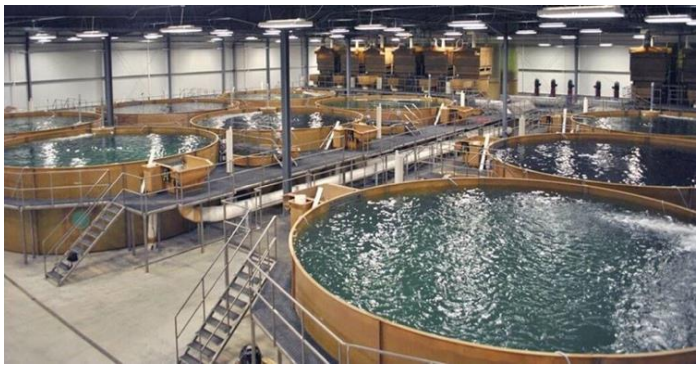
VSEP Vibes Newsletter

Welcome to the New Logic Research Newsletter.

VSEP for Fish Farming and Processing

Aquaculture, or fish farming, has grown substantially in recent years. With technology advancements, commercial fishing in the wild has become extremely efficient and this has put a strain on fish populations in certain areas. Fish capture by commercial vessels will not be able to keep up with worldwide demand. Annual consumption of seafood has doubled in the last three decades. Captively raised fish now account for about 25% of the world's supply and this is expected to grow to 50%. In addition to serving a need for sustainable supplies, fish farming is essentially an economic development run by small and medium sized businesses in remote areas where alternative employment is limited. This is the case with Atlantic salmon production in Scotland, Norway and Ireland. This overall trend has grown because of a general decline in catchable wild fish stocks and an increase in public demand for finfish and shellfish resources.

Captive fish production can generate large amounts of effluent. This wastewater can contain feces, medications, bacteria, viruses, pesticides, and other potentially harmful pollutants. Fish farm effluent is often discharged directly into shallow coastal habitats. Limits on pollutant loads from aquatic animal production facilities are increasing. The US Environmental Protection Agency is currently developing national effluent quality criteria for the US aquaculture community. VSEP has been used to treat pig, cow, mink, duck, chicken, shrimp, and fish manure. Fish farming on land is done in large tanks. To keep a healthy water quality, 20% of the water must be changed on a regular basis. Filtration is used continuously to remove suspended solids, but this alone is not enough to keep the water clean.



Once the fish are raised and ready for sale, the meat processing begins and this also generates a large amount of effluent. This effluent can contain some valuable byproducts when concentrated such as oil and parts of the fish that can be sold as fish meal, a farm animal feed product high in protein. Fish meal can be sold for about $500/ton. Extracting the organic materials from fish processing effluent can have economic benefit as well as making clean water for reuse or safe discharge.

Stick Water Protein Separation –

We did some test work for a Peruvian fish processing company. They use Anchovy to make a fish meal product that can be sold as a farm animal feed. During the processing, they would use

VSEP Vibes Newsletter

an evaporator to concentrate and dry the stick water, or liquid waste left from processing. This water contains a lot of proteins and also large organic suspended solids. These large solids cause problems for the evaporator. So our work involved using a Teflon Microfilter to separate the large solids and produce a clean protein water that could feed the evaporator. Proteins and organics of this kind would normally foul conventional crossflow membranes just as it did to the evaporator. The VSEP was able to efficiently filter this was with a flux rate of 42 GFD.

Seafood Tank Filtration –

A company in Minnesota raises shrimp in indoor tanks. They wanted to improve the water quality in the tanks and to minimize the waste generated. Typical methods of protein skimmers and coarse filtration has limits when it comes to water quality. We studied the idea of using a tight UF membrane with a molecular weight cut off of 5,000 Daltons. This would be a much finer filtration media and would produce much cleaner water if the VSEP was installed like a kidney and would remove particulates and proteins from the tank water. The VSEP performed well with a flux rate of 30 GFD and 98% recovery.

