# VSEP Vibes Newsletter

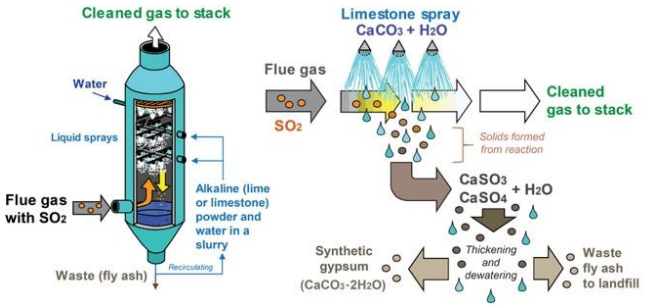
Welcome to the New Logic Research Newsletter.

## EPA Announces New Rule with VSEP as the BAT

Wet scrubbers are systems used in power plants to remove Sulfur Dioxide from its flue gas. Sulfur Dioxide contributes to Acid Rain. So while the scrubbers have eliminated the problem of air pollution, these now generate a wastewater containing pollutants. These scrubbers are known as Flue Gas Desulfurization (FGD) units.

In 2015, the EPA set limitations on the levels of certain metals including Arsenic, Lead, Mercury, Selenium, Chromium, and Cadmium. The rule was based on the technological capabilities of using chemical precipitation followed by a biological treatment process. The best available technology (BAT) advanced by the EPA included Hydroxide precipitation, Sulfide precipitation, and Iron Coprecipitation as chemical treatment options to remove various metals. Additionally, the BAT requirement was for a second stage process using fixed film biological treatment known as Abmet. Any type of membrane system followed by evaporation were shown as options but not designated as a best available technology.

In 2020, a new rule was established adding rules for Bromide and Nitrogen and also allowing use of chemical precipitation followed by membrane filtration using something called the voluntary incentives program (VIP).




On January 20th 2021, President Biden issued an executive order directing Federal agencies to immediately review and take action to address any regulatory actions during the previous four years that "conflict with the national objectives of protecting public health and the environment." The list of regulations included in the executive order included the 2020 coal fired power plant rule.

After this, the EPA announced it would reconsider all aspects of the 2020 rule and would consider the "advancements" in membrane technology (VSEP) and how this would "strengthen" (tighten) wastewater discharge limitations. In reality, with a few exceptions, the new rule actually requires that there would be no discharge at all and recovered water would be recycled in a Zero-Liquid Discharge situation.

The new rule under consideration prefers chemical precipitation (organo-sulfide) followed by membrane filtration (VSEP) as the preferred BAT for treatment of FGD wastewater. After considering all factors, the EPA has concluded that VSEP's membrane filtration is technologically available and economically achievable.

In the 2020 rule conclusion, the EPA decided not to include VSEP as a BAT due to the lack of a full-scale system in operation, even though dozens of pilot tests had shown the necessary capabilities and that VSEP was used for similar applications at full-scale such as landfill leachate. For the new proposed rule, the EPA

VSEP Vibes Newsletter

has reconsidered this and has taken into account additional information about the prevalence of VSEP in other power plant applications.

In the new rule rationalization, the EPA specifically refers to the full-scale pilot test conducted at the Water Research Center at Georgia Power's Plant Bowen facility. The EPA notes that the Electric Power Research Institute (EPRI) report's author gave glowing reviews of the VSEP and detailed a number of advantages that VSEP offered compared to the biological treatment option. The EPA notes that the report shows that the VSEP can remove 94% of contaminants after the first pass and 99.8% after an additional polishing step. Further, it notes that the VSEP demonstrated versatility across a range of concentrations of pollutants and was able to operate without decrease performance due to scaling or fouling. Because of this, the EPA has concluded the VSEP's membrane filtration is the best available technology for treating FGD wastewater.

EPA will conduct two online public hearings about this proposed rule on April 20 and April 25, 2023. After a brief presentation by EPA staff, the Agency will accept oral comments that will be limited to three minutes. The proposed rule would establish more stringent standards for three effluents generated at coal fired power plants: flue gas desulfurization wastewater, bottom ash transport water, and fly ash leachate.

EPA estimates that the proposed regulation would reduce pollutants discharged through wastewater from coal-fired power plants by approximately 584 million pounds per year. EPA's proposed wastewater discharge limits would foster less polluting electricity generation that supports clean air, healthy lands, and safe water for communities. The health and environmental protections of this action would especially benefit low-income communities and communities of color that are allegedly disproportionately impacted by pollution from coal-fired power plants.

