NEW LOGIC RESEARCH Case Study

VSEP Filtration to Remove Suspended Solids in Herbicide Wastewater
Advances in Module Designs Enhance Closed Loop Water Treatment

Introduction

The current trend in the chemical manufacturing industry is toward closed-loop water circuits resulting in greatly reduced or eliminated effluent discharge to the environment. There are several difficulties encountered in any closed-loop plan implementation including identifying the best technology for wastewater treatment, waste sludge disposal, and possible cycling up of undesirable TDS contaminants in the water loop. In spite of these difficulties during design and start up of a closed loop system, there are many benefits that can result once successful. Some benefits include: reduction in the cost of importing fresh water drawn from local tributaries, elimination of effluent discharged, reduced regulatory liabilities, and reduction in energy consumption since treated water is already partially heated.

Technological advances in membrane filtration systems have created an opportunity for chemical manufacturing facilities to treat their effluent stream to meet stricter environmental constraints. The new "Vibratory Shear Enhanced Process" or VSEP, developed by New Logic Research makes it possible to filter effluent streams without the fouling problems exhibited by conventional membrane systems. The VSEP membrane system can be configured to significantly reduce BOD, COD, TDS, and color bodies and to remove all TSS from effluent streams discharged from chemical manufacturing facilities, thus minimizing treatment cost. This Case Study highlights one example.

Customer History

A privately owned herbicide manufacturing company in the Midwest, produces liquid and solid herbicide products according to customer specifications. The company has now been in business for decades serving a wide area of the Corn Belt through a very prolific distribution network. Wastewater effluent is generated from blending tanks and tankers wash down, and on-site laundry facility.

During the 1990s, the company began to install advanced wastewater treatment systems. As with many other companies, at first the objective was to reduce the amount of loading to their sanitary sewer and storage lagoons. To complete the process the customer has endeavored to create a totally closed loop treatment process.

Pilot Testing

The customer contacted New Logic to investigate the use of Polymeric Membranes within their existing process to improve filtrate quality results and to reduce operating costs associated with chemical addition. After consultation with the customer, all the process objectives for membrane filtration were each identified. The idea was to separate the solids out of the water so that the permeate could go to another post treatment. Any reduction in BOD, COD, and TSS (herbicides and organic chemical particulates) would be an extra benefit. The remaining reject volume would be treated by another process to complete the treatment

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New Logic conducted initial bench scale tests at its research lab in Emeryville, California. During the initial testing, various process variables were verified. To begin with several Ultra-Filtration membranes were tested to see how they performed on a relative basis. Several membrane chemistries and pore sizes were tested. The winning membrane was a Kynar membrane with a nominal pore size rating of 250,000 MWCO (molecular weight cut off). This membrane produced good flow rates and clear filtrate that was free of suspended solids and turbidity. This membrane was then used for the balance of testing where the optimum pressure, temperature, and concentration factor were obtained. The conclusions made after the initial trials were that VSEP using Ultra-Filtration was effective at concentrating suspended solids and would produce a filtrate suitable for polishing using other treatment methods. After completion of the initial testing, a pilot test VSEP unit, known as the Series LP, was shipped to the customer site for long term operation on fresh wastewater material. The results from site confirmed the initial data and the VSEP performed as expected during the trial. The through put of the pilot system was consistent with the initial data and several cleaning studies confirmed that flux could be restored using periodical chemical cleaning. Due to variations in the feed solids level, the final solids in the concentrate and the permeate flux (flow rate) will change

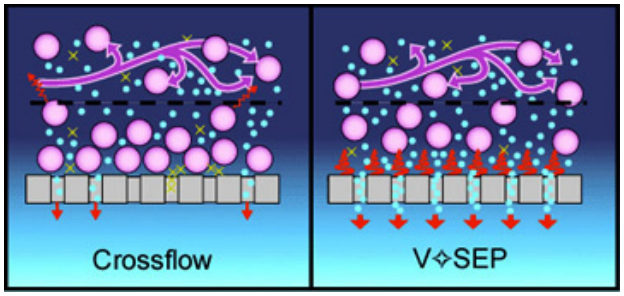
New Logic's Series LP VSEP Pilot Unit
Running a bench scale sample of herbicide wastewater

depending on the particular feed material being processed. During the initial testing in the New Logic lab, 47% total solids were achieved in the final reject. The following table illustrates three different concentrations studied during the onsite work:

