With a new maintenance-free police filter

Reduction of freshwater consumption and closing of water loops

Wolf Heilmann

Water is one of the most important auxiliary materials for papermakers. Essentially, it is the solvent in which we dissolve wood. And once the water has evaporated, we have the finished paper. From stock preparation to winding, water is the papermaker's most important tool.

Ideally, paper manufacturers would use fresh water or city water, if it weren't so expensive. So, in many applications, they try to use recycled water and keep freshwater consumption as low as possible. However, clarified water and ultra-clarified filtrate are often not of sufficient quality to be used as water for spray pipes, as they contain too many fibers and particles, which cause the nozzles to clog over time.

The Jet Wing Liquid Filter from Klass allows eliminating 100% of these harmful particles and fibers. Thus it is exactly the right tool for this task.

Jet Wing Liquid Filter

The Jet Wing Liquid Filter was originally developed for sewer flushing. In that application, it enabled the flushing water to be recycled repeatedly by separating solids and suspended solids. The Jet Wing Liquid Filter makes it possible to remove sinkable, floatable, and suspended solids in a single process step, even at high water flow rates (Fig. 1, 2).

The filter itself consists of a laser-drilled filter basket with 60 µm or 100 µm holes for standard applications. A rotor, consisting of two negative airfoil profiles and two additional struts, orbits around the filter basket. It rotates around the filter basket at 1,000 min^{-1}. This makes the filter self-cleaning; every 0.03 seconds, the filter plate is flushed clean by a negative pressure pulse. The rotor also generates high centrifugal forces exceeding 100 g. This keeps all heavy and abrasive particles away from both the filter basket and the rotor, preventing wear. Only particles with same specific weight as water or lighter will reach the filter basket. Besides it creates a high differential speed of the water tangential to the filter basket's surface, which makes the passing of particles even more unlikely.

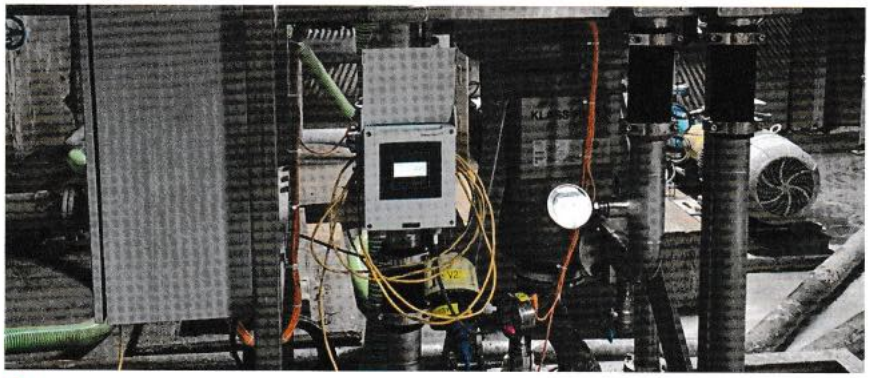


Fig. 1: Jet Wing Liquid Filter in the basement of a folding-boxboard machine © Klass

The Klass filtrate contains no suspended solids larger than 99 µm or 59 µm, but even particles larger than 25 µm are increasingly separated out as their size increases. Long fibers are also separated; only small fragments pass through the screen basket.

In a paper mill, many of the processes yield two types of accepts:

- Accept 1, the Klass filtrate at the outlet of the filter basket, is ideally suited for use as water for spray pipes, spray nozzles, lubrication, or barrier water, because it no longer contains any harmful or clogging components.
- Accept 2, which did not pass through the filter basket and still contains many long fibers. This fraction is used for pulping in a pulper or dissolving drum.

Another advantage is the very low energy consumption required for operation. For typical applications such as those listed below, energy costs range from 40 to 160 Wh/m^3 of Klass filtrate.

The Jet Wing Liquid Filter typically pays for itself within 6 to 18 months.

Application examples

The Jet Wing Liquid Filter is ideally used as a police filter in the paper industry. That's where it pays for itself the fastest.

Above all, it enables paper mills to significantly reduce their freshwater consumption—which is especially valuable in these times of water scarcity.

Case study 1 – Corrugated base paper mill

In the press section, the customer uses spray pipes with nozzles 700 µm in

diameter and municipal water. Previously, the customer used clear filtrate, but this caused the nozzles to clog too frequently. On average, the three spray pipes had to be cleaned every 18 to 21 days because too many nozzles were clogging. At times, this happened as early as two days after installation.

The clear filtrate had a solids content of 1,878 mg/l — with particles too large and thus clogging the nozzles. So municipal water was used instead.

We provided the customer with a Jet Wing Liquid Filter equipped with a basket featuring 100 µm perforations for eight weeks and had them treat the clarified filtrate. The clarified filtrate still contained 342 mg/l of solids; 81.7% had been removed. This included all solids larger than 99 µm (Fig. 3).

