

Effluent Treatment for Paper Coatings

A cost-effective and environmentally-sound solution

Background

The manufacture of coated paper is a major industry worldwide. Total paper manufacturing capacity in the United States is about 102 million tons per year with 5 million tons, or about 5%, being coated paper grades. The addition of coating materials to paper is expensive yet provides improvements to the sheet for its intended uses. Products that typically use coated paper include magazines, catalogues, brochures, labels, books, stamps, and book covers.

The paper making process is very sophisticated, with paper machines producing paper at incredible speeds, on which the coating is applied. The coating of paper may also be applied “off-machine” providing more flexibility in the production schedule and for grade changes, by separating the coating function from the paper machine operation. Coaters, the specific equipment that applies coating to the paper may be arranged in several configurations. One of the most common arrangements is that which uses a blade or bar to evenly distribute the coating across the paper web. The application of coatings in some systems produces excess coating material that is lost from the process. The expensive coating materials are also lost during wash ups or cleaning of the coater, as well as from the preparation of the coatings in the coating kitchen. The diluted coating stream from the coating operation is typically discharged to the effluent treatment plant increasing the solids load on the effluent plant as well as losing the value of the coating material from the process.

Objective

To better meet the requirements of both

ecology and economy, the filtration of diluted coating streams allows a paper mill to recover concentrated coating material for recycle and reduce overall solids discharge. The treatment of diluted coating streams in most cases provides a significant cost reduction to the coated paper mills operation.

Solution

Technological advances in membrane filtration systems have created an opportunity for the coated paper mill to treat diluted coating streams in order to reduce the environmental impact of effluent systems and recover valuable coating materials. The “Vibratory Shear Enhanced Processing” or VSEP™, developed by New Logic International makes it possible to filter diluted coating process order to generate a permeate stream of high quality water which can meet discharge or reuse criteria. The clear permeate can then be discharged or recycled to the process. In addition, VSEP concentrates solids

(coating materials) to a level suitable for recycle to the coating process. Nanofiltration or reverse osmosis filtration can also be used if smaller dissolved solids or color is an issue. In summary, the VSEP treatment system can be used to treat diluted coating process streams, supplement the coating materials required at the facility, and thus improve the plant economics.

In the paper mill coating process, as well as other pulp and paper processes, 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-enhanced design.

Process Conditions

A process schematic for treatment of diluted paper coatings using a VSEP system is presented in Figure 1. When the residual diluted coating is washed from the coaters, the stream is typically 1.5 to 2% by weight, total solids (TS).

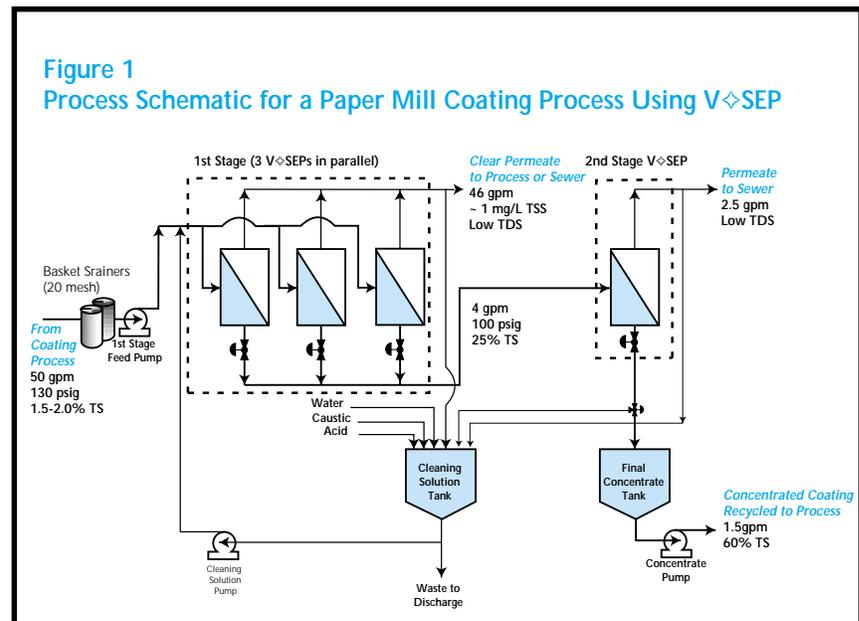
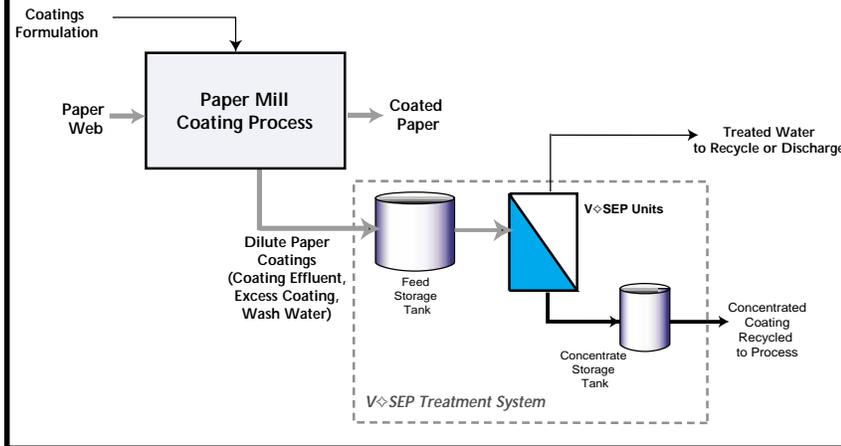


