VSEP Vibes Newsletter

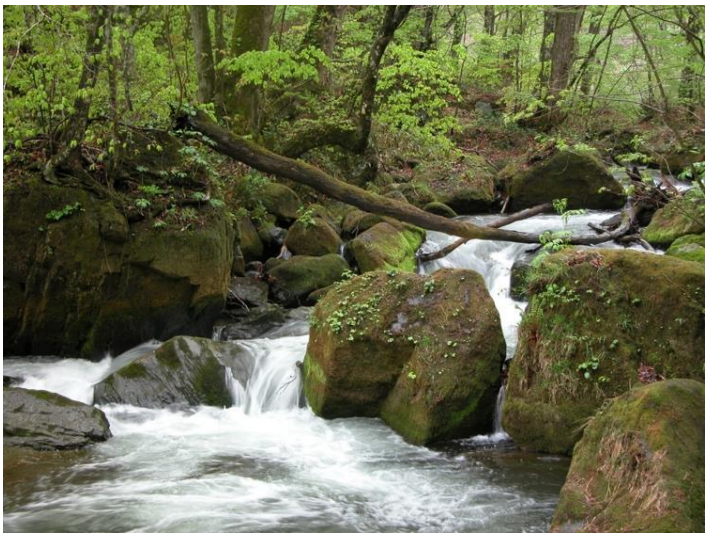
Welcome to the New Logic Research Newsletter.

New Chemicals Found in Drinking Water – Nobody knows if these are safe

Drinking water standards cover the known bad actors and limits have been established for the safety of the public. Testing and standards can even include herbicides and many man-made chemicals that can find their way into the drinking water supplies. But, there are many thousands of chemicals in our water and many of these are still yet unidentified. Therefore the pathways for health issues remain unknown. The fairly recent discovery of PFAS chemicals found in 7000 public water systems is an example of how we are still learning about what is in the water. PFAS are fluorinated chemicals that were used for decades in industry and that never decompose and have migrated all through the environment.

The addition of Fluorides for dental health is a topic of conversation now. There has been an ongoing debate about the advantages and disadvantages of this. Drinking water in public water systems needs to be sanitized to kill any incoming bacteria and to prevent bacterial growth as the water passes through the delivery system. Most of the time small doses of free Chlorine are used. This may only be addition of 2 parts per million and is sufficient to make the water free of bacteria. But there are potential side effects. When the water source contains humic materials common to natural water supplies, the Chlorine can combine with humic materials to create Trihalomethanes (THMs). These are know carcinogens. Chloroform is a type of trihalomethane and swimming pools with high levels of Chlorine will also have Chloroform present.

Because of the danger of THMs, water suppliers with significant levels of Humic materials have switched to using Chloramines. This is an effective



sanitizer and will not create THM chemicals. This has been assumed to be a safe method sanitizing water. The EPA reports that 20% of the nation's water suppliers use Chloramine instead of Chlorine. Chloramine is a combination of Chlorine and Ammonia, so Nitrogen is present in Chloramine. Chloramine has been used since the 1930s.

Researchers at the University of Arkansas have issued a paper November 22nd 2024 where they have identified a new compound that is the result of the decomposition of Chloramine. This compound called Chloronitramide previously did not have any analytic test that could identify it. Chloronitramide is a very stable low molecular weight anion. It was finally identified in drinking water by synthesizing the compound where analytic methods could be used. The study authors emphasized that this substance is a potential health risk. As with any newly discovered compound, there are questions about the safety and health risks. Currently, there have not been any toxicity studies done on this compound and so the safety of drinking water containing Chloronitramide is unknown.

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Sugar Beet Processing Effluent

About half of all sugar produced in the United States comes from sugar beets. Sugar cane can be grown in warmer climates, but the climate of the Northern United States is more conducive to sugar beets Special equipment is used to remove the leaves from the sugar beet. Another piece of equipment is used to lift the sugar beet roots from the soil and transport them to receiving stations. Once at the factory, all sugar beets are thoroughly washed to remove excess soil and debris before being sliced into thin strips called cossettes. The cossettes are sent to a diffusion tank where they are placed in hot water. Sugar is diffused from the cossettes into what is now called raw juice. Raw juice is sent to juice purification, while the solid beet pulp is sent to mechanical presses where residual water is pressed out. The dried pressed pulp is then sold directly to dairy or beef cattle operations as a nutritionally-rich livestock

feed. Lime and carbon dioxide (CO_2) are used to purify the raw juice, removing impurities using a clarifier and filters. In this process, the raw juice becomes a highly pure sucrose solution called thin juice. Thin juice is concentrated and turned into a syrup called thick juice. This liquor is further concentrated in vacuum pans causing sugar to crystallize. In order for crystals to grow uniformly, tiny sugar crystals are added to the liquor.

