

Black Liquor Treatment for Pulp Mills

Note

Background

As pulp mills have increased production rates to meet market demands, many mills built over the last 20 to 30 years have become limited in evaporator capacity to treat their black liquor volume. The ability to also recover excess liquor from storage areas to higher solids levels is another demand on the evaporators. For mills with outside storage ponds that receive a large amount of rain, the liquor is diluted and the evaporation of the excess water can become very expensive. The expense of adding new evaporator equipment has provided an opportunity for new technologies to fulfill this need.

Objective

Because many pulp mills are limited in evaporator capacity, a simple, economical process to pre-concentrate the liquor prior to evaporation is needed. To meet the operational requirements economically, the pre-concentration of black liquor streams allows a mill to reduce the load on the evaporators thus reducing energy costs and also providing the needed capacity along with a source of reusable water.

Solution

Technological advances in membrane filtration systems have created an opportunity for pulp mills to treat black liquor streams in order to debottleneck the process, to meet stricter environmental constraints and to improve the mill energy efficiency thus reducing operating costs. "Vibratory Shear Enhanced Processing" or VSEP™, developed by New Logic International makes it possible to filter black liquor streams without the fouling problems exhibited by conventional membrane systems.

The VSEP treatment system uses ultra- or nanofiltration membrane modules to treat the black liquor in order

to pre-concentrate solids (fibers, organic lignins and TDS) prior to the final evaporation. At the same time, VSEP generates a permeate stream that meets the water discharge or reuse criteria. The VSEP membrane system will also reduce BOD, COD, TDS, and TSS from pulp mill effluent streams. With pH adjustment, reverse osmosis filtration can also be used if dissolved solids or color is an issue. The clear permeate can then be discharged or recycled to the process. In summary, the VSEP treatment system can be used to supplement an evaporator at the facility, to increase the mill energy efficiency (reduce evaporator load), and to eliminate liquor storage considerations and treat pulp mill effluent.

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 because its vibrational, shear-enhancing design reduces fouling.

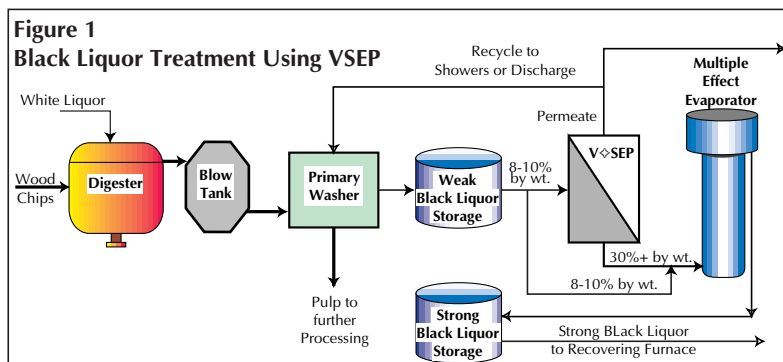
Process Conditions

A flow diagram of a typical black liquor treatment system in a pulp mill process is shown in Figure 1. When the residual lignin is washed from the pulp in the primary stage of washing, the result is a filtrate or spent black liquor, that is 8 to 10% by weight total solids (TS). This liquor is typically sent to evaporators in order to

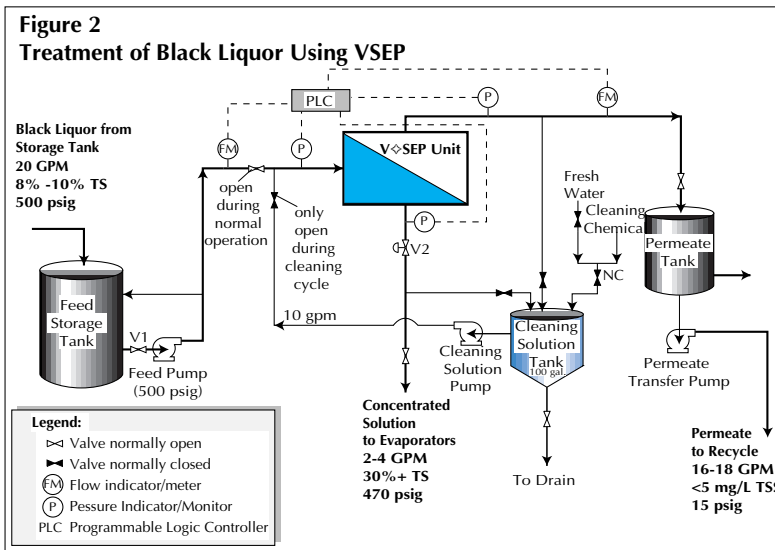
concentrate the liquor up to 60 to 65% by weight total solids. The concentrated solids are used as fuel for the recovery boiler which provides steam to the process. As the diagram shows, the addition of VSEP ahead of the evaporator to pre-concentrate black liquor reduces the load on the evaporator significantly, thus debottlenecking the overall process and allowing for additional processing capacity. The permeate can be reused in the washer showers or discharged.

A process schematic for treatment of black liquor using a VSEP system in a pulp mill is presented in Figure 2. This diagram includes a material balance and illustrates the performance as enhanced by VSEP. In this example, black liquor from the feed storage tank is fed to the VSEP unit at an average rate of 20 gpm. One VSEP unit using a nanofiltration membrane module processes the weak black liquor.

The VSEP produces a concentrated liquor stream at a flow rate of 2 to 4 gpm which is then sent to the evaporators. The concentrated stream contains approximately 30-35% by weight of total solids (TS). The VSEP treatment system also generates a permeate stream of about 16-18 gpm which is recycled to the process. Concentration of the feed to the VSEP unit is about 8 to 10% TS. The permeate solids concentration is less than 5 mg/L of TSS, well below the design criteria for process shower applications.



Note



- Improves the energy efficiency of the evaporation process.
- Provides high quality shower water for improved wash efficiency.
- Reduces BOD/COD/TDS and color levels of effluent that is discharged from the pulp mill.

Summary

New Logic International has supplied VSEP separation technology successfully to many industrial processes. The pulp and paper industry's effort to meet 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 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:

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

Using a nanofiltration module in the VSEP system is a commercially-viable option for treatment of black liquor streams. Nearly 80 to 90% of the feed black liquor is recovered as water suitable for reuse or discharge, while less than 10 to 20% is fed to the evaporator as concentrate, thereby greatly reducing the load to the evaporators.

Membrane selection is based on material compatibility, flux rates (capacity) and concentration requirements. One of the main issues in black liquor concentration is the high pH of the stream. This makes pH tolerance an important criterion to consider in selecting a membrane. In this example, the BOD reduction is over 80% while the reject is concentrated from 8% to 30-35% by weight, allowing the mill to reduce the load on the evaporator system. The permeate quality from the VSEP can be controlled through laboratory testing of membrane materials that fit the application parameters.

Successful pilot tests have been conducted at New Logic for black liquor treatment. Depending on process temperatures, membrane selection and the requirement for concentration or BOD/COD/TDS removal for effluent streams, the permeate flux rate in the VSEP can range from 20 to over 70 gallons per square foot per day. 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 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 for black liquor concentration that is far more economical than replacing or expanding conventional evaporator capacity. VSEP will provide solids concentration in a single, energy-efficient, compact package. The justification for the use of the VSEP treatment system for black liquor concentration is determined through analysis of the system costs and benefits. The VSEP system:

- Provides expanded capacity to the evaporator train in an economical manner.
- Recovers weak liquor from storage to provide high concentration levels to evaporators.
- Recovers spent liquor for concentration.