Like Diamonds, PFAS are Forever

Polyfluoroalkyl substances (PFAS) are a group of man-made chemicals that includes PFOA, PFOS, and 15,000 fluorinated chemicals. PFAS have been manufactured and used in a variety of industries around the globe since the 1940s. PFOA and PFOS have been the most extensively produced and studied of these chemicals. Both chemicals are very persistent in the environment and in the human body. There is evidence that exposure to PFAS can lead to adverse human health effects.

PFAS has been found in municipal drinking water supplies. PFAS compounds are used in non-stick cookware, water repellant clothing, and firefighting foam. These chemicals move quickly through the environment and have accumulated after decades of use. They increase in concentration in the soil and water over time. EPA has detected PFAS in 7,237 public water systems in the United States. Hundreds of these have levels above the proposed limits of 4-10 parts per trillion. Coastal states have the highest concentrations. Beverage companies that use Municipal water to make drinks will also have unsafe levels of PFAS. This has already led to litigation. PFAS was recently found in Hershey candy bar wrappers. PFAS was detected in rainfall in Florida. RO membranes can easily remove PFAS materials and VSEP has installed projects running for many years to remove these chemicals effectively.

VSEP

Vibes Newsletter

San Diego Groundwater

Due to continuous population growth and rapid economic development, production of drinking water from non-traditional sources is continuously being explored worldwide. Because of concerns about future water supplies from the Colorado River and elsewhere,, the City of San Diego intends to develop local groundwater sources to supplement their drinking water supply with a target of 10,000 AF/yr. Due to high salinity, many of the City's groundwater sources require desalination before it can be used to supplement drinking water supply. Several aquifers in the San Diego area including the San Diego Formation, Mission Valley Basin and the San Pasqual Basin can be utilized for mitigating future demand but are potentially impaired by high salinity.

The City of San Diego evaluated the level of treatment and associated costs required to produce drinking water from these sources. MWH Engineering was hired for pilot studies that included the VSEP for spiral RO reject volume reduction. Because the local groundwaters contained high levels of Silica (62 mg/L), the spiral RO system was only able to operate at 65-75% recovery leaving a large volume of concentrated brine. To reduce the volume of concentrate generated from the primary RO, a Vibratory Shear Enhanced System (VSEP) was studied. After pH adjusting with acid, an overall feed water recovery of more than 93 % was achieved by using VSEP.

The VSEP operated with a flux rate of 60 GFD (gallons per square foot per day) at a recovery rate of 75%. Cleaning was performed every 2-3 days. With the initial silica level of 62 mg/L feeding the spiral, the Silica level feeding the VSEP was about 250 mg/L. The VSEP reject had more than 1000 mg/L of silica. Scanning Electron Microscopy and EDS spectrum analysis on the VSEP membrane showed some Barium Sulfate fouling likely due to the use of Sulfuric Acid for pH adjustment. It also found that only 2% of the available foulant material was Silica. Even with these two normally difficult membrane foulants, cleaning of the VSEP membrane completely restored the specific flux to its initial value. The conclusion was that treating this brackish groundwater was economically viable and less expensive than seawater desalination. Because the VSEP could be used to minimize the reject brine volume, the project was considered successful. Without the VSEP option, brine disposal would have made the project unviable.

VSEP Vibes Newsletter

Polyphenols – Nature's Defense Mechanism

Polyphenols are a large family of naturally occurring organic molecules found in plants. The polyphenols serve many purposes including prevention of microbial infections, control of growth hormones, and signaling for ripening. They provide protection and good health for the plant. They are also strong antioxidants and are sold commercially as supplements for human consumption. Just as these phenols protect the plant, studies show that there are health benefits for humans as well. By reducing free-radicals and other toxins in the human body, they promote good health. Studies also have shown the ability of polyphenols to prevent or limit cancer and DNA mutations contributing to apoptosis (cell death) of rouge and aberrant DNA.