After reaching the right size, the crystals are separated from the remaining syrup with high speed centrifuges. The crystalized sugar is dried and cooled. The sugar is then screened and classified by granulation size.

This process can result in mixed effluents that are high in Chemical Oxygen Demand (COD). The effluents can include the wash water, condensate, pulp pressate, equipment cleaning, etc. New Logic installed a full-scale system in North Dakota to treat the mud wash or the sediment from the beet root washing. New Logic has also conducted pilot trials on the end of pipe wastewater. This mixed effluent will have very high COD and dissolved solids of about 2%. When using our standard pressure VSEP system, we can volume reduce the effluent by about 65% producing clean water that can be recycled for washing. The remaining concentrate could be evaporated or used as a feedstock for biogas production. The normal practice is to land apply this kind of effluent. The production plants are located in rural areas where the sugar beet is produced, so access to land for irrigation is not difficult. But years of land application and high COD levels cause concern of over fertilization and contamination of drinking water sources. The concerns exist for dairy cow manure land application. There will be increasing pressure on these industries to become zero discharge and to treat their effluent onsite.

Sample	Conductivity	pH	%Solids	COD	Recovery
Screened Wastewater	12,960 µS/cm	6.1	2.01%	16,500 ppm	100%
VSEP Permeate	428 µS/cm	5.6	0.04%	210 ppm	66.5%
VSEP Concentrate	27,000 µS/cm	6.5	5.76%	44,700 ppm	33.5%

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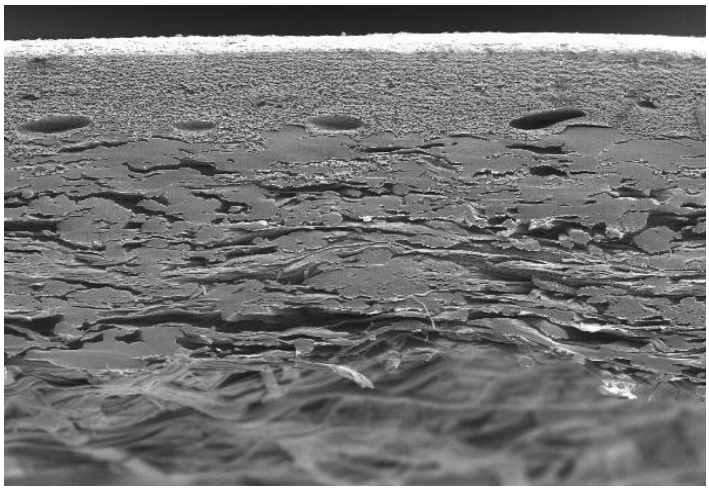
VSEP Training by Online Videos

The VSEP filtration system is unique and is something many are not familiar with. We take training very seriously and lifetime tech support is included with every purchase. The best way to learn about VSEP and membrane separation is with the LP VSEP pilot machine. We encourage customers to visit while their bench test is taking place. Also, when we ship pilot machines for onsite testing, we will send an engineer to get the equipment set up and then to train the onsite operator on how to use the equipment and evaluate the data. This training also extends to the full scale systems. With every system commissioned, we also send an engineer to start up the equipment and to fully train the operators who will be in charge. Follow up visits for additional training are also common,

Whether you would be operating a VSEP or not, we also have a set of training videos on our website that can be accessed by anyone and anytime to view. These training videos can be fond here: https://www.vsep.com/downloads/vsep-video-clips/vsep-series-lp-training-videos/

The History of Membranes

The Sartorius Company in Germany first made membrane filters commercially available in 1927. For many years it was used to remove microorganisms by micro-filtration. Then in 1960, researchers at the University of California at Los Angeles (UCLA) developed the first reverse osmosis membrane. The first full-scale commercial installation of these membranes was accomplished in 1965 in Coalinga California. Between 1965 and about 1980, these membranes were developed primarily for seawater desalination and specialized separations. By 1980 membrane use had become well established and during the 1980s several new membrane technologies were developed including Memtec's hollow fiber microfiltration membrane and New Logic's vibratory VSEP® membrane system developed in 1987. The creation of these new membrane delivery systems that were more resistant to fouling when used for wastewater applications has extended the scope of use of membranes. Today, membranes are used commercially for almost any liquid solid separation including very difficult to treat wastewaters. The creation of membrane and more advanced delivery systems has made it possible for industrial plants to completely recycle wastewater and become closed loop with zero liquid discharge.



