VSEP Vibes Newsletter

Welcome to the New Logic Research Newsletter.

Stretching Water Resources

With populations rising, water sources becoming stretched, and difficulty expanding infrastructure capacity, increasing attention is being paid to how water is used and reused. Industry, agriculture, and domestic water users are all competing for this most precious natural resource. Many of the Southwestern United States are seeing dramatic population growth rates, while population levels in the North and Northeast are remaining fairly stable. The problem is that populations are increasing in areas of the countries with the most limited water supplies. For example, the U.S. Census Bureau estimates that the population of Arizona will double within the next 25 years.

New Logic has done many industrial water reuse projects. But many of these are situations where the client is not allowed to discharge effluent and so they treat the effluent to make clean water and a concentrate that is evaporated. Then they reuse the water just because it has to go somewhere. They may use if for cooling tower make up water, or washdown water, or some other non-potable use. So far, the water reuse has not been done because of the value or scarcity of water.

From left to right, the initial wastewater, composite permeate and final concentrate

Some companies are looking ahead and see issues with the supply of water and possible restrictions. In 2014, I visited a large winery in Fresno California. It takes 7 gallons of water to make one gallon of wine. This customer gets water for free and simply pumps it out of the ground from the aquifer located in the San Joaquin Valley. They were pumping 870 gpm (200 m3/hr) of water 24 hours per day out of the precious aquifer. They were aware of the shrinking Aquifer and the real possibilities of future restrictions on water use because of that. Access to water is vital for the company to be able to function. So, at the time, water reuse from effluent was a plan B and would not be done because of the cost savings, but as a way of insuring access to water.

The initial winery effluent had about 0.3% total solids and a conductivity of about 5700 µS. We conducted pilot testing and demonstrated that our equipment could take the raw effluent with no pretreatment and recover 93% of the volume as clean water with a conductivity of 600 µS after one pass with VSEP RO. A second pass using spiral RO was done resulting in water with only 85 µS conductivity that would meet drinking water standards. Even though our results were excellent, the business case was not there for a large

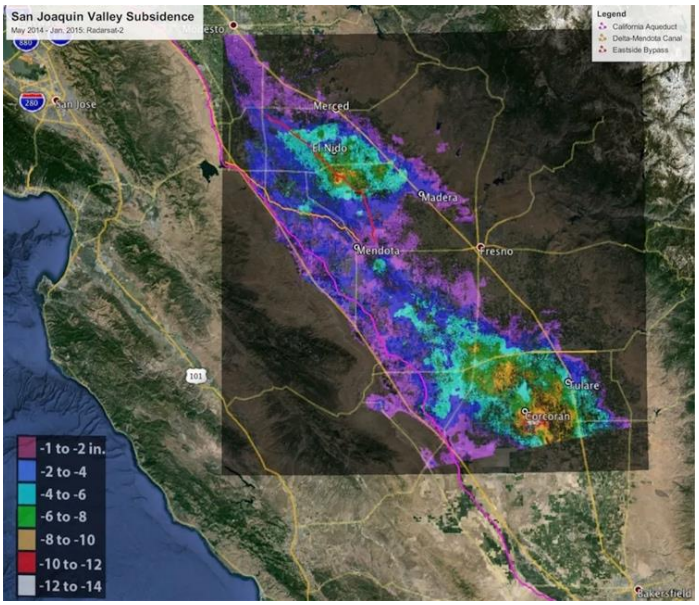
capex project and so it was shelved. The option will be there in the future if water supply issues arise.

California has always had an extreme water shortage problem. There are fights on both sides of the issue. Some blame global warming and drought. Others blame lack of investment in infrastructure. There have not been any significant new reservoirs built in 80 years. The groundwater and aquifer represent a huge reservoir of water storage, but it is becoming depleted and more needs to be done to insure water for future generations.

An example of the infrastructure problem, a new reservoir known as the Sites Reservoir was initially proposed in 1950. It has been languishing and going through the approval process ever since. It would store water taken from the Sacramento river and would hold enough water for 7.5 million people. It would be the 8th largest reservoir in the State. In 2018, a bond proposition passed by a majority which provided funding for the project. But before any thought of construction can happen, many permits from various agencies need to be approved. The latest deflection occurred on September 20th 2024 when the State Water Resources Control Board and the Army Corps of Engineers denied the permit and required additional information. The permit application will need to be resubmitted.

