End of Pipe Effluent Treatment for Pulp and Paper Mills

Background

Technological advances in membrane filtration systems have created an opportunity for pulp and paper mills to treat effluent streams in order to meet stricter environmental constraints. "Vibratory Shear Enhanced Processing" or VSEP™, developed by New Logic International makes it possible to filter effluent streams without the fouling problems exhibited by conventional membrane systems. The VSEP membrane system will significantly reduce BOD, COD, TDS, TSS and color bodies from effluent streams discharged from pulp and paper mills, thus minimizing treatment cost.

Objective

To meet the requirements of both ecology and economy, the filtration of effluent streams allows a mill to meet discharge requirements and/or provide a clean source of reusable water. The treatment of the effluent is in most cases required for discharge and/or reuse.

Solution

The Vibratory Shear Enhanced Processing (VSEP) treatment system uses ultra- or nanofiltration membranemodules to treat the effluent in order to separate fibers, fines, fillers and organic materials or dissolved solids, generating a permeate stream that meets water discharge or reuse criteria. The VSEP membrane system will reduce BOD, COD, TDS, TSS and color bodies from effluent streams. Reverse osmosis filtration can be used if TDS buildup is an issue. The clear permeate can then be discharged or recycled back into the various mill processes.

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. The VSEP is an attractive alternative to conventional filtration methods due to its vibrational, shear-enhancing design which reduces or eliminates fouling.

Process Conditions

A flow diagram of a typical conventional end of pipe effluent treatment system for the paper making process is shown in Figure 1. As the diagram shows, the process involves several treatment steps and generally a large volume of water is discharged from the system. By recovering water from the effluent streams, the amount of fresh water used by the mill can be greatly reduced. As shown in Figure 2, the VSEP would be applied to treat the effluent from the primary clarifiers as a secondary treatment step, or the effluent from the secondary clarifiers as a tertiary treatment step. The treated water can be reused in the system or discharged.

Figure 1
Conventional End of Pipe Effluent Treatment System

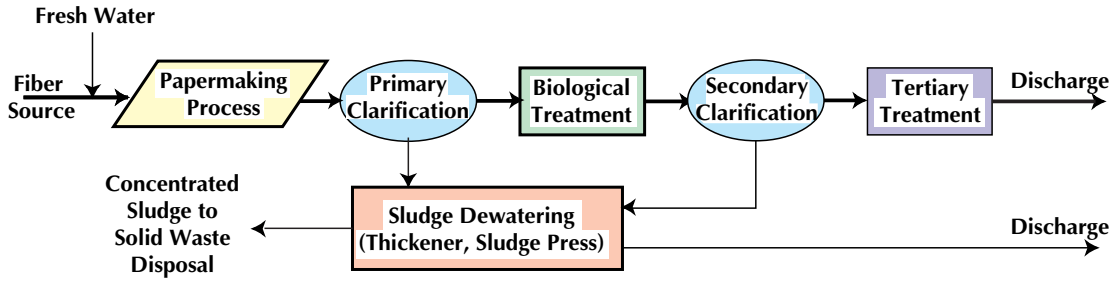
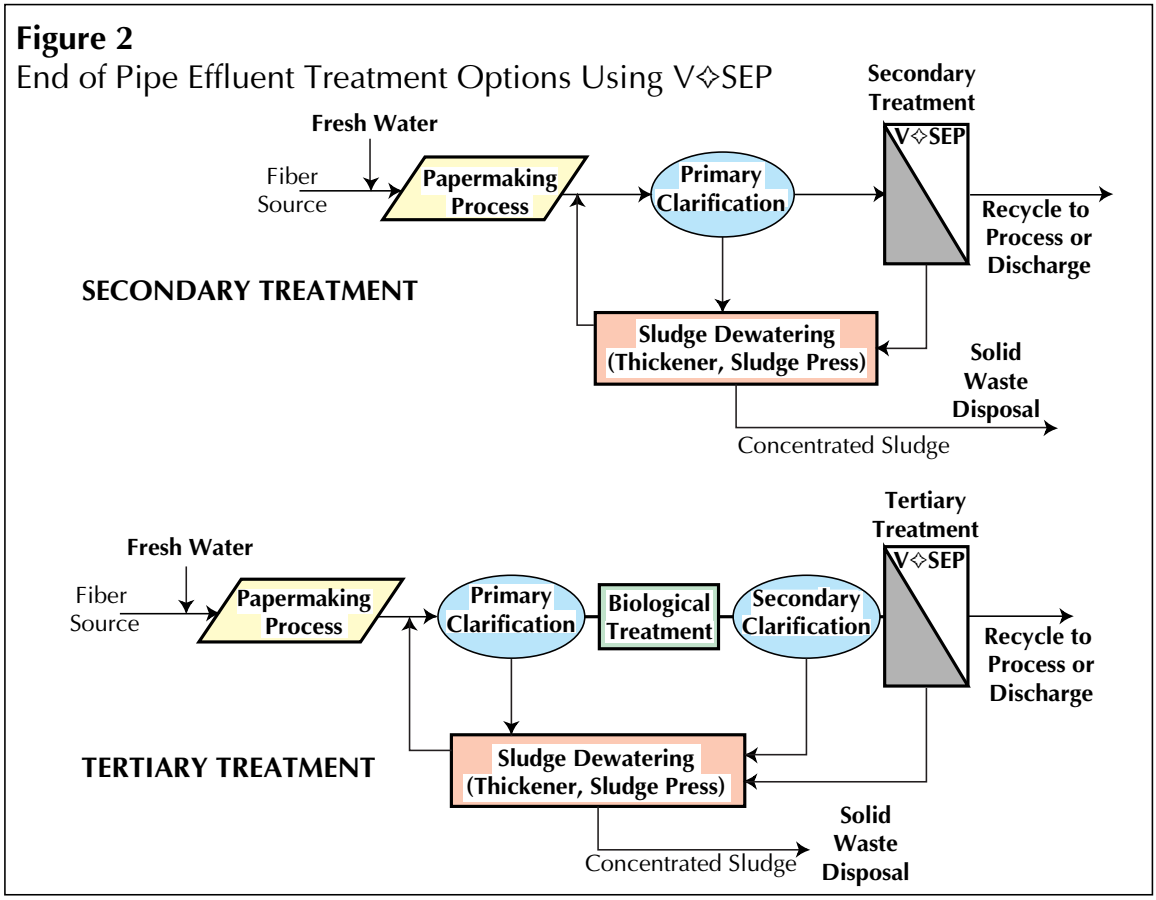