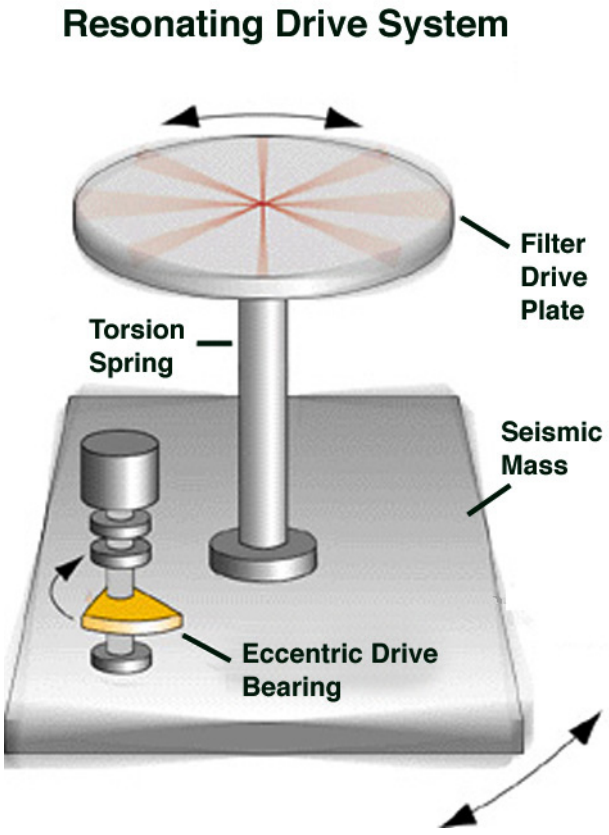
Feed Solids	Ave. Flux	Pressure	Temperature	Ending Solids	% Recovery
0.5%	38.3 GFD	100 psi	30 C	~6.2%	>90%
0.9%	33.8 GFD	100 psi	30 C	~10%	>90%
4.1%	23.6 GFD	100 psi	30 C	~27%	89%

VSEP Technology

A new membrane system know as VSEP, (vibratory shear enhanced process) employs torsional vibration of the membrane surface, which creates very high shearing energy at the surface and near the pores. The result is that colloidal fouling and polarization of the membrane due to concentration of rejected materials are greatly reduced. Since colloidal scale fouling is avoided because of the vibration, the use of pretreatment to prevent scale formation is not required. In addition, the throughput rates of VSEP are 5-15 times higher in terms of GFD (gallons per square foot per day). The sinusoidal shear waves propagating from the membrane surface act to hold suspended particles above the membrane surface allowing free transport of the liquid media through the membrane. This accounts for the increased performance of VSEP membrane filtration when compared to conventional crossflow membrane filtration.



Effects of vibration during filtration



VSEP's Vibrating Drive Mechanism

The VSEP membrane system is a vertical plate and frame type of construction where the membrane leafs are stacked by the hundreds on top of each other. The result of this is that the horizontal footprint of the unit is very small. As

much as 2000 square feet (185 m2) of membrane is contained in one VSEP module with a footprint of only 4' x 4'. This combined with the very low energy consumption makes VSEP a very attractive alternative especially for older plant installations where space is a premium.

