NEW LOGIC INTERNATIONAL, INC.

Case Study

Application of VSEP at a Major Medium Density Fiber Board Manufacturing Facility

Overview

New Logic International installed its Vibratory Shear Enhanced Processing (VSEP) system in August, 1998 at a major international Medium Density Fiber (MDF) Board manufacturing facility. The VSEP is used for treatment of thermomechanical pulping effluent at this facility with no pretreatment required. The VSEP system uses a nanofiltration membrane module and is able to treat pressate from the screw press operation after refining, in order to reduce COD, TSS, oil and grease below the required limits. The economics of installing this system are extremely attractive with a payback period of about 7 months. The application of VSEP membrane technology to medium density fiber board and similar manufacturing facilities (pulping, board, paper, etc.) is found to be an attractive and economical alternative to conventional wastewater treatment technology.

Background

The commercial production of refiner mechanical pulp (RMP) was initiated in 1960. RMP is produced by the mechanical reduction of wood chips (and sometimes saw dust) in a disk refiner. The process usually involves the use of two refining stages operating in series (i.e., two-stage refining), and produces a longer fibered pulp than conventional groundwood. As a result, it is stronger, bulkier, but usually somewhat darker in color, than stone groundwood.

The pressate (slurry) generated from the screw press dewatering the pulp at this facility needs to meet discharge requirements and thus requires treatment before discharge. For treatment of pressate, the client considered two treatment schemes, as follows:

- Use traditional technologies, namely dissolved air floatation (DAF) followed by multimedia filter, bag filter, and traditional reverse osmosis.
- Use a VSEP One Step Treatment System

Traditional technologies were evaluated to be much more expensive than the use of the VSEP system for treatment of screw press pressate. The use of the VSEP system results in substantial savings in operating costs primarily because of elimination of the chemicals/polymers addition. Upon installation of the VSEP, the concentrated wastewater stream is recycled to the plant chip belt dryer or used as refiner dilution. Clean water permeate generated from the VSEP is discharged to the plant holding ponds and is then recycled as process water. This medium density manufacturing facility has installed the VSEP system to allow the treatment of waste water pressate more efficiently and allow the recycle of the concentrated waste and the permeate streams to the process.

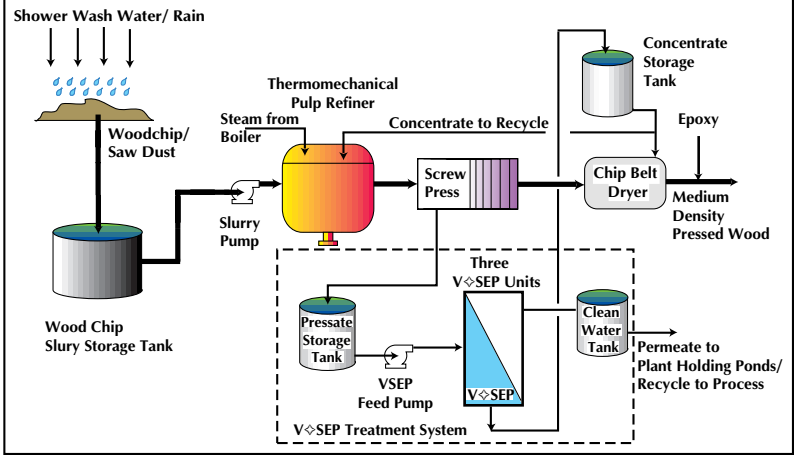
The medium density fiber board manufacturing facility where the VSEP is installed operates 24 hours a day, 350 days per year. The maximum pressate flow rate to be treated in the process is approximately 100 gallons per minute (gpm).

Using a nanofiltration membrane module in the VSEP has been shown to be a commercially viable option for treatment of pressate from the screw press. Nearly 85% of the feed pressate is recovered as clean water suitable for discharge, while 15% is recycled as the concentrated stream. The permeate concentration of COD, oil and grease, and total suspended solids are reduced well below the design requirements. This project summary report describes this application for the VSEP process, discusses the expected process performance, and presents the economic advantages for this application.

System Description

An overall simplified flow chart for the medium density fiber board manufacturing process, including the VSEP treatment system, is presented in Figure 1. Wood chips/saw dust are washed and introduced to the

Figure 1
Integration of VSEP with Medium Density Fiber Board Manufacturing Facility

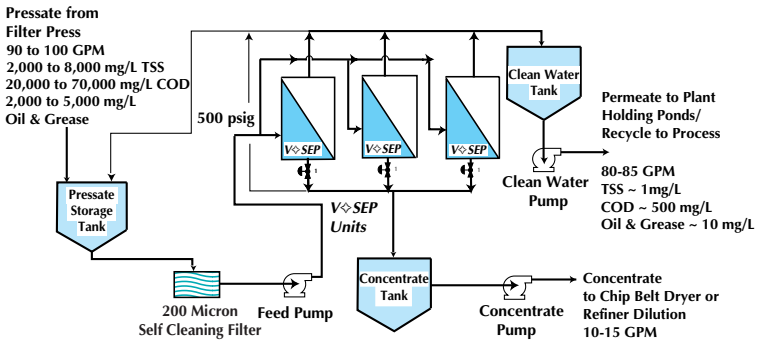


thermomechanical pulp refiner and screw press. The pressate generated from the screw press is fed to the pressate storage tank and then feeds to the VSEP treatment units. The introduction of VSEP results in the production of clean water which is suitable for recycle as process water for resin dilution or steam generation. The concentrated lignin stream is also recycled to the process.

