NEW LOGIC INTERNATIONAL, INC.

Application Note

Effluent Treatment for Box and Bag Plants

A cost-effective and environmentally-sound solution

Background

The manufacture of corrugated boxboard and paper bags is a major industry in the United States and elsewhere. There are about 1,500 corrugated box plants and a similar number of bag plants in the United States. Because of its relatively low cost and high strength characteristics, corrugated board has become the prime structural material for the manufacture of boxes and shipping containers. Linerboard materials and paper are used to manufacture corrugated boxes and paper bags. Corrugated paperboard is a sandwich structure formed by gluing a fluted corrugating medium ply to two linerboard facings. The disposal of wastewater generated in a box or bag plant has become a problem due to the high levels of organics primarily resulting from glue starch and heavy metals. These contaminants result in a discharge stream not meeting the regulatory requirements.

Objective

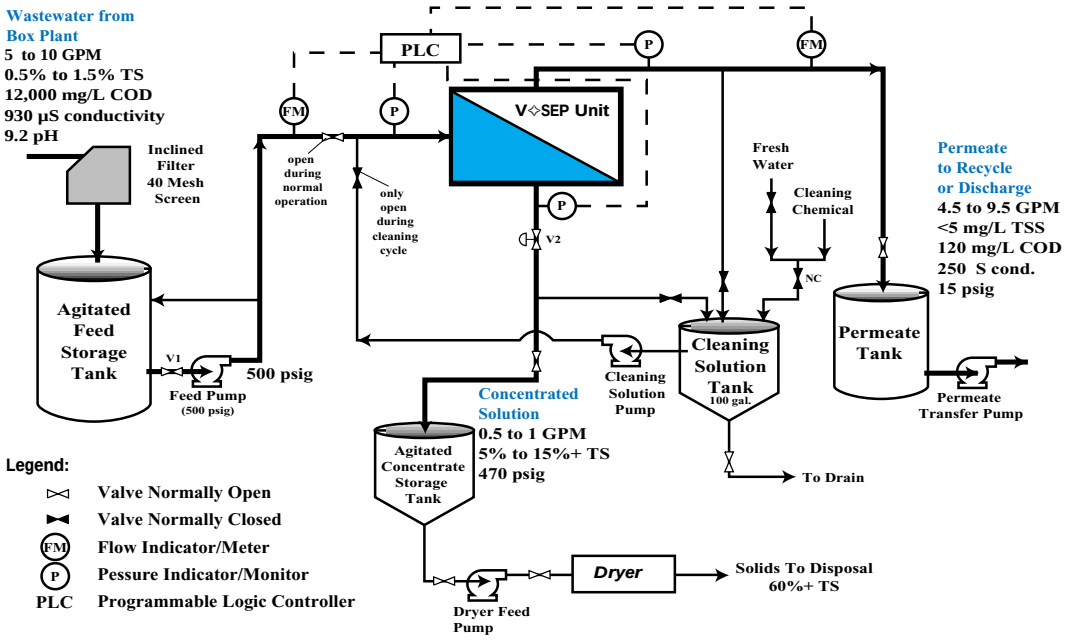
To meet the requirements of both ecology and economy, the filtration of effluent streams allows a box or a bag plant to meet discharge requirements and/or provide a clean source of reusable water. The treatment of the effluent is in most cases required for discharge and/or reuse.

Solution

Technological advances in membrane filtration systems have created an opportunity for box and bag plants to treat wastewater effluent streams in order to meet stricter environmental constraints. The "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 box and bag plants as well as pulp and paper mills, thus minimizing treatment cost.

The VSEP treatment system uses nanofiltration membrane modules to treat the box and bag plant effluent in order to generate a permeate stream that meets the water discharge or reuse criteria for the required concentration of organics and heavy metals. The clear permeate can then be discharged or recycled to the process. In addition, VSEP preconcentrates solids (starch, ink and TDS) prior to the final evaporation or drying step. Reverse osmosis filtration can also be used if dissolved solids or color is an issue. In summary, the VSEP treatment system can be used to treat box plant effluent, supplement the dryer at the facility, and thus in-

Figure 1
Treatment of Box Plant Effluent Using VSEP



crease the plant energy efficiency (reduce dryer load).

In the box and bag plant industry, as well as 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-enhanced design.

Process Conditions

A process schematic for treatment of a box plant effluent using a VSEP system is presented in Figure 1. A paper bag plant effluent treatment would be similar. When the residual ink and starch is washed from the printer press and the glue preparation equipment, the result is a wastewater effluent, at 0.5 to 1.5% by weight total solids (TS). This wastewater effluent is typically sent to a chemical treatment step followed by a filter press, dryer or an evaporator in order to concentrate the solids to 60 to 65% by weight. The concentrated solids are sent off-site to be disposed at a solid waste disposal facility. As you can see in the diagram, the addition of VSEP ahead of the dryer to preconcentrate the wastewater effluent reduces the load on the dryer significantly, thus improving the process efficiency. The permeate can be reused in the process or discharged.