Figure 2
End of Pipe Effluent Treatment Options Using V✧SEP



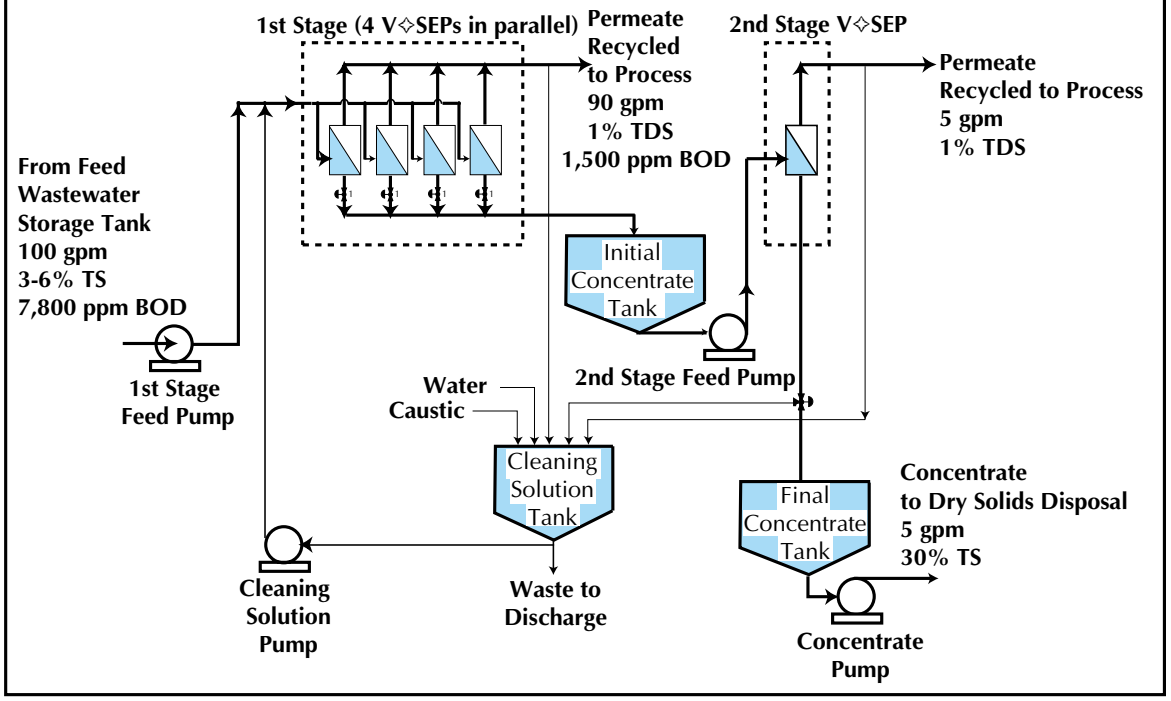
Recycle Paper Mill Applications

Figure 3 presents a process schematic for the application of VSEP membrane technology to effluent treatment for a de-ink paper mill. Five industrial VSEP units are utilized in two stages to treat the waste water. This diagram includes a material balance for the effluent treatment system and illustrates the performance as enhanced by VSEP. Effluent waste water from the feed storage tank is fed to the four first stage VSEP units at an average rate of 100 gpm. The discharge BOD level in the effluent stream can be reduced from 7800 ppm to less than the targeted 1500 ppm, in a simple operation without chemical addition or the related expense. The concentrate from the first stage is fed to the initial concentrate tank and then pumped to a single second stage VSEP unit for final concentration.

Membrane selection is based on material compatibility, flux rates (capacity) and reject concentration requirements. The membranes selected for this application are nanofilters with 10% and 50% NaCl rejects. These membranes are selected through laboratory and pilot trials in order to reduce the BOD of the effluent.

The BOD reduction is over 80% while the reject stream is concentrated from 1% to 30-35% by weight, allowing the mill to simplify the reject handling system. The permeate quality from the VSEP can be controlled though the laboratory testing of available membrane materials that fit the application parameters. Filtration systems are available to treat many paper mill streams to a quality that allows mills to reintroduce the permeate into the system. This reuse off-sets fresh water make-up needs. A wide range of membranes can be utilized to provide filtration ranges from microfiltration to reverse osmosis.

Figure 3
Typical Process Schematic for Effluent Treatment at (De-ink) Recycle Mill



The VSEP produces a concentrated waste stream at a flow rate of 5 gpm which is discharged. The concentrated stream contains approximately 30-35% by weight of total solids (TS). The VSEP treatment system also generates a permeate stream of about 95 gpm which is recycled into the process. The feed to the VSEP unit has about 3 to 6% solids (TS). The permeate concentration of fibers is less than 1% of TS, well below the design criteria for process recycle requirements.