**VSEP is Worldwide in Scope**

VSEP is one of the best kept secrets. We don't do any marketing or proselytizing, yet VSEP has been installed in nearly all of the developed countries of the world. We have about 300 projects installed with about half domestic and half international. When a new project comes our way, the engineer might often say they have known about us for years, but just now have a good project fit. Sometimes we get calls from people who have never heard of us and can't understand why. We rely on a good product and word of mouth and this has sustained us for 35 years. Here is the list of top 10 domestic (US) and international project installations.

| International | | Domestic USA | |
|---|---|---|---|
| Japan | 14 | California | 20 |
| Australia | 11 | Ohio | 12 |
| Korea | 11 | Pennsylvania | 10 |
| Belgium | 9 | Texas | 10 |
| Canada | 9 | Georgia | 5 |
| China | 9 | North Carolina | 5 |
| United Kingdom | 8 | Oregon | 5 |
| Ecuador | 7 | Illinois | 4 |
| Italy | 6 | Louisiana | 3 |
| Mexico | 6 | Washington | 3 |

V✧SEP Vibes Newsletter

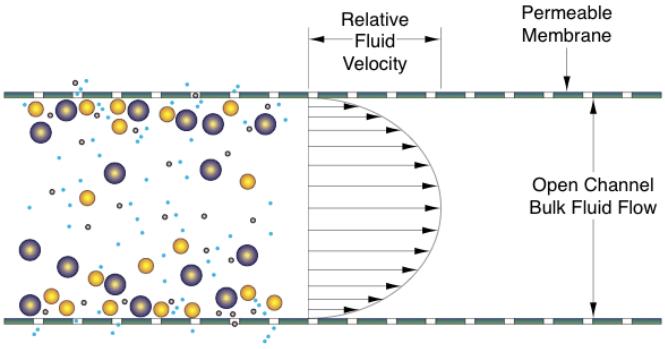
**VSEP Resonance makes Turbulence**

Shear rate is the rate at which a fluid is sheared or during flow. it is the rate at which fluid layers or laminae move past each other. Shear rate is determined by both the geometry and speed of the flow. Shear can also occur in the air and with gases. If you ever experienced turbulence in plane, this is caused by wind shear or differences in wind speed or direction over a very short distance. Shear in a membrane system creates this same kind of turbulence which can cause mixing of the solutes present. The reason this is important is that as water is leaving and passing through a membrane, the dissolved solids are rejected and left behind. They can build in concentration near the membrane surface and this can lead to impedance for the water to pass to the membrane and can also lead to precipitation and scaling if the solubility limit is exceeded. This is known as concentration polarization.

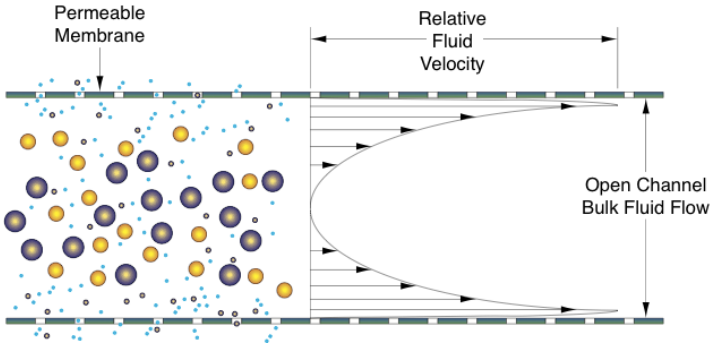
Viscosity is a measurement of the resistance to flow where there is some friction between the layers. Simple liquids at constant temperature and pressure have a constant viscosity. These are called Newtonian liquids. The viscosity remains constant with changing shear rate. However, most fluids are non-Newtonian and their viscosities are a function of shear rate. This is true for many fluids especially those containing solids, either dissolved or un-dissolved.

So many fluids can be thicker or more viscous under static conditions, but as soon as you apply shear, the viscosity is reduced and will flow more easily. Quicksand is an example of this. These fluids are known as "Thixotropic". When water or a fluid passes through a membrane its viscosity will determine the speed or flux rate of travel. Low viscosity will result in high flux rates. So shear in a membrane system is important for two reasons. It will mix the solutes to make the fluid more uniform with less of a concentration gradient and it will also reduce the viscosity thereby increasing the flux rate.