Because of pumping, groundwater levels in the central valley are reaching record lows. In addition, as the water is pumped out, the ground level is sinking. California's Department of Water Resources estimates the water levels are up to 100 feet (30 meters) lower than previous levels. Many wells have gone dry and require drilling to greater depths. As the land is sinking this puts nearby infrastructure at greater risk of costly damage.

Ground levels subsiding could have long-term consequences. If the land shrinks too much, and for too long, the aquifer ceiling will shrink and it can permanently lose its ability to store groundwater.



To quantify this accelerated sinking, researchers at the Department of Water Resources and NASA's Jet Propulsion Lab in Pasadena, California, compared satellite imagery of California over time. Thanks to images taken from both satellites and airplanes using a remote-sensing technique called interferometric synthetic aperture radar (InSAR), which uses radar to measure elevation differences, researchers can now map changes in the surface height of the ground with incredible precision. They have found that some areas of the central valley in California are sinking as much as 2 inches per month (5 cm).

Scientists have found that groundwater losses in the Central Valley since 2003 have totaled about 36 million acre-feet, or about 1.3 times the full water storage capacity of Lake Mead near Las Vegas, the country's largest reservoir.

Ten years has passed since my visit to the winery. But at some point this will become a critical issue and more attention will be paid to reuse of water due to scarcity, not just for the economics. After all, it is wasteful to use water only one time and then throw it out.

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New Logic offers VSEP Pilot Testing

VSEP is often called on when nothing else works or for very difficult effluents. Many times our clients have already tried several other options and have seen them all not work. So it can be challenging when we approach them with our solution. Pilot testing at the client's facility with a small scale VSEP is the best way to assure the client that VSEP can do the job. We enjoy seeing the reaction from a customer when they see the clean water coming out of the LP VSEP pilot machine. Many times, we don't need to pilot test to collect data, but we conduct these demonstration tests to prove that the technology works.

Sometimes the first step is a bench test at our facility where a customer would ship 80 Liters of effluent and then we perform the small scale test as an initial feasibility test. The next logical step is to conduct onsite pilot testing where the VSEP can run for a longer period of time on larger volumes of effluent. Sometimes when we are sure about the best membrane and operating conditions, the bench test can be bypassed and we will go straight to onsite pilot testing. This can save time and lead to a quicker resolution of the treatment options for the client.

New Logic is currently pilot testing five projects including power plant wastewater, fruit processing effluent, PVC Latex wash water, palm oil refinery effluent, and herbicide wastewater. The VSEP LP pilot machine is being used for all of these except the power plant effluent where we have provided a full-scale system to be used as a pilot. New Logic has full-scale systems that can be rented. But to save on cost and set up time, nearly all of our customers will opt for the smaller LP VSEP. This is about the size of a small refrigerator and comes on casters so it can easily be moved around and set up. The throughput rate will vary but is normally between one and two liters per minute.

Sometimes the VSEP LP is the only equipment needed. But in other cases, a spiral RO pilot, a prescreen, a water heater, or other equipment can be provided as needed. This is all clarified with the client as to what they would need to conduct a pilot that would simulate the permanent full-scale project. The equipment is factory tested before shipping and a new membrane is installed. The equipment is then loaded into wooden crates for shipping to the customer's site.

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One of the current pilot tests is for a customer who produces all kinds of dried fruits. In the process, the fruit is cleaned and thermally dried. This generates effluent from cleaning the fruit as well as cleaning all of the equipment used. This client generates about 70 gpm (16 m3.hr) of wastewater and does not have the option for sewer discharge. They currently haul all of this wastewater at great expense. The VSEP would be used as part of a zero-liquid discharge (ZLD) process. The plan is for the VSEP to clean the effluent by removing about 75% of the volume as clean water that can be reused. The remaining concentrate is not much more concentrated than the initial effluent and would have value as a feedstock to a local dairy that is looking for organics to feed to a biogas digester that they run. The concentrate can also be evaporated if the digester option does not work out. Initially, this customer was considering evaporating 100% of the volume. But because VSEP can be used first, the cost of evaporation can be reduced by 75%.