Using a nanofiltration module in the VSEP system is a commercially viable option for end of pipe treatment at a paper mill. Nearly 90 to 95% of the feed wastewater is recovered as clean water suitable for reuse or discharge, while less than 5 to 10% is discharged as concentrate.

A number of successful pilot tests have been conducted at New Logic for end of pipe treatment of pulp and paper processes. Depending on process temperatures, membrane selection and the requirement for BOD/COD removal, the permeate flux rate in the VSEP can range from 20 to over 70gallons 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 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 kind of drive acts to control the rotational speed of the pump, thus controlling the flow rate.

Economic Value

New Logic's VSEP system provides an alternative approach to effluent treatment for "end of pipe" applications. In a single operation step, VSEP will reduce BOD, COD, TSS, TDS and color to provide a high quality stream for discharge or reuse in the process. In many applications, the addition of VSEP will eliminate conventional treatment process requirements and technologies without requiring chemical treatment. The justification for the use of a VSEP treatment system in your process is determined through

analysis of the system's costs and benefits including:

- Reduction of BOD, COD, TSS, TDS and color for the effluent stream.
- Reduction of effluent discharge volume and associated treatment cost.
- Provision of high quality water for reintroduction into the process.
- Reduction of fresh water demands and pretreatment costs.
- Retention of heat in recycled process water, and thus reduction of energy requirements.
- Elimination of biological growth and odor in effluent.
- Simplification of effluent treatment with a compact, low-energy system.

Summary

New Logic International has supplied VSEP separation technology successfully to many industrial processes. The pulp and paper industry's efforts to meet environmental regulations will be enhanced by the utilization of membrane filtration techniques and Vibratory Shear Enhanced Processing. VSEP technology along with the development of applications for pulp and paper and the availability of new membrane materials make it possible to treat 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

Smook, G. A., Handbook for Pulp & Paper Technologists. Second Edition, Angus Wilde Publications, Vancouver B.C., Canada, pp. 98-132.

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:

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