A process schematic for this application of the VSEP is presented in Figure 2. This diagram includes the overall material balance for the thermomechanical pulping effluent treatment system and illustrates the performance of the VSEP unit. Pressate from the screw press is fed to the pressate storage tank and the VSEP units at a rate of 90 to 100 gpm. Three industrial scale VSEP units, using nanofiltration membrane modules, processes the feed pressate.

The VSEP produces a concentrated lignin stream at a flow rate of 10 to 15 gpm that is recycled to the chip belt dryer or to the thermomechanical pulp refiner. VSEP also generates a permeate stream of about 80 to 85 gpm that is routed to the holding ponds and the sewer. Concentration of the feed to the VSEP units ranges from 2,000 to 8,000 mg/L of TSS, 20,000 to 70,000 mg/L of COD, and 2,000 to 5,000 mg/L of oil and grease. The permeate concentration is reduced to ~ 1 mg/L of TSS, ~ 500 mg/L of COD, and ~ 10 mg/L of oil and grease, all well below the design requirements. The permeate is reused as process water for resin dilution or steam generation. All permeate is recycled or sent to the holding ponds (fire ponds). Process water also comes from the holding ponds.

Figure 2
Thermomechanical Pulping Effluent Treatment by V✧SEP



The concentrate level out of the VSEP unit is controlled by an automatic timed control valve. This valve is set such that the concentration of the lignin fraction from the VSEP is held atthe desired level. A multi-stage feed pump supplies the pressate to the VSEP unit at flows ranging from 90 to 100 gpm at a pressure of about 500 psig. 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.

The VSEP field tests for treatment of thermomechanical pulping effluent were successfully conducted in early 1998. At a temperature of 80°C, permeate flux ranged from 22 to 40 gallons per square foot per day (GFD) at a feed COD concentration of about 29,000 mg/L. The effluent COD levels ranged from 480 to 530 mg/L. These test results are based on data from a 16.8 sq.ft. VSEP pilot unit at a feed pressure of 500 psig. The actual

Table 1
Estimated Construction, Operation, and Maintenance Costs

Item	VSEP System Costs (a)	Cost of Conventional Alternative(b)
Equipment/ Installation Cost		
o VSEP System, freight, filter cleaning system, feed pump, holding tank, piping and control (a)		
o Alternative Conventional Treatment Technology, feed tank, pumps, piping and controls (b)	-	
Operation and Maintenance Cost		
Power Cost		
37 KW @ $0.04/KWh		
30 KW @ $0.04/KWh	-	
System Maintenance and Cleaning		
Membrane Replacement		
Chemicals/Polymer		
Labor Cost (c)		
2-full time operators	-	
1/2-time operator		
Total O&M Cost		

(a) The VSEP system consists of three industrial scale VSEP units and is able to process 90-100 gpm of pressate from the screw press and produce about 80-85 gpm of clean water suitable for discharge.

(b) The alternative conventional technology consists of a flash mixer, dissolved air floatation (DAF), storage tanks, multimedia filter, bag filter, and conventional reverse osmosis unit.

(c) Labor costs include raw salary as well as company-paid benefits.

commercial installation has been able to achieve similar performance and meet or exceed the project objectives.

Project Economics

The cost of installing and operating the VSEP system when compared with the alternative conventional treatment technology has been calculated.

For the VSEP treatment system, the operating costs are calculated based on the power costs to operate the filter unit (15 HP), filter feed pump (34 HP), filter cleaning cost, membrane replacement, and the operating labor that would be required. The alternative conventional treatment technology costs include power costs for the feed pump (5 HP), the multimedia filter pump (5 HP), the conventional reverse osmosis filter pump (25 HP), and the DAF air compressor (5 HP).

A comparison of operation and maintenance (O&M) costs are presented in Table 1.

The major differences between the two technologies are the membrane replacement costs, the cost of chemicals and polymers, and labor costs, which are significantly higher than those for the VSEP system.

