

White Water Treatment for Pulp and Paper Mills

Background

The modern trend in white water treatment is towards greater closure of systems to reduce fresh water demand and effluent volumes. This objective can be partly achieved by utilizing equipment which minimizes fresh water requirements by reusing filtered white water in applications normally requiring fresh water. New Logic International's Vibratory Shear Enhanced Processing (VSEP™) system can be used to economically treat filtrate streams in order to generate clean permeate suitable for showers, seals, lubrication, and dilution water.

Objective

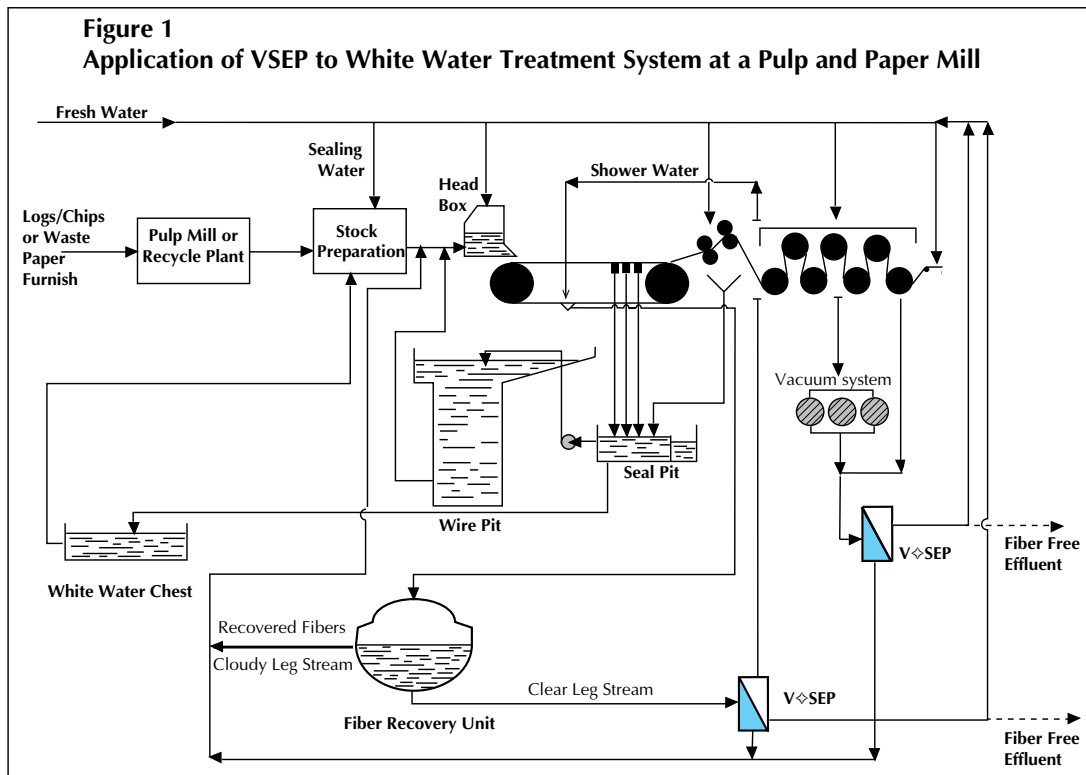
White water is filtered to separate fibers, fines and filler materials in order to provide a clean source of reusable water that meets operational and ecological requirements. Typically, a saveall or disk filter is used as a fiber recovery unit to recover fiber from the white water stream, while the filtrate requires additional treatment. The filtrate must

be treated to provide water that is clean and free of suspended solids and/or dissolved solids if it is to be reused in the process.

Solution

The Vibratory Shear Enhanced Processing (VSEP) treatment system uses micro- or ultra-filtration membrane modules to treat the white water filtrate. The system separates fibers, fines and fillers, generating a permeate stream that meets the water reuse criteria. The suspended solid material is easily concentrated to high solids in a VSEP treatment system using 0.1 to 5 μm microfiltration membranes or ultrafiltration membranes with a molecular weight cut-off of 8,000 to 100,000 Daltons. Nanofiltration can also be used if total dissolved solids (TDS) removal is an issue. The clear permeate can then be recycled to the process.

In the pulp and paper industry, VSEP membrane systems can now be utilized where traditional cross-flow membrane technologies faced substantial membrane fouling problems in the past. VSEP is an attractive alternative to conventional filtration methods due to its increased fouling resistance resulting from its vibrational, shear-enhancing design.