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Energy from Scotch Whisky

Biogas is featured in many futuristic movies. In the Mel Gibson movie, Mad Max – Beyond Thunderdome, a city known as Bartertown was run completely on biogas produced from pig waste. In the movie, a crude methane refinery fueled by pig manure makes electricity, vehicles, and all functioning technology possible. The refinery is located under Bartertown and is operated by the "Master", a small man who is carried around by his enormously strong bodyguard, "Blaster". "Master Blaster" holds an uneasy truce for control of Bartertown and begins to exploit his position with energy embargoes challenging for leadership. Master is the only one with the technical know-how to operate the machinery that powers Bartertown.

For actual real life biogas facilities, dealing with the digester effluent can be a problem. In Northern climates there is a short time available for land application because the ground is frozen. There are only a few months during the year when fertilizers and irrigation can take place and the growing season is short. In other areas available land is hard to come by to get rid of the waste. Also there are concerns about over-fertilization and run-off pollution. New Logic is seeing more and more projects where the client needs to volume reduce the effluent to make disposal easier.

New Logic has installed 26 biogas projects.

VSEP stands out with its simplicity, reliability, and economical benefits. Conventional membranes are limited in their abilities. Many people have tried to use spiral membranes with elaborate pretreatment, but even still, particles can become lodged in the spiral membrane module and the pores can be blocked from fouling and scaling. This will cause reduced flow and permeate recovery as well as more frequent cleanings. A laminar boundary layer will form at the surface of the membrane resulting in a formation of a barrier that restricts permeate flow. By applying a shear force to the surface of the membrane to disrupt the boundary, these problems can be decreased or even eliminated.

New Logic has recently commissioned another biogas project in the UK at a distillery where the digestate is high strength. The VSEP system contains several modules and each one is processing about 4 m3/hr at 25 Bar and 60% recovery. Even though the digestate contains much higher dissolved solids concentration than was pilot tested, the system is performing as expected. The client is already planning for expanding the system.

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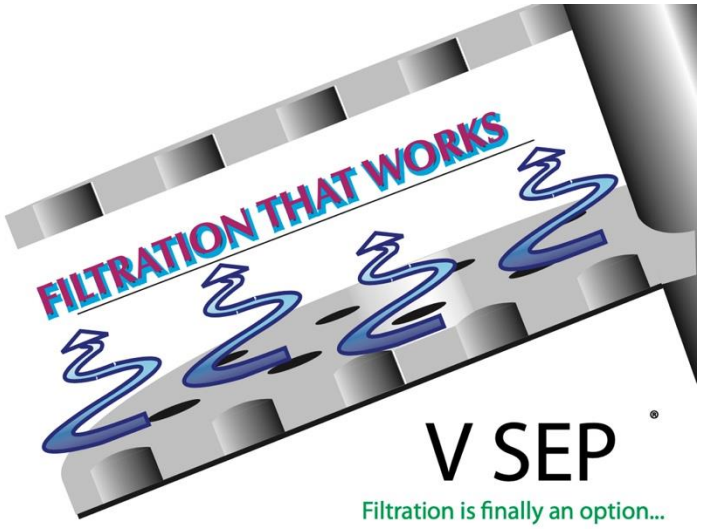
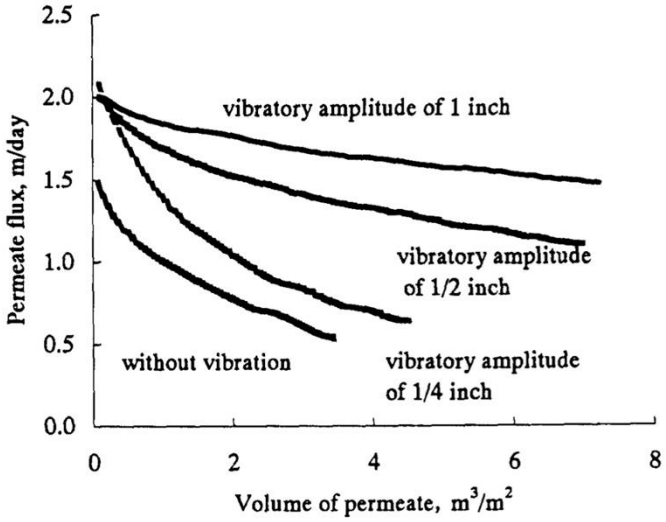
Shear Rate Benefits