Polyphenols can be extracted by solvents including water. Many of these molecules are water soluble and can have molecular weights of 100-800 Daltons. Wastewater from food processing facilities can contain significant amounts of these valuable materials. One of our distributors in Mexico participated in a study of extracting polyphenols from corn tortilla wastewater (Nejayote). New Logic has explored the idea of extracting the polyphenol, Resveratrol, from winery wastewater. New Logic has also done a great deal of work in conjunction with UC Davis to look at polyphenol recovery from Olive Milling wastewater.

With over 600 million gallons of wastewater generated per year, the California olive industry is looking to find new ways to save water and reduce discharge fees. Land application of this wastewater that is high in phenols can also have a negative toxic impact on the soil microbiology

that promotes good plant growth. Taking it one step further, New Logic and the UC Davis Olive Center studied how to find ways to harvest beneficial polyphenol products from the waste streams for use in nutraceuticals.

The polyphenols found in olive mill wastewater include Gallic Acid, Hydroxytyrosol, Coumaric Acid, Vanillic Acid, and others. New Logic conducted testing where Ultrafiltration was used

to remove suspended solids and molecules larger than 1000 molecular weight. The UF permeate was then a purified form of polyphenol water. This was then concentrated using a RO membrane. The separated samples were tested by chromatography for the total phenol concentrations. The combination of UF pretreatment and RO concentration resulted in a purified solution with a 3x concentration of polyphenols. This RO concentrate can be spray dried to produce a dry powder that could be commercially available for the supplement industry.

	Total Phenol (mg/L)
Olive Mill Wastewater	146
VSEP UF Permeate	118
VSEP UF Concentrate	404
Spiral RO Permeate	25
Spiral RO Concentrate	439

By treating food wastewater from fruit and vegetables, wastewater discharge problems and fees can be avoided, water can be recycled, and possibly value added products can be extracted from what was once a waste product.

Rep Spotlight – Lange Lyche Teknisk

Increasing its presence in Northern Europe, New Logic has partnered with Lange Lyche Teknisk. New Logic CEO, Greg Johnson has held meetings with Lange Lyche managing director, Wojitech Sargalaski to discuss how the VSEP technology can complement the other solutions provided by Lange Lyche when serving the biogas and aquaculture markets.

Lange Lyche was established in 1931 and has evolved from importing quartz sand and chemicals for the smelting and paper manufacturing industries to a leader in environmental technology. The transition began in the 1970s under Jens Fredrik Lange Lyche and was focused on air and water purification. The company markets rotary press filters and an assortment of pumps. To complete the solutions offered to its clients, Lange Lyche has begun marketing of the VSEP membrane filtration solution. The company is based in Sande Norway catering to diverse sectors including Aquaculture, Energy, and Offshore.

Today, Lange Lyche Teknisk is a hub of specialized expertise, guiding decision-makers in Aquaculture, Biomass/Biogas, Pulp & Paper, and municipal Wastewater and Sewage treatment towards sustainable, cost-effective solutions. Our dedicated team of engineers and technicians are committed to optimizing processes and propelling industries forward.

LANGE LYCHE
Part of the PG Flow Solutions Group

VSEP Vibes Newsletter

VSEP Produces Drinking Water From Manure

The VSEP was studied for its ability to make drinking water from liquid manure for the pigs at a farm. The evaluation was done in a trial at Ridgetown College, University of Guelph in Canada using New Logic's VSEP (Vibratory Shear Enhanced Process). The VSEP employs the use of oscillating vibration, which limits the effects of fouling which can limit permeation of conventional spiral RO membrane systems. Many liquid/solid separations are now possible that were not previously using the VSEP membrane technology. This includes liquid/solid separation of liquid swine manure and other types of manure.

The objective of the Ridgetown study was to evaluate the impact on the health and growth of pigs when drinking VSEP RO permeate that was recovered from the manure. This involved a comparison study where one set of pigs drank only VSEP permeate and the other group drank the normal water used at the farm. Another group drank a mixture of both. The water was recovered from liquid manure using the VSEP RO system. The quality of the recovered water was measured against drinking water standards and provided for drinking water to young pigs.

