several water ramps. Each ramp includes between 20 and 40 spray nozzles depending on the machine width. The fine nozzle apertures, typically in the range of 0.03 inches (0.8mm), need to be protected by filtration equipment sized to accommodate flow rates of 4 to 8 gpm (1 to 2 m<sup>3</sup>/h). Depending on the paper machine capacity, there may be several filter systems (10 to 20) along the production line to ensure appropriate

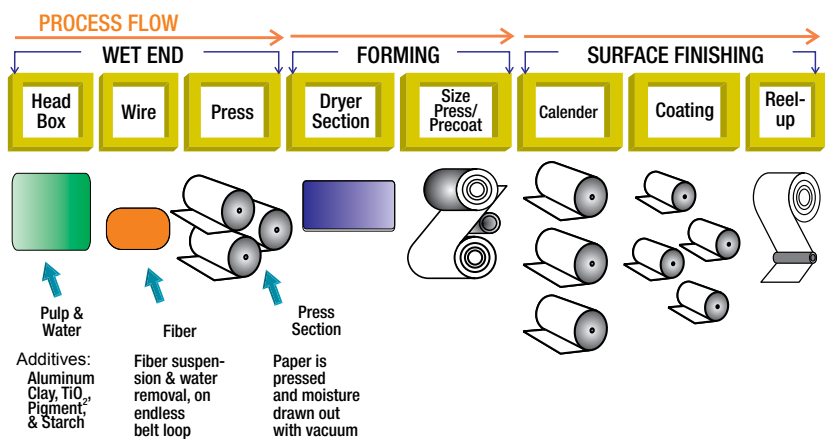


Figure 1. - Typical Manufacturing Process

contaminant reduction and desired wetting.

- Paper width is then adjusted by a water jet cutting process. High-pressure (300 psig / 20 bar) water, sprayed through fine nozzles with a diameter of 0.008 inches (0.2 mm), is used to cut the paper sheets. The water is filtered to prevent the nozzles from plugging.

The support belt requires continuous cleaning to maintain the surface quality and to avoid any deposition that would affect the paper quality or thickness. The belt is washed with water sprayed through fine nozzles, 0.008 inches (0.2 mm) at a 10 bar pressure. The cleaning water should be filtered to avoid any nozzle plugging.

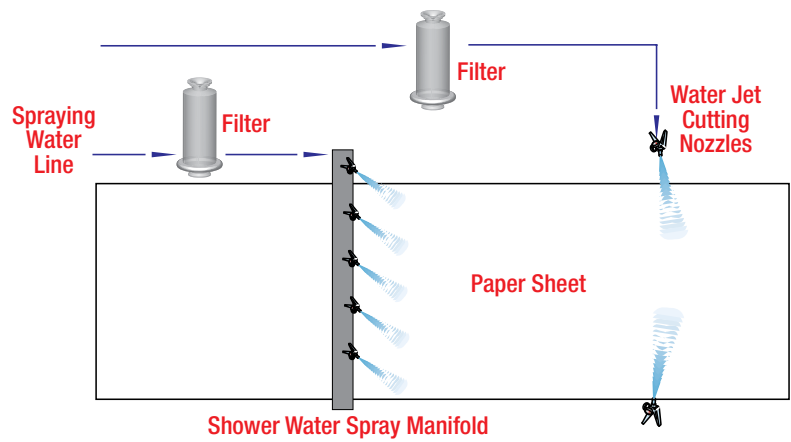


Figure 2. - Shower Water & Water Jet Cutting Applications

## The Problem

Paper manufacturers are most concerned with their ability to maintain production without stopping the process while reducing unscheduled maintenance.

- **Spray Nozzle Plugging:** As water is one of the most important ingredients in paper formulation, it is essential to maintain the water quality as consistent as possible. Because of seasonal changes, organics, sand, and gels very often contaminate raw water. Scaling in the water piping or corrosion deposits also produces contaminants. When the water is not properly filtered, these contaminants can block the spraying nozzles, reducing or even stopping the water sprays.
- **Production yields:** The continuous paper making process requires no downtime if at all possible. A paper machine can run at speeds up to 6600 ft/min (2000 m/min), so any defects introduced, however small, can affect a lot of production. Production machines use high speed rotating equipment and any production stop due to paper breakage will require restart time (from 5 to 15 min) to reach full speed again. Loss of revenue can reach \$300/min.
- **High maintenance costs:** If not well protected, the spray nozzles can plug. The less downtime that is required to change out the spray nozzles, the greater the productivity of the manufacturer. Furthermore, frequent and unpredictable nozzle change-out increases maintenance and labor costs, as wire wash nozzle replacement is not an easy task to perform
- **Filter cartridge change out:** cartridge life time and consistent filtration quality are key issues. A deformable cartridge structure, especially after pump shocks or high delta P, will allow by pass or unloading resulting in poor water filtration and shorter life time
- **Non-rigid filters,** as the system pressure increases, will often unload or release previously captured contaminant and reduce flow or plug the spray nozzles.