Process Conditions

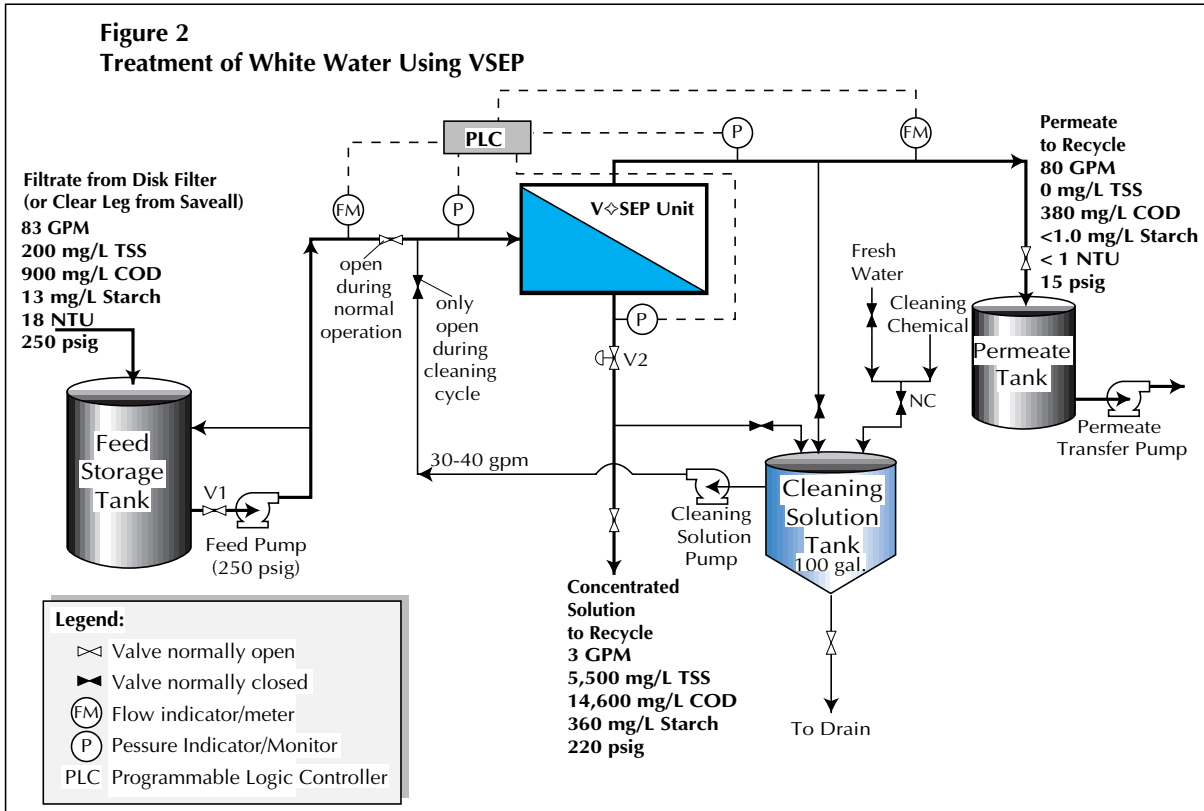
A flow diagram of a typical white water system around a paper machine is shown in Figure 1. As the diagram illustrates, a large volume of fresh water is introduced into the system at various places. By recovering more excess water from the effluent stream (saveall filtrate), the amount of fresh water used in the process can be greatly reduced. Generally, VSEP would be applied to treat the white water from the clear leg of the saveall for reuse in the system or to clean the discharge water from the vacuum pumps to recover water that is typically sewered. Vacuum pump seal water can also be treated for close looping seal water systems.

an average rate of 83 gpm. One VSEP unit using an ultra-filtration membrane module processes the feed water.

The VSEP produces a concentrated fiber stream at a flow rate of 3 gpm which is recycled back to the process. The concentrated stream contains approximately 5,500 mg/L of total suspended solids (TSS). The VSEP unit also generates a permeate stream of about 80 gpm which can be routed to machine showers or discharged as effluent. The concentration of the feed to the VSEP unit is about 200 mg/L TSS. The permeate concentration of fiber fines is less than 1 mg/L of TSS, well below the design criteria for process shower applications.