Tangential Flow Pattern in Crossflow Membrane Systems

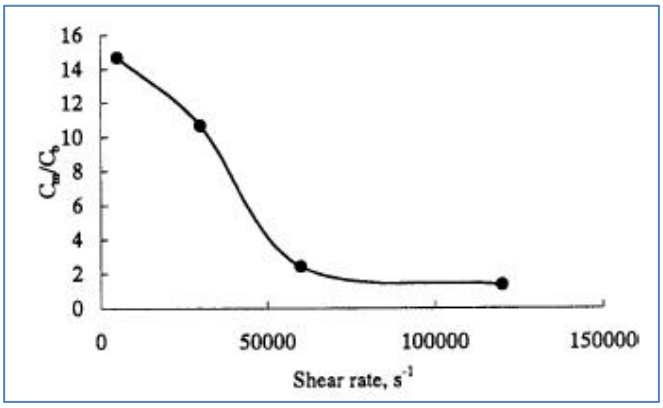



Tangential Flow Pattern in Vibratory V✧SEP Membrane Systems




VSEP employs the highest shear rate of any membrane system. Conventional spiral membranes rely on laminar crossflow and high velocity pumping of the liquid to create shear. But this is dampened by the drag from the membrane surface. Others have tried spinning the membrane or using a turbulence device spinning above the membrane.

VSEP Vibes Newsletter




Shear Rate = speed of movement in meters/second ÷ membrane gap in meters squared

At ½" amplitude and 60 hz, the speed differential is 0.751 meters/second

With a 1/8" membrane gap = 0.003175 meters
0.003175 meters squared = 0.00001008062

VSEP Shear at ½" amplitude = 0.751 ÷ 0.00001008062 = 74,500 $s^{-1}$ (inverse seconds)

**Get to know New Logic – Brad Culkin**

The most senior and important engineer at New Logic is Dr. Brad Culkin, one of the founders of the company. Brad endured 10 years of college education receiving his BS in Chemical Engineering from the University of Pennsylvania and the getting his Masters Degree from John Hopkins University in Maryland. Finally Brad earned his Ph.D. from Northwestern University in Chicago with a dissertation on Rivulet Meandering. A rivulet is a small stream and the presentation described the forces at work that caused the path of the stream to change course and meander.

Brad then worked for Dorr-Oliver, a filtration company, and was promoted to senior scientist in less than 2 years. He headed a research team developing a colloid mobility measuring instrument and developed a separation technology using electrophoretics in combination with Ultrafiltration to dewater a colloidal suspension. Brad cofounded Velodyne Associates where he developed servo-controlled loudspeakers.

Since then, Brad has been the thought leader and chief design engineer for New Logic. Brad has never had any shortage of ideas and is constantly coming up with new improvements and designs. Brad holds more than a dozen patents. He is like a fountain of invention ideas and pushes us all to do more when everyone says it can't be done.

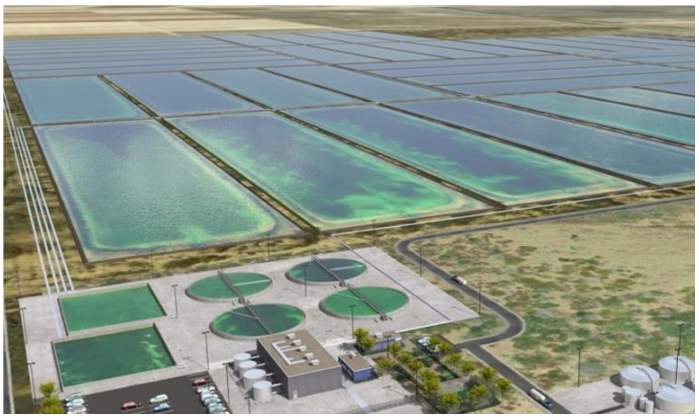
# VSEP Vibes Newsletter

**Algae Dewatering with VSEP**

New Logic Research has a unique filtration separation process that involves vibrating polymeric membranes. Membranes are able to give you very precise separation based on particle size and molecular weight. The vibratory aspect of our membrane module prevents clogging that you would find in static or crossflow membrane separation processes. The combination of precise particle size separation and anti-plugging characteristics of our equipment make it unique in the marketplace

New Logic has been involved in many process development projects having to do with renewable energy emerging just in the last few years. Most interesting of these is the use of specialized Algae that produces oil that can be harvested and used as a biofuel.