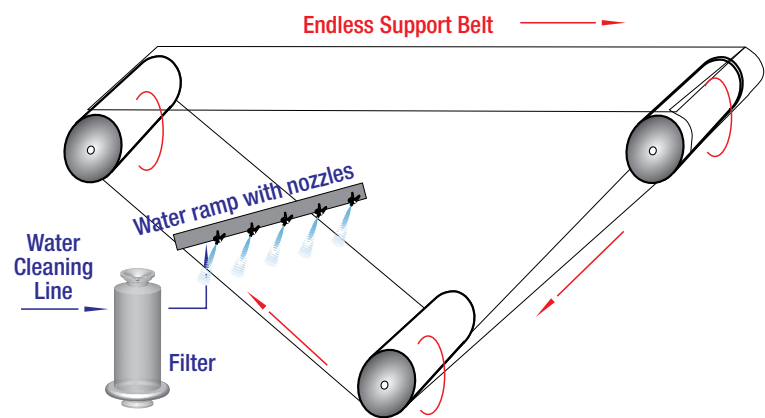


Figure 3. - Spraying nozzle application for wire belt washing



Figure 4. -Betapure™ BK Series Filters

## The Solution

An effective water filtration will reduce nozzle blockage thus reducing down time and maintenance. Filters must protect nozzles from premature plugging while maintaining flow and providing long service life. To ensure low total production costs, an optimum filtration solution will significantly reduce paper breakage.

### *The Filter Cartridge*

The filter designed to protect spray nozzles must be effective at reducing particles that are one-third the diameter of the nozzle orifice that they are protecting. Since the filter is located immediately upstream of the spray nozzle, the cartridge must be of rigid construction to ensure that previously reduced particles are not unloaded into the effluent stream. Finally, the filter cartridge should utilize a graded porosity media structure to allow the capture of contaminant throughout the depth of the filter media and provide long filter service life.

3M Purification Betapure™ BK series filter is a rigid, resin bonded, graded porosity cartridge and is the best choice for the protection of the spraying nozzles (Figures 4 & 5). The Betapure BK series filter's pore size gradient media will capture particles throughout the depth of the filter and provide effective particle reduction resulting in excellent protection. These filter cartridges feature a rigid structure and graded porosity media (Figure 5) ensuring long service life, consistent quality, and will not unload under changing system pressure. Betapure BK series is available with retention efficiencies from 5 to 70 µm absolute so that the proper grade can be selected to protect a specific size nozzle.

### *3M™ Housing:*

Because the space around the water ramp is limited, the filter housings are typically designed to hold one 10" or 20" cartridge. A compact and robust filter housing should be located as close to the spray nozzle as possible.

3M™ CT series 316 stainless steel filter housing (Figure 6) meets these requirements and can be installed just in front of each shower water spray manifold and water jet cutter ramp.

For belt washing processes that require higher flow rates, 3M Purification offers 3M DC housings (Figure 7). 3M DC housings are made of 304 SS, and include filter capacities from four (10 inch long) filters to 22 (40 inch) filters.

The clamp closure ensures easy and quick change-out, reducing maintenance labor costs. 3M Purification's recommended filtration solution is the necessary step required to ensure that water quality meets the specifications dictated by the end user, thereby reducing the potential for paper breakage, without adversely affecting the speed of the manufacturing equipment. The benefit of efficient nozzle protection is clearly seen as paper breakage is eliminated and production yields increase.

## **Recommendations**

Utilizing 3M Purification high efficiency filtration equipment will provide proper spray nozzle protection, eliminating production downtime which can cost \$300 for each minute of lost production.

The exceptionally long service life of the 3M Purification Betapure BK series filters used for nozzle protection in the water line will reduce total maintenance cost, because fewer filter change-outs require less labor.

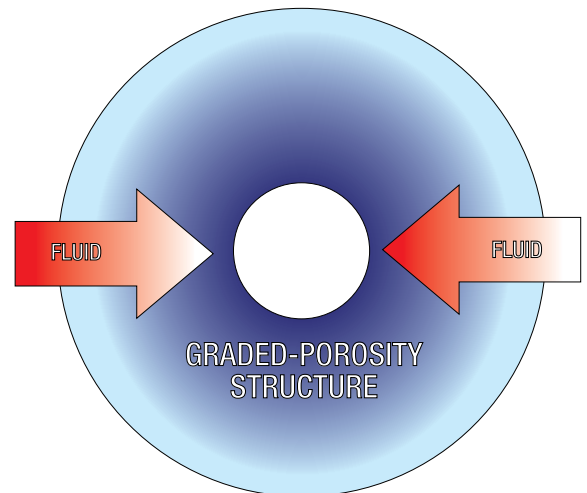


Figure 5. - Betapure™ BK Series Filters Feature Graded Porosity



Figure 6. - 3M™ CT Series Filter Housings (1 round 10", 20" or 30")



Figure 7. - 3M™ DC Series Filter Housings

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