A method to keep a filter clean is to create relative shear forces at the surface, or to create turbulence and scour the surface. Generally, the more shear, the better. Spiral RO membrane systems use the laminar crossflow velocity to do this. Like when you hose off your driveway, higher velocity works better than a weak flow. VSEP employs incredible shear by resonating or vibrating the membrane surface. So the liquid is moving gently across the membrane, but the membrane itself is moving violently.

During filtration, water passes through the membrane and the solids are left behind and will accumulate at the membrane surface. This is known as concentration polarization. This results in increasing filtration resistances due to the formation of a concentration polarization boundary layer and a cake layer near the membrane surface. Experiments have been done concerning the effects of an increasing shear rate at the edge of the membrane and how that affects membrane fouling during filtration of river water. Concentration polarization of humic substances on membranes can be reduced by increasing the shear rate. The concentration polarization model can predict the removal efficiency of humic substances successfully. The high removal efficiency of humic substances in a membrane filtration process can be sustained even when the water recovery rate reaches to 96%, if the membranes are vibrated. A cake layer formation on the membrane surface due to deposition of suspended colloids and humic substances normally dominates membrane fouling. Membrane fouling can be evaluated by the cake filtration model and controlled by increasing the shear rate. Humic substances with molecular weight of more than 6,000 Da are transported away from the membrane surface by the shear-induced diffusion. Humic substances with molecular weight of 2,000 Da and with molecular weight of less than 500 Da are transported away from the membrane surface not only by the shear-induced diffusion, but also by Brownian diffusion. No other type of membrane system produces the amount of shear that the VSEP does. The ability to generate high shear allows for the use of membranes for very difficult effluents without elaborate pretreatment.



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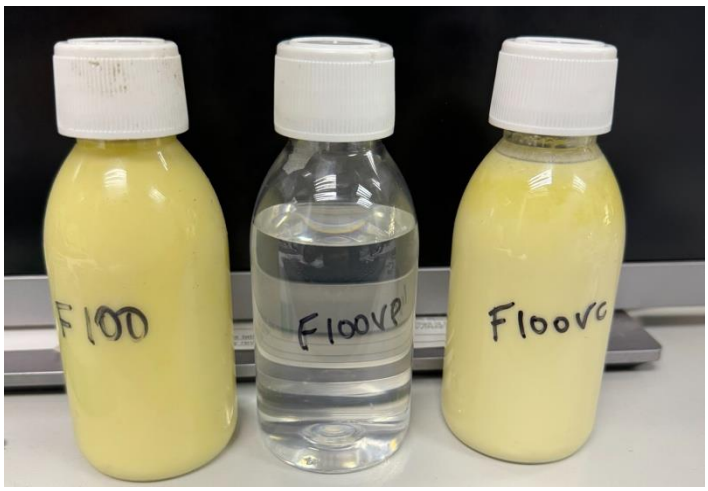
Palm Oil Refinery Effluent

New Logic has installed a vibratory reverse osmosis systems known as VSEP to treat the effluent generated during the production of palm oil. The company acquiring the technology operates three palm oil mills in Guatemala. The VSEP system has been installed at the company's new facility in Mexico near the border between Mexico and Guatemala. The 3 existing mills and the new mill can process 60 tons of oil per hour. The new mill will use fruit from existing trees in the surrounding area. The company will also plant its own trees and will grow production as these come online.