The testing for this project is ongoing and will be finished in a couple of weeks. The pilot test has been very valuable in our ability to show the customer what kind of water we can produce. It also helps them to understand how the VSEP is operated and cleaned. On deck, New Logic is coordinating several future field pilots including power plant scrubber water, bean soak water, refinery stripped sour water, phosphoric acid purification, oily wastewater from a Tesla plant, thin stillage, landfill leachate, and others. Many of our distributors around the world also have our LP pilot machine and are conducting pilot tests of their own.

VSEP.com Users in August

		771 100% of total
1	United States	347
2	India	61
3	United Kingdom	29
4	Japan	28
5	Germany	24
6	China	20
7	Spain	20
8	Mexico	18
9	Canada	13
10	France	12

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VSEP Commissioned at Colorado Dairy

New Logic has commissioned a VSEP manure treatment system at a large Dairy north of Denver Colorado in order to reduce hauling costs. The typical method of disposal of manure that has been practiced for thousands of years is to apply the manure to fields to use as fertilizer. However, while this can work easily for small family farms, large farming operations that have thousands of animals need large areas of land available to dispose of the manure. However, as long as this option exists, it costs nothing and so it is the best option for the farmer. Obviously, there is no need to spend money on any kind of water treatment system if land application is possible at a reasonable cost.

When there are situations where land applying is difficult, expensive, or not possible, the farmer will need to have a treatment process. In some cases in colder regions, the ground is frozen for most of the year. Land application can only occur when the ground has thawed and the water and nutrients will soak into the ground. They can only land apply the digested manure for 3-4 months out of the year in some cases. And so, the farm would need very large storage capacity for the manure

during the rest of the year. Storing this much manure for that long can be expensive and problematic. In addition, because there is a very short time to land apply and the ground can only absorb so much water, it requires a much larger area of land to apply the manure than it would if year round land application were possible

In some regions where there are large concentrations of animal farms (pigs or cows), the available land for disposal can be hard to find or far away. This is the case in Northern Italy where we installed a project. Many farmers would need to haul the manure 100 km or more to find land that can accept the manure

Constant land application can cause over-fertilization of the land. In Europe, there are strict limits on the amount of nitrogen that can be put on the land. In Belgium we installed projects because for thousands of years pig farmers put the manure on the land and now it has very high levels of phosphorous. High levels of Phosphorous reduces the ability of water to absorb into the ground. (It stays muddy). Here again there are regulations on the amount of nutrients that can be land applied.

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Manure or digested manure is very high in ammonia, dissolved solids, and COD (Chemical Oxygen Demand). Membranes are the perfect method for treatment because RO membranes can make drinking water quality from any effluent. But, because the spiral membranes plug, VSEP is the perfect answer. For the VSEP system commission in Colorado, the objective was to dewater the manure to save on transportation costs. The client wanted to capture all of the volatile solids from the cow manure and to make clean water that the dairy could keep and use for washdown or for irrigation. The concentrate including the volatile solids is transported to an anaerobic digester where biogas is produced. The VSEP system has been operated for several months now.

To accomplish this, a VSEP RO system is used as primary treatment. Then a conventional Spiral RO system was used to polish the VSEP RO permeate to make drinking water quality filtrate. The final concentrate from the VSEP captured 100% of the volatile solids with a total solids level of 8.1%. The treated water from the two-stage system had near zero levels of Chemical Oxygen Demand (COD) and conductivity of only193 µS.

Analyte	VSEP Feed	VSEP Reject	VSEP Permeate	Spiral RO Permeate
TS (%)	3.64	8.13	0.14	0.02
TSS (ppm)	28,879	82800	0	0
VSS (ppm)	10604	28275	0	0
Conductivity	12890	21920	2160	193
COD (ppm)	35480	62050	360	<0.01
TN (ppm)	1950	4490	170	13.60

The full-scale system purchased processes about 58 gpm (13.2 m3/hr) of screened manure and will produce 70-80% of the volume as clean treated water and 20-30% as concentrated solids for biogas production.

LP Training for Pilot Testing

New Logic has many representatives around the world who have pilot machines and conduct pilot testing of VSEP for their customers. For representative without pilot equipment, New Logic will dispatch equipment from its factory in Nevada. New Logic does have a LP training video that can be found on our website. Training is also free of charge when customer or representatives visit our facility. Upon completion of training a certificate is given to those who complete the program. We also will send an engineer to our customer or representative's location for hands on training.