A process schematic for treatment of white water (filtrate from disk filter) using a VSEP system in a recycled fiber mill is presented in Figure 2. This diagram includes a material balance for a white water system and illustrates the performance as enhanced by VSEP. Filtrate from the disk filter is fed to a feed storage tank and the VSEP unit at

Using an ultrafiltration module in the VSEP system is a commercially viable option for treatment of filtrate from disk filters or of the clear leg from a saveall unit. Nearly 90-98% of the feed white water is recovered as clean water suitable for reuse or discharge, while less than 2-10% is recycled or discharged as concentrate.



A summary of successful pilot test results conducted at New Logic for treatment of white water is presented in Table 1. Depending on process temperatures and membrane selection, the permeate flux rate in the VSEP can range from 80 to over 160 gallons per square foot per day (GFD). The concentration level out of the VSEP unit is controlled by an automatic timed control valve. This

valve is set such that the concentration of the solids is held at the desired level. A multi-stage feed pump supplies the VSEP unit at a pressure suitable for the membrane being used. A variable frequency electronic drive is used to set feed pressure through a P.I.D. (Proportional-Integral-Derivative) control loop. This type of drive acts to control the rotational speed of the pump, thus controlling the flow rate.

Table 1

**Pilot Test Results at Various Sites
Application of VSEP for White Water Treatment**

Pressure (psig)	Temperature (°C)	Membrane	Feed (TS, % by Wt.) (a)	After Processing (TS, % by Wt.) (a)	Permeate Recovery (%)	Average Flux (GFD) (c)
100-250	25	1 µm Teflon	0.01	0.2	92-98	133
100-250	45	0.1 µm Teflon	0.13	1.58	92-98	161
100-250	45	100,000 MWCO Ultrafiltration (d)	0.24	1.92	87-98	133
100-250	25	3 µm Teflon	0.07	0.59	88-98	125
100-250	24	8,000 MWCO Ultrafiltration (d)	0.08	1.13	93-98	134
100-250	48	100,000 MWCO Ultrafiltration (d)	0.02 (TSS)	0.55 (TSS)	97	80

a) TS: Total Solids

c) GFD: Gallons per sq. ft. per day

b) TSS: Total Suspended Solids

d) MWCO: Molecular Weight Cut-Off

Economic Value

New Logic's VSEP treatment system provides operational benefits beyond those of conventional white water treatment equipment such as strainers, filters or clarifiers. The VSEP system will easily remove 100% of all suspended solids and can be tailored to effectively remove dissolved solids from the white water stream without chemical treatment demands. The justification for application of the VSEP system on white water is determined through analysis of the system's costs and benefits including:

- Total removal of suspended solids to eliminate shower plugging.
- Elimination of dissolved solids build-up.
- Reduction of problems with slime, foam, corrosion, odor and precipitation.
- Improved retention and reduced retention aid usage.
- Recovery of fiber, fines and filler materials.
- Reduced fresh water usage.
- Minimized primary treatment cost for raw water.
- Retention of white water heat value and reduced heating costs.
- Reduced effluent volume and associated treatment costs.
- Reduced pumping requirements.

- Lowered installed cost with minimal space requirements.
- Improved quality and performance efficiency of the paper machine.

If a paper mill is limited in fiber recovery (saveall) capacity, the VSEP, along with a fiber-scalping device, may be used to perform this function and to debottleneck the process without additional investment in a new saveall unit.

Summary

New Logic International has supplied VSEP separation technology successfully to many industrial processes. The pulp and paper industry's effort to meet economical restraints and environmental regulations will be enhanced by the utilization of membrane filtration techniques combined with Vibratory Shear Enhanced Processing. The development of applications for pulp and paper, along with VSEP technology and the availability of new membrane materials make it possible to tackle the most difficult streams with very successful and economical results. Contact a New Logic representative to develop an economic analysis and justification to include a VSEP in your system.

References

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Dexter, R. J., "Industry's Efforts at Effluent Closure Must Focus on Competitive Innovation," *Pulp and Paper*, February, 1996, pp. 2-4.

For more information on VSEP technology and its potential application to your process, please contact:

New Logic International, Inc.

1295 67th Street
Emeryville, CA 94608

(888) 289-VSEP toll free
(510) 655-7305 tel
(510) 655-7307 fax
e-mail: info@vsep.com
web: www.vsep.com