After the raw palm oil is harvested, it must be purified using a multistep process. There are two methods referred to as Physical Refining and Chemical Refining. They both accomplish the same thing. The first step is to remove water soluble free fatty acids, chlorides, and other contaminants. This is similar to how olive oil is processed. The water containing the contaminants is separated from the oil using a centrifuge. Then the oil is passed through a bleaching media with steam where the metals and color are removed. The steam is condensed. Another steam process is then used at higher temperature to remove odor. This steam is also condensed and becomes an effluent. A final step with sulfuric acid and steam breaks the soap-like mixture into a clean oil and acid water. The combined effluent streams are very difficult to treat and only now can membranes be considered to treat this effluent and reuse the clean water. VSEP has demonstrated its ability to handle this difficult emulsion-like effluent with stable flow rates and high recovery.

New Logic recently completed a multi-month pilot trial in Spain at a Palm Oil Refinery who has been looking for a good solution for this effluent problem. A VSEP LP machine was sent for testing along with a VSEP technician. We tested the effluents individually and as a mixed stream. It was found that the final effluent from splitting the soap stock had very high TDS and that it was better to segregate this and evaporate. The initial effluent from adding water to remove water soluble materials also had high TDS, but a portion of this effluent was added to a mixed effluent treated by the VSEP. So the remaining effluent streams were mixed and treated. The optimum pressure was found to be 500 psi (30 Bar). The VSEP ran with 24 GFD (gallons per square foot per day) with a permeate recovery rate of 80%. A second stage RO spiral pilot was also tested to measure the treated water quality after two passes with RO. The COD (Chemical Oxygen Demand) in the final VSEP concentrate was 236,632 mg/L !!. Something that is unimaginable with conventional membranes.

Analyte	Units	Effluent	VSEP Permeate	Concentrate	Spiral Permeate
COD*	mg/L	47544	1522	236632	50
Conductivity	µS/cm	6470	1733	20308	903
pH	pH unit	11.4	11.6	11.0	11.5

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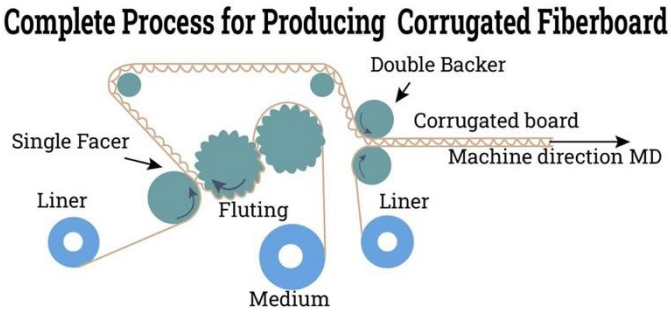
Box Plant Effluent is Increasing

As I'm sure everyone can imagine, the use of carboard has grown exponentially with the rise of Amazon and internet shopping. In addition to the tons of waste cardboard, there is also the issue of increased wastewater generated during the manufacture of corrugated box material.

The corrugated cardboard industry uses starch, glue, pigments, and ink during the manufacturing of the product. The process can generate .75 to 2.75 tons of wastewater for every ton of product. Because of the chemicals used, the effluent contains very high levels of chemical oxygen demand (COD). Because of the high COD, the effluent must often be treated prior to discharge. The conventional method used is a physical/chemical treatment involving coagulation and flocculation. However, the treated effluent can still be very high in pollutants.

Most of the wastewater comes from the ink and glue. Organic and inorganics pigments are used. The ink can contain metals, acrylic resins, anti-foam additives, and solvents. The glues that are used can contain starch, boric acid, anti-foams, and caustic. The mixture of all of these makes the treatment of this wastewater very complicated and difficult.

Wastewater that results from the corrugator process where the cardboard is made comes from cleaning of the equipment. Most of this is the glue circuit and the glue preparation tanks. This must all be kept clean to allow for smooth automated processing. Wastewater from the corrugator process can have COD of 2300 mg/L and BOD of 260 mg/L. This is a ratio of 0.11 BOD/COD. Wastewater is considered biodegradable if the ratio is between 0.4 and 0.8. So the low value of the ratio indicates that this effluent is not easily digested or degraded biologically. The other wastewater results from the cleaning of the flexographic printing machines where labels and advertisements are applied. This effluent will have very high turbidity and will have a BOD/COD ratio of 0.06 indicating that is it not biodegradable.