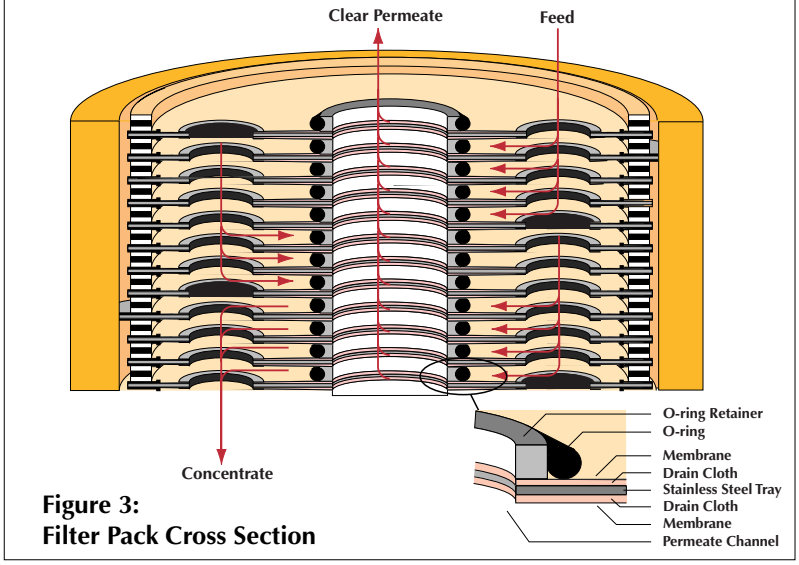


Figure 3:
Filter Pack Cross Section

Table 2 presents the cost savings that are realized upon installation of the VSEP system and the pay back period when compared to the alternative conventional technology. Compared to the alternative conventional treatment technology, it would take 7 months to recover the additional capital requirement for the VSEP treatment system.

VSEP Technology and Its Applications

VSEP (Vibratory Shear Enhanced Processing) technology is being incorporated into the treatment schemes for product concentration/dewatering, recycled effluent and/or water/wastewater treatment in various process industries. Developed by New Logic International, Inc. of Emeryville, California, a VSEP system can filter streams containing a variety of materials or contaminants without the fouling problems exhibited by conventional membrane systems. The process not only filters suspended solids, but it also reduces or eliminates BOD, COD and color bodies. The result is a crystal clear, reusable water stream and a concentrated product stream or sludge.

Rather than simply preventing fouling with high-velocity feed, VSEP reduces

Table 2
Savings Realized Upon Installation of a VSEP System Compared to the Alternative Conventional Treatment Technology

Pressate Feed Rate (gpm)	Permeate Flow Rate (gpm)	Concentrate to Recycle (gpm)	Total Cost Savings per Year (a) ($/year)	Pay Back Period Compared to Alternative ConventionalTreatment Technology (b) (Months)
100	85	15	651,700	7

(a) Assumes operation 24 hours per day for 350 days per year.

fouling by adding shear to the membrane surface with vibration. This vibration produces shear waves that propagate sinusoidally from the membrane's surface. As a result, the stagnant boundary layer is eliminated which increases the filtration rates.

As shown in Figure 3, the industrial VSEP machines contain many sheets of membrane that are arrayed as parallel disks separated by gaskets. The disk stack is contained within a Fiberglass Reinforced Plastic (FRP) cylinder. This entire assembly is vibrated in torsional oscillation similar to the agitation of a washing machine. The resulting shear is 150,000 inverse seconds, which is ten times greater than the shear in crossflow systems. High shear has been shown to significantly reduce the fouling of many materials. The resistance to fouling can be enhanced with membrane selection where virtually any commercially available membrane materials such as polypropylene, polyester, polysulphone and Teflon can be used.

Figure 4 presents a photograph of an industrial scale Series i system. Each Series i system contains up to 1600 square feet of membrane filtration area. A single VSEP unit is capable of processing from 5 to 100 U.S. gallons per minute while producing crystal clear filtrate and a concentrated sludge in a single pass. This large throughput capability can be accomplished with a system that occupies only 20 square feet of floor space and consumes between 5 and 20 hp.

The VSEP system can offer a very economical solution to control water and waste water streams within the fiber board manufacturing processes. Traditional membrane separation capabilities coupled with the unique characteristics of the VSEP, make it possible to successfully concentrate product streams and also to handle a variety of contaminants at high flux rates. Operational savings generally can be attributed to the following areas:

- chemical treatment (reduction or elimination)
- retained BTU value
- reduction of fresh water usage and effluent flows
- improvement in filtrate quality
- pumping energy reduction
- reject concentration improvements
- eliminate fouling of cooling towers, heat exchangers & evaporators
- reduce BOD, COD, TSS, TDS and color
- lower labor and maintenance costs due to one step process

The major applications of New Logic's filtration technology include:

- Pulp and Paper (e.g. thermomechanical pulping effluent from medium density fiber board manufacture, whitewater, bleach plant effluent, box plant effluent)
- PVC latex/Chemical Manufacturing (e.g. product concentration, raw water treatment)
- Industrial and Institutional Laundries (e.g. wastewater treatment and water recycling)
- Electronics Manufacturing (e.g. heavy metals recovery, raw water treatment)
- Chemicals Manufacturing (e.g. calcium carbonate washing and concentration)
- Oil production and petroleum processing (e.g. produced water filtration)
- Paints and Pigments (e.g. paint and pigment concentration and washing)
- Inks and Dyes (e.g. flexographic inks and starch concentration)

Reference

Smook, G.A., 1994, Handbook for Pulp & Paper Technologists, Second Edition, Angus Wilde Publications, pp. 45-58.

Fig. 4: An Industrial Scale Series i Unit

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