For first evaluation, a 9-meter-long spray pipe was supplied with the Klass filtrate. This pipe was equipped with all the nozzles available at the plant, as well as all the nozzles desired by the paper mill. While the pipe had to be removed after just 18 to 21 days when using the clarified water, not even nozzles with a 200 µm orifice became clogged during the entire experiment when using the Klass filtrate. Thus, they achieved a service life that was at least three times longer than with clarified water.

The customer must now redesign its water system and supply the spray bars with Klassfiltrat in the future — a significant cost savings.

Case study 2 – Corrugated base paper mill

A corrugated base paper mill is having problems with its ultra-clear filtrate. This filtrate is only partially suitable for spray pipes. The clear filtrate passes through four sand filters and enters an ultra-clear filtrate tank. This tank can also be filled with fresh water if the flow from the sand filters is too low. At the same time, it is possible to supply the ultra clarified filtrate tank from the clarified filtrate tank. This occurs when there is an insufficient supply of ultra clarified filtrate, but the clarified filtrate is of particularly high quality.

A 10-bar line for low-pressure spray nozzles and cleaning hoses, as well as a 30-bar line for high-pressure spray nozzles are supplied from the ultra-clear filtrate tank. The high-pressure nozzles frequently become clogged (Fig. 4).

Initially, the plan was to remove all contaminants from the water in the 30-bar line using a Jet Wing Liquid Filter (Fig. 5). As the project progressed, it became clear that the sand filters enhance biological activity in the system. The bacteria then contaminate the felts and forming fabrics. In addition, the required water consumption indicated that two Jet Wing Liquid Filters would be needed at times for the high-pressure spray nozzles.

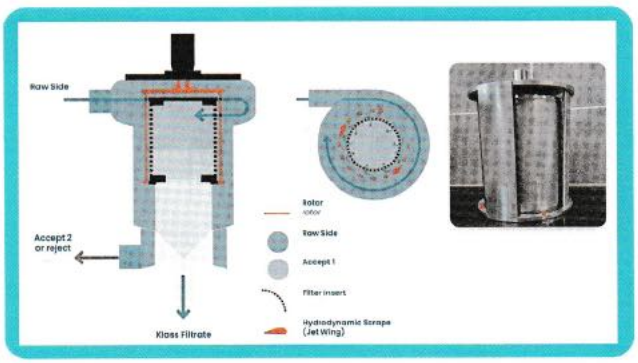


Fig. 2: Schematic diagram of the Jet Wing Liquid Filter, showing a side view on the left, a top view in the center, and the rotor on the right. © Wolf Heilmann, Klass



Fig. 3: Feed stream, Klass filtrate, and paper filter residues. The large particles in the feed stream, which cause the nozzles to clog, are clearly visible on the left filter. The right filter exhibits just minute particles and fibers. © Heilmann, Klass

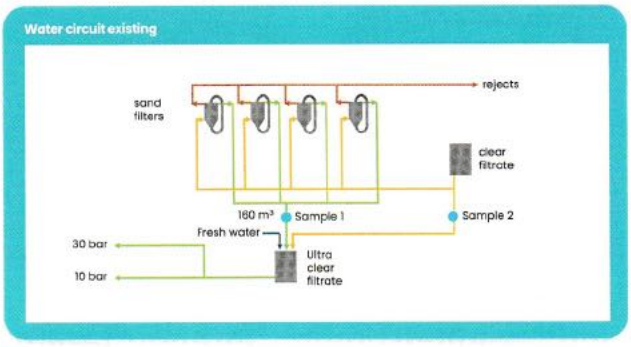


Fig. 4: Original design for supplying the low-pressure and high-pressure spray pipes © Heilmann, Klass

A trial showed that a Jet Wing Liquid Filter produces better water than sand filters. With two filters, the same purification performance can be achieved as with the existing sand filters. These will be replaced by Jet Wing Liquid Filters, which require much less installation space. At the same time, the longer fibers still present in the clarified filtrate are separated and returned to the pulping drum. This minimizes fiber loss (Fig. 6).

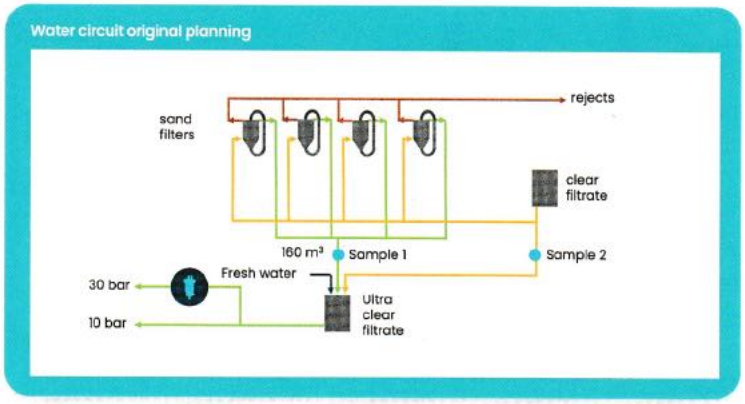


Fig. 5: Planned layout for supplying the low-pressure spray lines as well as Jet Wing Liquid Filter to feed the 30-bar high-pressure spray lines © Heilmann, Klass