Figure 1 also includes a material balance and illustrates the performance as enhanced by VSEP. Effluent from the feed storage tank is fed to the VSEP unit at an average rate of 5 to 10 gpm. One VSEP unit, using a nanofiltration membrane module, processes the feed water.

The VSEP produces a concentrated waste stream at a flow rate of 0.5 to 1.5 gpm which is then sent to the dryer. The concentrated stream contains approximately 5-15% by weight of total solids (TS). The VSEP treatment system also generates a permeate stream of about 4.5 to 9.5 gpm which is recycled to the process or disposed to the sewer. The concentration of solids is less than 5 mg/L of TSS, well below the design criteria for process recycle or discharge requirements.

Figure 2
Corrugated Box Plant Including VSEP Wastewater Treatment System

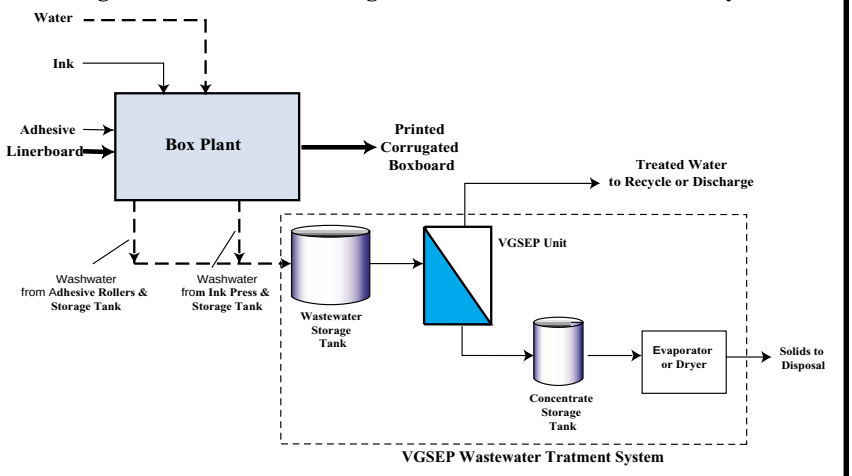


Figure 2 presents an overall flow chart for a corrugated box plant including the VSEP wastewater treatment system. Corrugated paperboard sheets are produced in a continuous manufacturing process. The paperboard from a roll of corrugating medium is shaped into flute form, adhesive is applied to one side of the flute tips, and a linerboard facing is brought into contact with the adhesive and bonded to the medium to produce a single-faced web. The single-faced web proceeds to the double facer operation where adhesive is applied to the opposite side of the flute tips and a second linerboard facing is glued to the medium. This simplest form of the sandwich structure is called single-wall corrugated fiberboard. Double-wall and triple-wall corrugated fiberboard is produced in a similar fashion. Finally, the corrugated board web is scored and slit to the required box size. The finished box is then formed from the sheets in a discrete process operation where the corrugated sheets are printed using a printing press, slotted to form the top and bottom flap closures, and scored to provide the required box dimensions.

The materials required for this process include the corrugating adhesive, process steam to provide heat to set the corrugator adhesive, some possible coatings applied to the surface of the linerboard facings, along with chemicals impregnated into the linerboard and/or medium, the manufacturer's (glue) joint adhesive, and the printing ink. The wastewater is generated from daily washing of the adhesive rollers, the ink press rollers and the corresponding storage tanks.

Using a nanofiltration module in the VSEP system is a commercially viable option for treatment of box and bag plant effluent streams. Nearly 90 to 95% of the wastewater is recovered as treated water suitable for reuse or discharge, while less than 5 to 10% is fed to the dryer as concentrate, thereby re-

ducing the load to the dryer by a great margin.

Membrane selection is based on material compatibility, flux rates (capacity) and concentration requirements. In this example, the BOD reduction is over 90% while the rejects are concentrated from 0.5% to 5-15% by weight. The permeate quality from the VSEP can be controlled through laboratory selection of membrane materials available to fit the application parameters.

Successful pilot tests have been conducted at New Logic for box and bag plant effluent treatment. A commercial project is also under construction for treatment of a box plant effluent in California. Depending on process temperatures, membrane selection and the requirement for concentration or BOD/COD removal for effluent streams, the permeate flux rate in the VSEP can range from 40 to over 70 gallons per day per square foot (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 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 box plant effluent treatment 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 chemical treatment demands. The justification for the use of VSEP treatment system in your process is determined through analysis of the system cost 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.
- Offset fresh water demands and pretreatment cost.
- Retain heat in recycled process water as a possible method to reduce energy requirements.
- Elimination of biological growth, and odor in effluent.
- Simplify effluent treatment with a compact, low energy system.

Summary

New Logic International has supplied VSEP separation technology successfully into many industrial processes. The box and bag plants as well as the pulp and paper industries effort to meet environmental regulations will be enhanced with the utilization of membrane filtration combined with "Vibratory Shear Enhanced Processing". The development towards applications for box plants, 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.

References

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

New Logic International
1295 67th Street
Emeryville, CA 94608

(888) 289-VSEP(8737) toll free
(510) 655-7305 tel
(510) 655-7307 fax
e-mail: info@vsep.com
www.vsep.com