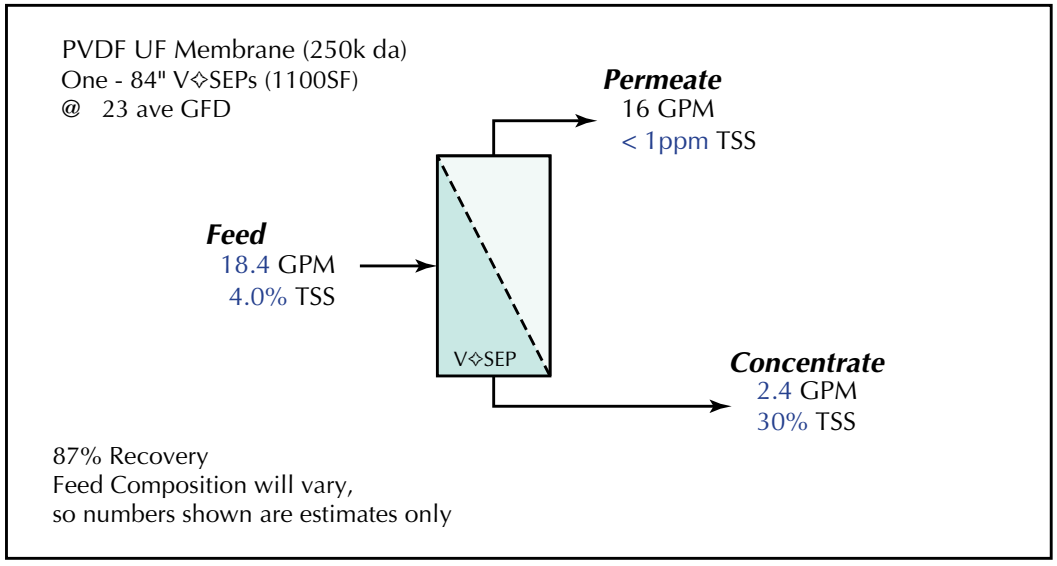
VSEP has made it possible to dewater or separate high solids applications previously not possible with conventional membranes. This has created an opportunity in the chemical industry for a technologically advanced separation device that can efficiently and economically help to close the process loop. The ability to reach high solids in this case was only possible because if Vibrational Filtration utilizing polymeric membranes.

Process Description:

The industrial VSEP unit contains hundreds of sheets of membranes, which are arrayed as parallel disks separated by gaskets. The disk stack is contained within a fiberglass reinforced plastic cylinder (FRP).

This entire assembly is vibrated in torsional oscillation, similar in principle to the agitation of a washing machine. VSEP can produce extremely high shear energy at the surface of the membrane. The membrane module is attached to a spring assembly and moves at an amplitude of 7/8" peak-to-peak displacement. The membrane module oscillates at between 50 and 55 Hz.

The fluid is gently pumped through the module while a highly focused shear zone at the surface of the membrane is created by the resonating oscillation. Rejected solids at the membrane surface are repelled by the shear waves and are washed away becoming more and more concentrated until the reject exits the module. An AC motor controlled by a variable frequency speed controller provides the resonant excitation that produces the vibration. The motor spins an eccentric weight coupled to the heavy seismic mass. Since the eccentricity of the weight (i.e., its center of mass lies heavily on one geometric side) induces a wobble, the Seismic Mass begins to move as the motor speed increases. This energy is