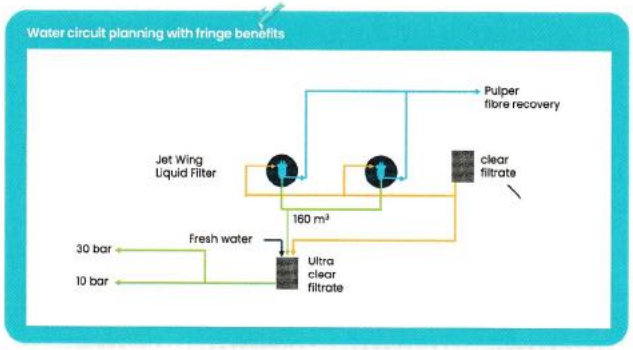


Fig. 6: Modified design for the water supply system, replacing the sand filters with Jet Wing Liquid Filters to reduce biological fouling © Heilmann, Klass



Fig. 7: Laboratory test with clear filtrate on the left, and results using the Jet Wing Liquid Filter in normal operation on the right © Heilmann, Klass

The Klass filter will be used for all high-pressure and low-pressure spray pipes, as well as for the cleaning water.

Case study 3 – Folding box board mill

A cardboard factory uses fresh water for the spray nozzles on its screen belt presses. The quality of the clarified water is inadequate, and the nozzles clog too frequently. For this reason, municipal water was used for this application. An initial audit revealed that the Jet Wing Liquid Filter removes all harmful particles from the clear filtrate and reduces the



Fig 8: Filtration of the super-clear filtrate from a specialty paper mill. The turbidity caused by fibers was reduced, and all particles larger than 99 µm were removed. © Wolf Heilmann, Klass

total particle count by over 90% (Fig. 7). Besides, 100% of big and harmful particles as well as fibers are eliminated. The high-pressure spray bars of the belt filter presses can now be fed with the Klass filtrate. As a follow-up, the high-pressure spray nozzles on the screens are now also being retrofitted.

Case study 4 - Specialty paper mill

A specialty paper mill must reduce its specific freshwater consumption; otherwise, it risks losing its environmental certifications. The nozzles of the disc filter account for a good 40% of the total freshwater consumption. They can only be supplied with fresh water as they cannot be accessed for replacement while the system is running, so they must not become clogged.

We tested various types of water, and the customer decided to improve the ultra-clear filtrate using the Jet Wing Liquid Filter. The ultra clarified filtrate still occasionally contains particles that are too large, which clog the nozzles. It also contains many fibers. Until now, the ultra-clarified filtrate could only be used to break down the pulp in the pulper and for dilution ahead of the fan pump. The rest went to the wastewater treatment plant. And with the ultra-clarified filtrate, about 0.5% of the fibers ended up in the wastewater treatment plant (Fig. 8).

The Jet Wing Liquid Filter now processes the ultra-clarified filtrate. The Klass filtrate, i.e. accept 1, is fed into the nozzles of the disc filter. The accept 2 contains the fibers and is now used to feed the pulper. This ensures that highly valuable



Fig. 9: Clarified water and Klass filtrate from a fine paper mill, as well as screen residue © Heilmann, Klass

specialty fibers are retained. Fiber purchases will be reduced by 0.5%. Another side effect: those 0.5% of fibers accounted for one third of the paper mill's COD value. As a result, the paper mill reduced its freshwater consumption by a good 40%, lowered its COD level by one-third, and reduced its fiber consumption by 0.5%.

Case study 5 - Fine paper mill

A fine paper mill would like to use the clear filtrate for various applications. However, it contains too many particles that are too large, which cause the nozzles to clog. An initial evaluation of the clear filtrate and other wastewater samples revealed that the clear filtrate from the Jet Wing Liquid is ideal for use even with small 200 µm nozzles. It can filter out a good 70% of the particles, including all those that cause the spray nozzles to clog. The Jet Wing Liquid Filter differs from other filters in that it makes a very clear distinction based on particle size, thereby reliably preventing nozzles from clogging (Fig. 9).

Summary

The Jet Wing Liquid Filter introduces a new, highly robust, low-maintenance, and cost-effective water treatment technology. With its Klass filtrate, it enables all applications that require small-diameter nozzles—no fresh water is needed for those purposes. At the same time, it allows for a reduction in nozzle diameter, thereby lowering the consumption of clarified water.

It is largely maintenance-free, as it continuously cleans itself while consuming minimal energy. A particular advantage is that the reject usually contains fibers and is therefore used as dilution water—thus keeping the fibers in the cycle. In addition to the applications mentioned, there are many others—the only limit to the Jet Wing Liquid Filter is your imagination.

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