NEW LOGIC

Case Study

Concentrating Carbon Black Slurries with Vibrating Membranes

INTRODUCTION

Carbon black is manufactured using petroleum-based feedstock. It is found and used in many different industries. One example is in the tire industry where it is used as filler to reinforce the natural and synthetic rubbers. It is also used to create black pigments and printing inks and can be found in paints and plastics.

Carbon black is made when oil is pumped into a specially designed furnace, where it is heated above 1200° C. This process “cracks” the oil to produce a gas stream containing carbon black powder. The gas stream then passes through a series of filters that separate the carbon from the gases. The carbon black powder is combined with a small amount of water to form granules that are passed through a dryer and packaged for customers.

New Membrane Technology

A new technology being used to concentrate carbon black is known as VSEP™ (Vibratory Shear Enhanced Processing). Developed by New Logic Research, Inc. of Emeryville, California, this revolutionary technology has made it possible to filter streams containing suspended solids without the fouling problems exhibited by conventional membrane systems.

This advanced membrane system concentrates the suspended solids while creating a crystal-clear water stream.

The main difference between VSEP and traditional cross flow membrane filtration is the mechanism by which the foulants are prevented from accumulating on the membrane surface. A traditional crossflow system relies on the fluid velocity of the feed material alone to create shear forces needed to reduce fouling. This mechanism assists in slowing the fouling process but because a thin, stagnant boundary layer remains on the membrane surface, the foulants from the stream will accumulate over time and deteriorate the throughput rate. On the other hand, a VSEP system utilizes a patented vibratory drive mechanism that vibrates the membrane surface creating a shear force that disrupts the boundary layer. The resulting motion of the vibration drive is a ¾ inch peak-to-peak displacement, which constantly repels solids and other foulants away from the membrane surface. This mechanism enables the filter module to maintain higher, sustained throughput rates and process larger volumes of material economically.

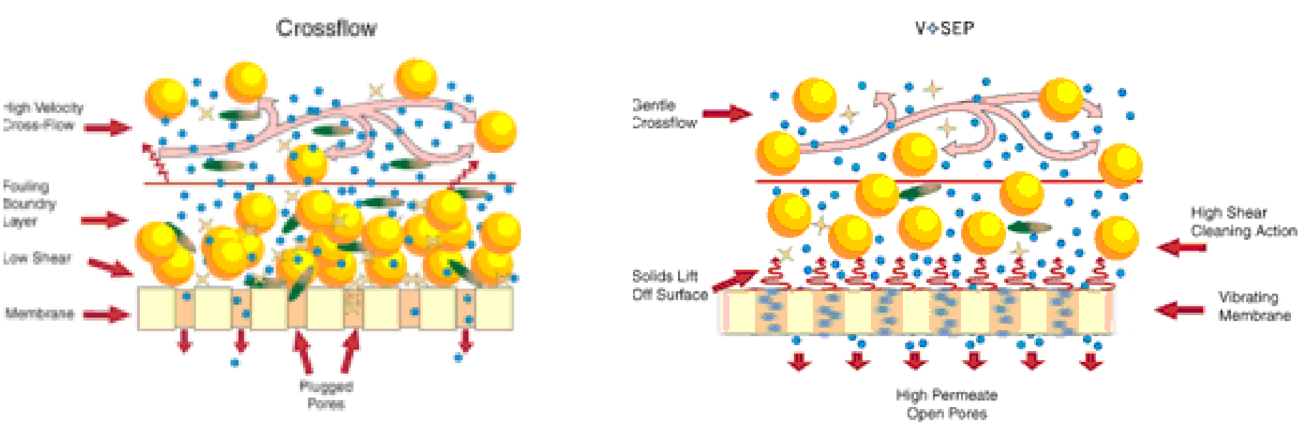

Figure 1: A visual diagram of conventional crossflow filtration versus VSEP. In the crossflow filtration there is a stagnant boundary layer where solids can accumulate and limit flow through the membrane. With VSEP, the agitation of the membrane surface eliminates the stagnant boundary layer.

Although a number of industrial VSEP units have been installed for processing carbon black feed slurries, the following installation was selected to highlight in this article.

CASE STUDY

Industrial Installation for Radioactive Decommissioning

New Logic has recently installed an industrial VSEP system into a facility that manages waste with intermediate and low level radioactivity. The overall process takes waste streams of various compositions and through pyrolysis breaks down the stream components. The resulting stream is then processed through filters, a gas handling system and an energy recovery system until its volume is reduced to one-tenth of its original volume.

There are several different treatment steps in the entire decommissioning process. The VSEP is used in the salt scrubber process that is linked to the gas handling system. One purpose of the gas handling system is to convert acid gases into stable salts. The salty solution is then fed to a VSEP system to remove radioactive carbon black particles from a salt scrubber solution. The purified salt solution is then fed to a drier to form a cake.