VSEP can be used to dewater the algae after it is collecting from the growing ponds. Algae do not settle well and would clog a conventional filter, so VSEP offers a unique solution for economical processing.



After growing, algae need to be harvested for biofuel production. The amount of water that must be removed is very large. There are many ways to produce this algae and the carrier fluid may be saline. Current options for algae dewatering include: Flocculation/Dissolved Air Floatation, Centrifugation, and Electro-coagulation. The later two above may cause some degradation of the algae product. The filtrate would contain nutrients and could be returned to the growing baths.

VSEP could be used to polish any Algae that leak from Centrifugation or Coagulation. Or, VSEP alone can be used for dewatering using a microfiltration membrane. VSEP has many advantages including: Simplicity and easy to use, Small Footprint, Good suspended solids removal rate, and Low Energy Consumption.

New Logic has completed several pilot trials for startup algae biofuel clients. The results indicate that the VSEP can accomplish a 25x concentrate of the algal biomass removing 96% of the volume as water that can be returned to the process. This water can be high in Nitrogen, Phosphorous, and other soluble nutrients.

# VSEP Vibes Newsletter

**Rep Spotlight – Wastewater Ability**

South Africa is one of the best markets for VSEP. New Logic has installed 6 projects there. The key to serving this remote country is having good local partners. New Logic has had representatives in the past that have achieved some success. But New Logic's recent association with Wastewater Ability has resulted in development of 24 potential projects in just a very short time. During this short time, 4 projects have been sold already with 3 of those 4 being installed and commissioned.

South Africa is subject to droughts and major water shortages. Also, mining is a huge industry there. Both of these combined with other industrial application make this country a great place to promote VSEP. The country is also in the process of modernizing many of the industries there. This results in the need for new water treatment technologies like VSEP. Of the projects developed so far, precious metals recovery has been the biggest opportunities uncovered by Wastewater Ability. South Africa is the world's largest producer of Chromium, Manganese, and the Platinum Group Metals.

Wastewater Ability's mission is to build, modernize, and manage wastewater filtration projects throughout Africa by partnering with technologies like VSEP. The company was founded by Mohau Lekopa and Mark Sproson and already has been a huge success. Their efforts have resulted in the best early performance by any of New Logic's distributors. Wastewater Ability staff are fully trained and have pilot equipment to conduct customer pilot trials.

Mohau Lekopa and Nick Auger from VSEP

Mohau or Mark can be contacted at:
info@wastewaterability.com
https://wastewaterability.com/
+27 (010) 500 1482

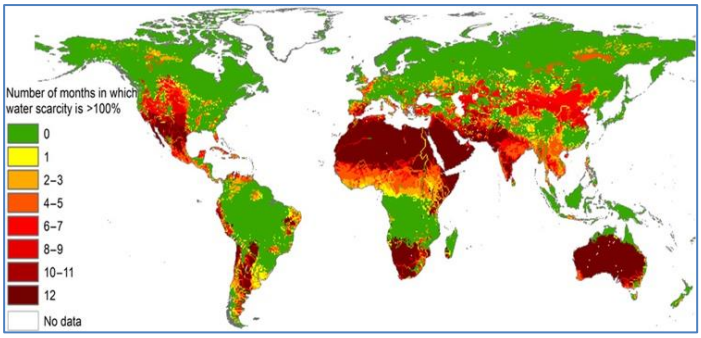
WASTE WATER ABILITY

# VSEP Vibes Newsletter

**VSEP and Bottled Water Sustainability**

Bottled water can come from natural springs where no purification is done. It can also come from conventional sources of water where it is purified, most of the time by RO membrane filtration. These water sources can include river water, well water, or municipal town water. Since water is heavy, transportation costs are key to the economics and many water bottling facilities are located near large population centers where water availability may be problematic.

If you are in the water bottling business, there are many risks to your supply chain and your ability to grow your business. As discussed in the previous newsletter, the drought in the Southwest has caused the levels of Lake Mead to drop to record levels. The Colorado River and the various reservoirs in this watershed supply water to 40 million people. This has prompted officials to require mandatory water cuts to agriculture and industrial users. Many regions of the world are facing water stress as populations increase. The continued availability of water sources for bottling companies is a risk to their business model.