Figure 2
Overall Flow Chart
Paper Mill Coating Process
Including VSEP Treatment System



The addition of VSEP to concentrate the coating process effluent improves process efficiency by providing a concentrated stream of recovered coating up to 60% total solids. The permeate can be reused in the process or discharged.

In this system the diluted coating is fed to the VSEP treatment system at a rate of 50 gpm and a pressure of 130 psig. Three industrial scale VSEP units, using ultrafiltration membrane modules with 10,000 Molecular Weight Cut-Off (MWCO) membranes, treat the diluted coating stream. A second stage VSEP unit, also using an ultrafiltration membrane module with similar membrane, processes the concentrate from the first stage to recover coating material and eliminate solids and color agents from the permeate stream. The produced concentrated stream at a flow rate of 1.5 gpm and a solids concentration of 60% TS is recycled to the coating preparation system.

Stage #1 VSEPs also generate a permeate stream of about 46 gpm which is recycled to the process or discharged to the sewer. The permeate stream from the second stage is about 2.5 gpm and

is sent to the sewer. The feed concentration is 1.5 to 2.0% total solids (TS). In the first stage, the permeate concentration is reduced to ~ 1 mg/L of total suspended solids (TSS), and a low level of total dissolved solids (TDS). Figure 2 presents an overall flow chart for a typical coating process including the VSEP treatment system.

Paper coatings have many ingredients. Each one has a very specific purpose and function. The exact mix made depends on the grade or type of paper that is to be run. The most frequently used coatings include color coatings, ground and precipitated calcium carbonate, kaolin clay and titanium dioxide. Membrane selection is based on material compatibility; flux rates (capacity) and concentration requirements. In this example, the TSS reduction is over 99% while the coatings are concentrated from 1.5-2% to 60% by weight. The permeate quality from the VSEP can be controlled through laboratory selection of membrane materials available to fit the application parameters.

The addition of VSEP to concentrate the diluted coating improves the process

efficiency. Using an ultrafiltration module in the VSEP system is a commercially viable option for treatment of paper mill diluted coating process streams. Nearly 95 to 97% of the water is recovered as treated water suitable for reuse or discharge, while the remaining 3 to 5% are recycled as high solids concentrate, thereby supplementing the coating material requirement by a great margin.

Successful pilot tests have been conducted by New Logic for diluted coatings. Depending on process temperatures, membrane selection and the requirement for solids concentration or BOD/COD removal for effluent streams, the permeate flux rate in the VSEP can range from 15 to over 70 gallons per day per square foot (GFD). The concentration level from the second stage 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 or a progressive cavity feed pump supplies the VSEP units at a pressure suitable for the membrane used. A variable frequency electronic drive is used to set feed pressure through 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 for processing diluted coating applications. VSEP will provide a concentrated coating stream and also reduce BOD, COD, TSS, TDS and color to provide a high quality permeate stream for discharge or reuse in the process. In many applications, the addition of VSEP will eliminate conventional treatment process requirements and technologies. The justification for the use of VSEP treatment system in your process is

determined through analysis of the system cost and benefits including:

- Recovery of coating material in a concentrated stream suitable for recycle to process.
- Reduction of solids from discharge stream and the associated treatment cost.
- Reduction of BOD, COD, TSS, TDS and color for the effluent stream.
- Provision of high quality water for reintroduction into the process.
- Offset fresh water demands and pretreatment cost.
- Retain heat in recycled process water as a possible method to reduce energy requirements.
- Simplify coating material recovery and effluent treatment with a compact, low energy system.

References

Smook, G. A., Handbook for Pulp & Paper Technologists, Second Edition, Angus Wilde Publications, Vancouver B.C., Canada, 1998.

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

Summary

New Logic International has supplied VSEP separation technology successfully into many industrial processes. The coating process as well the pulp and paper industries effort to reduce costs and to meet environmental regulations will be enhanced with the utilization of membrane filtration combined with "Vibratory Shear Enhanced Processing". This development in coating process applications along with the availability of new membrane materials and VSEP technology make it possible to treat the more difficult streams with very successful, economic results.

Contact a New Logic representative to develop an economic analysis and justification for the VSEP in your system. **For additional information and potential application of this technology to your process, visit New Logic's Website @ www.vsep.com or contact New Logic, 1295 Sixty Seventh Street, Emeryville, CA 94608, Phone: 510-655-7305, Fax: 510-655-7307, E-mail: info@vsep.com.**