Parameter	Barn water	50%barn 50%permeate	VSEP Permeate
Initial Wt. (Kg)	12.4	12.4	12.6
Week 1 Wt. (Kg)	15.0	14.9	15.3
Week 2 Wt. (Kg)	17.8	17.8	18.3
Week 3 Wt. (Kg)	21.8	22.1	22.7
Final Wt. (Kg)	26.6	26.9	26.9
ADFI (Kg)	1.20	1.18	1.23
ADG (Kg)	0.50	0.52	0.51
F/G	2.38	2.28	2.40

The growth performance of the subject pigs
ADFI - average daily feed intake; ADG - average daily gain; F/G - Kg feed per Kg gain.

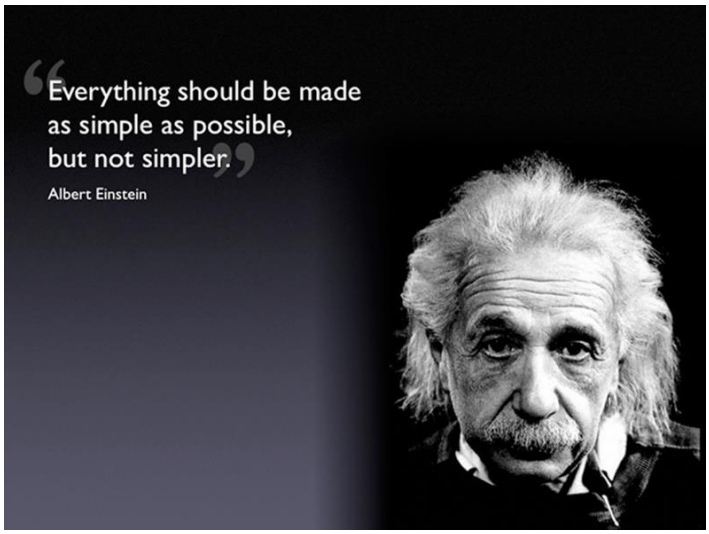
The study involved three groups that drank regular barn water, half barn water and VSEP permeate, and VSEP permeate. A total of 54 pigs were allocated to 9 pens of 6 pigs each. All pens were balanced for sex with 3 barrows and 3 gilts being allocated to each pen. The data collected included initial and weekly body weights, daily feed consumption and feed consumption on a pen basis. Mortalities and their causes were recorded. Morbidity of the pigs was assessed in several ways including their growth performance, frequency of treatment and the levels of feed and water consumption. Results showed that the VSEP produced permeate at a quality level acceptable to pigs. The data revealed that no performance or health effects resulted from providing the recovered water to young weaner pigs (12 - 26 kg liveweight). The pigs drank as much of the permeate from the VSEP as the normal barn water supplied to the pigs. It can be assumed that if young pigs will accept this water with no seemingly ill effects, then the water should be quite acceptable to older pigs.

VSEP Vibes Newsletter

To Pre-treat or not to Pre-treat

That is the question. We work with a lot of engineering companies who always want to design a VSEP project like a Spiral RO project. They assume that since we use membranes, the same rules apply. In spite of our recommendations, they often don't listen and will use VSEP on the backend to polish when VSEP could be used on the raw effluent and could get better results doing that. There are a number of companies who use very complicated pretreatment steps as tricks to get a spiral system to get to higher concentration levels. These include the companies like HERO®, CCRO, and Salt Works. Some even call these "sacrificial" spiral membrane systems because they know that the membranes will not last long and will require massive cleanings even with all the elaborate pre-treatment. These pre-treatment steps can include softening, carbon filters, clarification, ultrafiltration, pH adjusting, anti-scalants, and many other tricks.