In 2008, New Logic installed a VSEP Nanofiltration system at an International Paper box plant in Hanford California. Because the COD is a result of organics, the VSEP Nanofilter was able to reduce the COD from 12,000 mg/L to about 100 mg/L. This resulted in large cost savings from surcharges on COD discharged to the sewer. The NF membrane was also able to remove turbidity, suspended solids, starch, color, and multivalent ions. The system operated at a flux rate of about 25 gallons per square foot per day (GFD) and a recovery rate of about 90%. The reject from the VSEP was sent to a drum dryer. For more information: https://www.vsep.com/pdf/BoxAndBagPlant.pdf

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Reclaimed Water from Municipal Sewage

Water recycling from municipal sewage can either be planned or unplanned. Reuse of treated wastewater for irrigation is an example of planned water reuse. As an example of unplanned water recycling, many cities that draw drinking water supplies from the Mississippi river are in a sense reusing some treated wastewater that has been discharged into the river water upstream. The fact that treated wastewater from municipal sewage and from industrial wastewater is being blended with the drinking water supply has been readily accepted since regulators and the public have assurances that the treated water will not have a negative impact on downstream operations. Large cities such as Philadelphia, Cincinnati, and New Orleans have been practicing indirect potable water reuse.

There are currently only a few examples of treated wastewater that is intentionally directly introduced into the drinking water supplies. On the International Space Station, membranes are used to treat sewage to recycle water for consumption. Although there are many instances of unplanned indirect reuse as in the example above, there are also increasing numbers of planned indirect water reuse applications. When indirect water reuse is planned, the purpose of introduction to the water supply is to augment the volume of water source. This treated water will migrate through the watershed system and finally end up in the distributed supply. Orange County in California treats its municipal sewage and then injects this water into the seawater barrier to limit salt intrusion. The Wulpen wastewater treatment plant in Belgium also treats municipal sewage and then injects it into the aquifer. Saudi Arabia has designed a 10 MGD plant to do the same thing.

There are only a couple of examples where the treated water is directly added to the distributed water supply. Namibia is a small country in Africa, which is also located in a desert. In 1960, water supplies to the capital city of Windhoek fell well short of the need. After that, the Country implemented an emergency water plan. At first this involved construction of large reservoirs and importation of 80% of its water from great distances. Local aquifers were also tapped and depleted at a rapid rate. With this temporary fix in place, a water reclamation project was then begun. In 1968, the Gammans Treatment Plant started treating municipal effluent for reclaimed use. This water is then blended at a ratio of 1:3.5 with water from the Goreangab Dam. This blended water is then treated using conventional water treatment methods to meet drinking water standards and again blended into the drinking water reservoir.

The treatment is accomplished by dissolved air floatation, sedimentation, and sand filtration. Recently ozonation and activated carbon filtration have been added. Also, addition of membrane treatment and an additional 140 days storage are being considered as additional process improvements. There have been toxicity studies completed for this project and a wealth of data exists from this plant that has been in operation since 1968. The studies have shown that the

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facility is providing water that is safe and that no health effects from reclaimed water reuse have been observed. Singapore is a densely populated city/state with no water resources of its own. Previously water supplies were imported from Malaysia. In 2003, Singapore has begun a process of reclaiming wastewater effluent using the advanced treatment methods of reverse osmosis filtration followed by ultraviolet disinfection. In 2003, about 2.4 MGD of treated water was introduced and blended with the other water supplies in storage reservoirs.

The Ultimate Analytic Test

Our VSEP RO membranes are used in many industries. A RO membrane is very tight and will reject almost all the dissolved solids and all of the suspended solids. RO membranes are used all the time to make drinking water. Seawater desalination and bottled water production are two examples. People have no hesitation at all in drinking water filtered by a RO membrane when the feed to the membrane is just salty or brackish water. But there are huge psychological issues when the source water is something else. University studies have shown the VSEP can filter pig manure and then the permeate can be used as drinking water for the pigs. They have no issue at all with this and studies have shown there are not health risks from this. But Humans who are capable of critical thinking have a big problem with the toilet to tap idea. Even though the Mississippi river is basically a giant sewer and drinking water is taken from there, ignorance is bliss. It will be a long time or maybe never when filtered wastewater will be socially acceptable for human consumption. Interestingly, many of our customers have given our system the ultimate test. Even though the analytic will show the water is perfectly safe to drink, the mental block for this is difficult to overcome. In spite of this, several of our customers have tasted the VSEP permeate as the final stamp of approval.

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