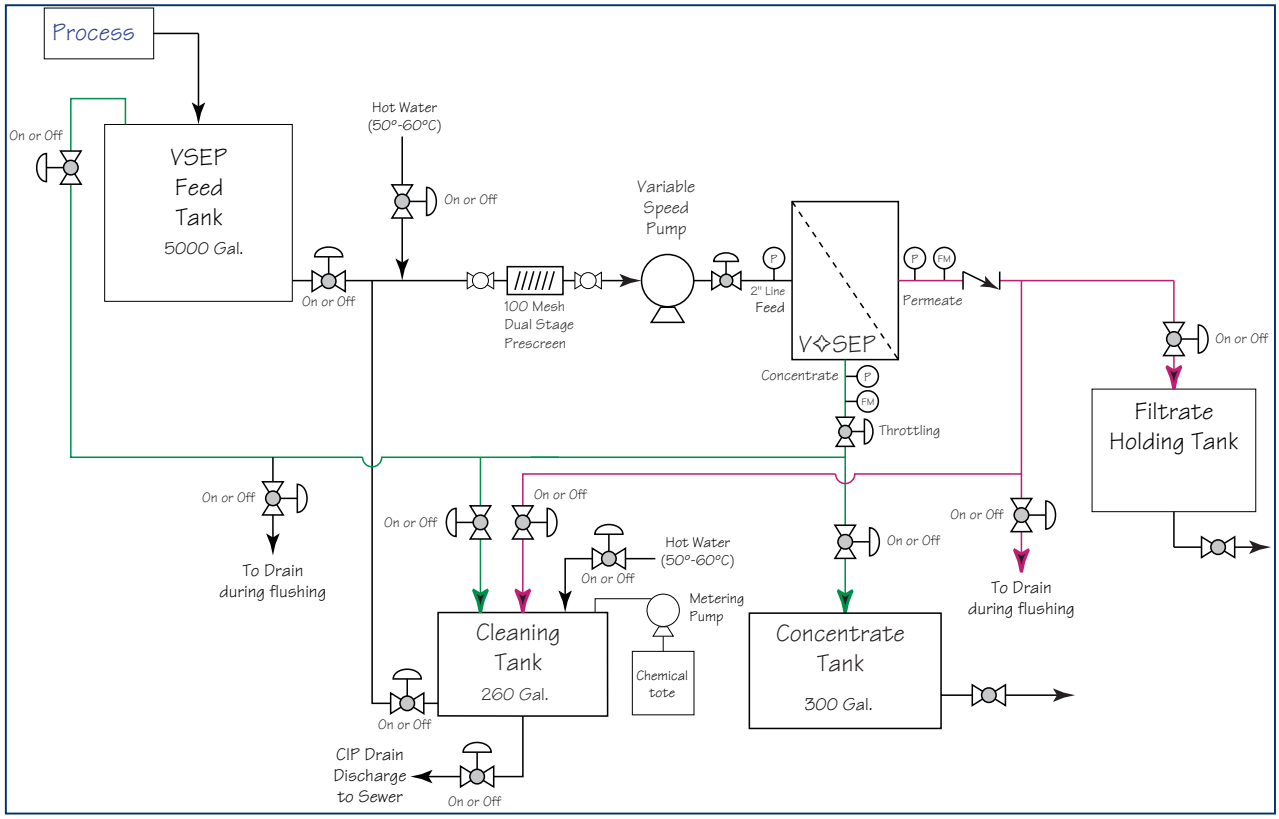
Design performance of the installed VSEP Unit

transmitted up the torsion spring inducing the same wobble in the filter pack, however 180° out of phase. As the motor speed approaches the resonance frequency, the amplitude of the moving filter pack reaches a maximum. The resonant frequency vibration employed by VSEP is extremely energy efficient.

System Automation

The VSEP membrane filtration system has been designed specifically for the chemical processing user. The systems are completely automated, compact, and reliable. With very few moving parts, maintenance is simplified. Each VSEP system built is custom designed for a particular application with special materials of construction including exotic alloys and thermoplastics to fit the job. The VSEP is a complete integrated Plug and Play process requiring only process in and process out connections during installation. The system is controlled using a sophisticated Allen Bradley Industrial Computer that monitors data and implements the program functions in a seamless and automatic process. The VSEP controls are compatible with plant Distributed Control Systems (DCS) and can be operated as stand-alone devices or as a component of a much larger process.

Operation of the VSEP is automatic through a PLC system that monitors pressure, flow rate, pH, and other process variables. The control system provides for automatic membrane cleaning. The system includes an operator friendly interface display. The system has proven to be successful in meeting all process objectives and has performed well to provide high quality water for reuse in the manufacturing process.



NEW LOGIC RESEARCH

Case Study

VSEP®

Company Profile

New Logic is a privately held corporation located in Emeryville, CA approximately 10 miles from San Francisco. New Logic markets, engineers, and manufactures a membrane dewatering and filtration systems used for chemical processing, waste streams, pulp & paper processing, mining operations, and drinking water applications. Dr. Brad Culkin invented the VSEP technology in 1985. Dr. Culkin holds a Ph. D. in Chemical Engineering and was formerly a senior scientist with Dorr-Oliver Corporation.

About the Author: Greg Johnson, Chief Operating Officer, has been with New Logic Research since 1992 and has a Chemical Engineering background. He is responsible for engineering and design of the patented VSEP Vibratory Membrane System.

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