We had a Casino customer that used the VSEP to filter the reject coming off their EDR system that treated brackish groundwater to make drinking water. The VSEP system worked great for about 8 years. We recommend replacing the membrane filters every few years, but this customer just could not accept the fact that the filter should be replaced and did not like the cost. So, they shopped around and found one of these sacrificial membrane companies who sold them a system and claimed to be zero-liquid discharge as well. They dismantled the VSEP system and piled it in the back parking lot, destroying most of it in the process. They installed the new magic low cost system and then turned it on. It never even worked



for one day in spite of all the pretreatment. Before our system was originally installed, they had been hauling the EDR concentrate to a POTW that was 90 miles away. So after they destroyed the working VSEP system and tried the alternative, they went back to hauling. Hauling does not require any Capex.

Some recent tests on power plant scrubber water has given us data on the subject of pre-treatment. We have tested more than a dozen of these projects that involve what is called FGD effluent. In all cases the client has come to us with very elaborate pretreatment and we recommend that they give us just the raw effluent after it has been screened so that suspended solids (gypsum) larger than 100 microns have been removed. In a few cases we have been allowed to test the raw effluent side by side with their proprietary pretreatment. The results shown in the table show that the VSEP flux rate or throughput rate is almost 50% higher on the raw effluent even though it has higher solids compared to the pretreated effluent. Not only that, the recovery rate is about 28% higher. VSEP is not like other membrane systems.

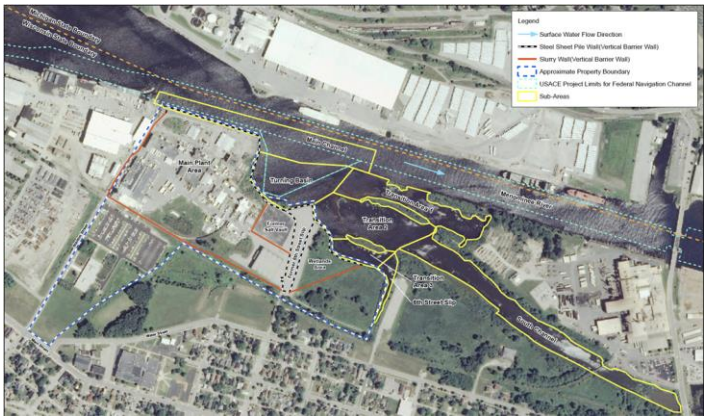
Sample	Average Flux	Pressure	Recovery	% Total Solids
Raw Screened FGD	14.0 GFD	500 psi	68.7%	5.46%
FGD w/ Polymer solids removal	9.8 GFD	500 psi	53.5%	3.22%
Softened FGD with screened solids	11.4 GFD	500 psi	56.9%	3.05%
Softened FGD with no solids	11.4 GFD	500 psi	68.8%	-2.17%

VSEP Vibes Newsletter

Arsenic Remediation in Wisconsin

CH2M Hill prepared a construction completion report (CCR) to document the Menominee River sediment removal remediation activities implemented in 2012 and 2013 adjacent to the Tyco Fire Products. The facility in Marinette, Wisconsin was used for lumber mill operations, sawdust disposal, and storage of raw and cut lumber. The site began manufacturing operations in 1915, and included cattle feed, refrigerants, and specialty chemicals. One of these was an Arsenic-based agricultural herbicides that was manufactured between 1957 and 1977. Tyco acquired the company producing the arsenic-based herbicides in 1990. A byproduct of the manufacturing of this herbicide was a salt that contained approximately 2% arsenic by weight and was stockpiled at several locations on the property. Some of this arsenic subsequently entered site soil and groundwater, as well as sediment and soils in the adjacent Menominee River. By 1978, the facility ceased production of arsenic-based herbicides, and since 1983 has produced only fire extinguishers and fire suppression systems. In 2009, the EPA ordered remediation clean-up of river sediment with concentrations greater than 50 mg/kg.

The remediation work included dredging, stabilization, and disposal of contaminated sediment in the river adjacent to the site. Soft sediment containing total arsenic concentrations greater than or equal to 50



mg/kg was mechanically dredged using a crawler crane equipped with a cable arm dredge bucket. The free water was pumped off of the dredged material for water treatment. The dredged material was loaded into watertight scows and moved adjacent to the unloading barge along the western side of the site. Excess water was decanted and sent to wastewater treatment. Reagents and pozzolanic materials were blended into the dredged material in a pug mill unit for stabilization to reduce leachable arsenic, eliminate free water, and provide strength gain of the material to acceptable standards for disposal in a nonhazardous waste landfill.