Lab and Pilot Testing

The customer sent a simulated sample containing carbon black particles in an aqueous solution. The initial testing was used to identify a membrane that would not foul and concentrate the solids thus volume reducing the feed material. The membrane that was selected from the screening tests is a polyethersulfone membrane with a 4,000 molecular weight cutoff. This membrane is known for its durability and resistance to fouling.

The testing was completed at our facility in California using a small lab VSEP machine. The lab or L mode machine contains a single sheet of membrane with approximately 0.5 square feet of membrane area. The data collected gives an idea of the anticipated flux relative to the amount of permeate recovered or relative to the amount of solids in the concentrated stream. It was determined the recovery would depend on the level of solids in the feed material. One sample that was tested only contained 6.5% solids while another sample sent separately contained 17.8% solids. The results of the two Series L tests can be seen in the following graph.

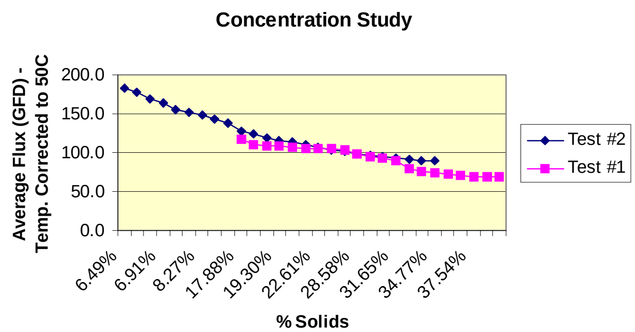

Figure 2: A comparison of the two test samples that were evaluated on a Series L VSEP lab unit.

As you can see from the graph, the points where the data overlapped appeared to correspond well which indicated that the material behaved the same on this particular membrane even with a different starting solids level. This was important information as this data is used for the design of an industrial filter pack. This information not only helps to design the interior of the filter module but also helps with the system design.

Industrial Installation

The industrial VSEP system was designed using 150 square feet of membrane area. The VSEP is fed at a feed pressure of 100 psi. The salt scrubber effluent is collected in a tank. The contents of the tank are fed to the VSEP filtration unit where the solids are concentrated so that approximately 95-98% of the feed is recovered as permeate. This purified salt solution is sent to the drier where a cake is formed and then disposed of at a local landfill. The radioactive solids are separated into the concentrate stream that is volume reduced to 2-5% of the original volume. The stream is then sent for hauling to an approved facility. Figure 3 shows a simplified flow diagram for the VSEP portion of the system.

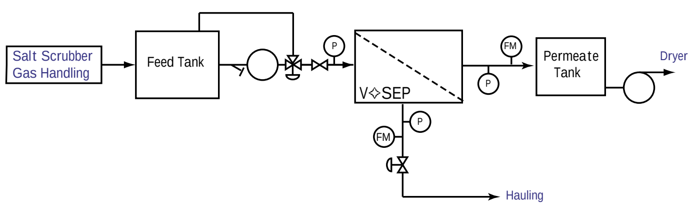

Figure 3: Simplified flow diagram of industrial unit.

The performance of the industrial unit corresponded well with the lab test results. The system did achieve the desired high solids as well as high recovery. The unit is designed to operate for 24 hours per day with a caustic/acid cleaning scheduled when necessary but anticipated to be no more than once per week. The cleaning is completed with a small CIP tank and a low pressure feed pump. The cleaning solution is recirculated through the filter pack for anywhere from 20 to 30 minutes. This procedure followed by a flush is all that is needed for the system to be ready to run.

The advantages of the VSEP system for this facility were the small footprint, low operating costs and minimal operator attention. Once the system was started the customer desired limited operator interface. Any interaction with the equipment was by trained personnel from their facility who had attended a New Logic training course. The following diagram gives an idea of the size of a single VSEP unit. The only peripheral equipment is a feed pump, feed tank, collection tanks and a small cleaning system.

Figure 4: Industrial unit photo.This photo shows the installed filter pack that is 15”tall.

V✧SEP, the one step solution, the new standard in rapid separations.

CONCLUSIONS

Concentrating and washing of carbon black slurries was once reserved for treatment with either evaporative technologies or belt filter style process equipment. VSEP makes it possible to concentrate dilute carbon black streams to high solids using membranes. With a large number of commercial membranes available, the customer is able to achieve a specific separation simply by screening their slurry against a variety of membranes. These membranes can have various molecular cutoffs or pore sizes and unique surface chemistries. New Logic International has supplied VSEP separation technology successfully into many industrial applications and is able to tailor a filter pack to meet your process requirements with an economical system.

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

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