Additionally, these companies face risks from rising prices for water they consume, competing uses and increased demand from other industries, regulatory changes, and most importantly social acceptance of bottled water. Many bottled water companies have elaborate marketing campaigns to show that they use water wisely and that the plastic they use is recycled. Showing that your impact on the environment is light handed is key. Achieving sustainability goals Is paramount.

Economics can also drive the conservative use of water as a feedstock. Many water bottling facilities are not allowed to sewer discharge the concentrated brine from their spiral RO treatment system. The reason is often concern about adding salinity to inland waterways where sewage treatment plants discharge. This means that the brine must be hauled long distances where it can be discharged to brine-lines or ocean discharge locations. The expense of this can often blow up plant operating costs.

New Logic developed the VSEP vibratory membrane system to be able to handle difficult wastewater streams that exceed the limits of conventional Spiral RO membrane modules. By doing this, membranes

VSEP Vibes Newsletter

can be considered for applications thought previously to not be possible. The open channel flow and the vibratory shear created by the resonant frequency allows for filtration of brine water solutions near saturation that would scale a spiral membrane module. One of the best uses of VSEP is to filter the reject from other membrane systems. VSEP can be used to extend the use of RO membranes to increase the yield of treated water and reduce the volume of reject brine that is left over. RO groundwater desalination is an application where people have struggled with the use of membranes for a long time. One problem with inland desalination is the disposal of the salty reject that is left over. New Logic has now perfected a process for efficiently filtering spiral RO reject leaving a very small volume to dispose of.

VSEP is a high efficiency membrane-based water filtration system. We are currently working with Pepsi, Coca Cola, Nestle, Niagara Bottling, and other similar purified bottled water companies as well as other beverage companies to increase the yield of water that they use. Without the addition of the VSEP system, the conventional spiral RO process may waste 10-30% of the water they take in. By adding the VSEP system, the leftover brine concentrate can be as small as 1-2% of the total volume taken in.

New Logic's largest bottle water installation consists of a VSEP system with 40 VSEP modules processing about 1 MGD (700 gpm) of spiral reject. The average US family household uses about 300 gallons per day. So, for this one VSEP installation, our system is recovering additional water that is equal to the amount consumed by about 3,300 households.

New Logic has delivered VSEP RO systems to bottling companies around the world and many in the United States. For some companies, VSEP has become part of the standard design when they build a new bottling plant. The benefits of adding a VSEP system to reduce the brine volume include reduced water consumption and cost, reduced effluent costs, improved sustainability credits, better social acceptance, easier plant permitting process, and many other factors.

**Product Spotlight – Batch Titan**

New Logic's Batch Titan® 1000 membrane coupon tester is designed to quickly test the separation capabilities of various small coupons of membranes. An assortment of membranes is provided with each Batch Titan®. Additional membranes can be purchased separately. New Logic carries over 200 types of membranes ranging from Reverse Osmosis to Microfiltration.

The Batch Titan® is filled with the test liquid and then pressurized using compressed air or nitrogen. The unit is operated at about 60-70 psi (420-490 kPa). Once air

VSEP Vibes Newsletter

pressure is applied to the liquid solution, filtrate passes through the membrane and is discharge out a small tube at the bottom of the unit. Measurements can be taken on the water quality of the filtrate compared to the feed solution used. Flow rate comparisons can also be made between various membranes that are tested on a relative basis. This device is also useful to verify which membrane will remove turbidity and produce clear filtrate.

Specifications:

| | |
|---|---|
| Capacity: | 200-1000 ml |
| Temperature: | 5-60oC |
| Maximum Pressure: | 75 psi (5.3 kg/cm2) |
| Wetted materials: | Polypropylene, Acrylic |
| Elastomers: | EPDM |
| Retainer Frame: | Stainless Steel |
| Membrane: | Select from 200 available |

The test cylinder capacity is 1,000 ml (0.264 gallons). The Batch Titan® can also be used for small batch concentrations. All of this testing can be done prior to larger scale VSEP pilot testing so that many membranes can be compared to verify proper membrane selection prior to the setup of larger VSEP equipment. For more information contact your New Logic Sales Engineer.

About the newsletter author:

Greg Johnson is CEO of New Logic Research and is responsible for the development of VSEP technology since 1992. gjohnson@vsep.com

New Logic Research, Inc.
2527 Aviation Way
Minden, NV 89423 USA

775-783-7600

www.vsep.com
info@vsep.com

March 2023 Newsletter Edition