The onsite wastewater treatment system used a series of processes to treat water. First was pretreatment using coagulation/filtration in geotextile tube filters and microfiltration before treatment in a Reverse Osmosis (RO) system. The permeate from this unit was routed to the effluent tank, and the concentrate was routed to a holding tank. A vibratory shear enhanced processing (VSEP) unit then treated this reject water. Permeate from the VSEP unit was then routed to the effluent tank, and the concentrate routed to a holding tank for eventual offsite disposal by hauling. During the 2012 dredge season, 1,563,328 gallons were discharged, and during the 2013 dredge season, 6,633,091 gallons were discharged. A four module VSEP system was used to treat about 44 gpm of reject from the spiral RO system. Arsenic levels fed to the VSEP system varied but were as high as 500 mg/L. The

VSEP Vibes Newsletter

VSEP was able to operate at high recovery and meet the discharge requirements for Arsenic. The small volume of VSEP concentrate was hauled for disposal. After completion of the remediation project, CH2M Hill repurposed the equipment for another Tyco effluent treating spiral concentrate

Changing Horizon for Landfills

According to the EPA, there are at least 3500 municipal landfills in the United States. Many of these are able to transport the leachate generated to a local municipal sewage treatment plant where it is blended with sewage and then discharged. With the new rules regarding the forever chemicals known as PFAS, this form of discharge will likely not be possible in the future. Some of the largest landfills by potential capacity are found in the Western United States.

Municipal Landfills in the United States

Alabama	28	Montana	82
Alaska	217	Nebraska	21
Arizona	59	Nevada	56
Arkansas	67	New Hampshire	33
California	278	New Jersey	14
Colorado	72	New Mexico	79
Connecticut	11	New York	42
Delaware	3	North Carolina	114
Florida	67	North Dakota	12
Georgia	159	Ohio	63
Hawaii	10	Oklahoma	94
Idaho	37	Oregon	88
Illinois	61	Pennsylvania	47
Indiana	32	Rhode Island	4
Iowa	77	South Carolina	37
Kansas	58	South Dakota	13
Kentucky	12	Tennessee	81
Louisiana	29	Texas	678
Maine	27	Utah	54
Maryland	25	Vermont	61
Massachusetts	106	Virginia	152
Michigan	54	Washington	25
Minnesota	26	West Virginia	22
Mississippi	14	Wisconsin	46
Missouri	30	Wyoming	59

Source EPA Total 3,536

VSEP Landfill Project in Ecuador

VSEP is a vibrating RO membrane system developed by New Logic Research of Nevada. This unique design allows for membranes to be used efficiently to treat landfill leachate. Membranes have been tried for more than two decades for this application, but only now can membranes be employed for this use in an efficient way to solve the leachate problem. Landfill leachate can vary a great deal depending on the age of the landfill, the waste received, the amount of rainfall, and many other factors. Other technologies such as digesters, chemical treatment, or engineered wetlands can have selective success, but none represent a complete treatment solution. Only RO membranes are able to remove nearly all contaminants in the leachate and only VSEP with its vibratory shear can achieve high flow rates and volume reduction using RO membranes.

The treated water from VSEP is clean enough to meet surface water discharge requirements. VSEP allows landfills to reduce the size of containment ponds and to more efficiently manage water balance and disposal.

New Logic custom designs each system and manufactures them according to these specifications. The equipment is shipped to the client and then installed by trained New Logic engineers who perform the commissioning and

training of onsite staff. It normally takes about 6 months from the time of the order to start up of the plant. New Logic also supplies cleaning chemicals and spare parts as requested by the client.

New Logic has supplied hundreds of its VSEP systems around the world and about 24 of these have been for landfill leachate projects. VSEP has worldwide reach and each system is monitored by New Logic's staff of engineers.

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

December 2024 Newsletter Edition