New Logic's representative in France, Inovaya, is currently evaluating the VSEP for many applications including pharmaceutical, PFAS pollution, tannery effluent, and several others. Recently, our pilot test manager, Landon Graham, traveled to their facility to train five of Inovaya's staff. The training was completed successfully and the technicians learned how to operate in I mode and then convert the LP VSEP into P mode where a larger filter area is used once the membrane type has been selected.

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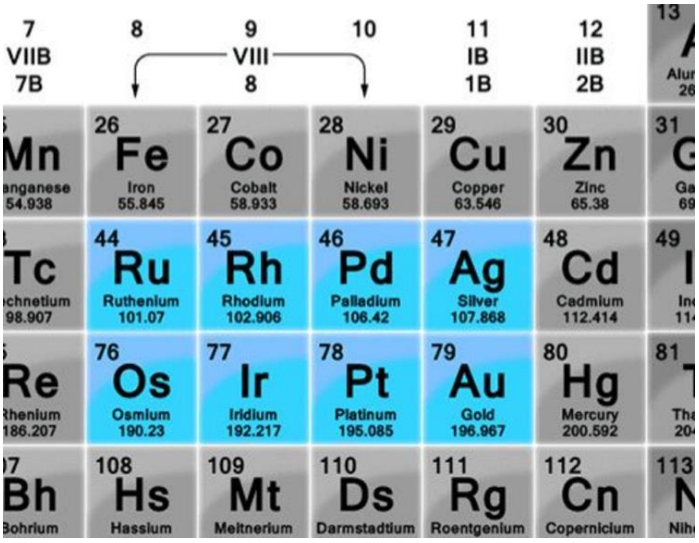
Precious Metals Recovery

The category of precious metals (PM) includes gold, silver, platinum, palladium, ruthenium, rhodium, iridium, osmium, and rhenium. These are all very expensive metals used in all kinds of industries. They are found right in the center of the periodic table. When used in industry, the loss of any amount of these materials can significantly affect the bottom line. These metals are often used as catalysts. I visited a catalytic Converter coating facility one time where a ceramic coating is applied that contained platinum, Cerium, Lanthanum, and other expensive metals as the catalysts. The scrutiny over the chain of custody and accounting for these metals was so extreme that I was asked to use a show scrubber as I left the room so they could collect the dust from my shoes.

When mining these metals, or when re-refining metals that are recycled in E-waste, waste streams can be generated that may have a small amount of PMs. Even as low as 3 ppm of Platinum. New Logic recently installed a full scale VSEP Nanofiltration (NF) system at a metal recycling company's facility. The idea here is to volume reduce the effluent and concentrate the dilute PMs so they can more easily and economically be recovered. In this case, the effluent contained

Sample			
Membrane	Feed	Permeate	Concentrate
Ag	1	<1	7
Al	60	<1	1533
Ca	4	<1	87
Cr	1	<1	12
Cu	2	<1	143
Fe	5	<1	108
K	2485	855	1
Mg	1	<1	111
Na	2447	840	1
Os	83	<1	123
Pb	1	<1	23
Pd	3	<1	46
Pt	12	<1	163
Rh	3	<1	116



some monovalent ions such as chloride and nitrate. So NF was used which will allow the water and monovalent salts to pass through the membrane while the PMs and other multivalent ions are concentrated.

The VSEP system is able to operate at a high flux rate without scaling that would be seen in conventional spiral membrane systems. The VSEP also does not require pretreatment or solids removal ahead of it. The VSEP operates at about 90% recovery and this results in a 10x concentration of the precious metals while very significantly reducing the volume from which the metals can be recovered. New Logic has also installed about ten projects at catalytic converter coating companies where the VSEP is used to filter the washdown water containing large amounts of Platinum. Mining of PMs is another area where VSEP can be deployed. Spent leach solutions are often sent to a storage pond. This leach solution can contain significant amounts of product metals that can easily be recovered using NF membranes. Additionally, New Logic can offer acid resistant NF membranes to filter pregnant leach solutions so the Sulfuric Acid can be recycled and does not need to be neutralized or stored in acidic ponds.

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VSEP – Resonating in Modular Fashion

With modular design, the design principle subdivides a system into smaller parts which can be independently modified, replaced, or exchanged. VSEP systems use this design concept where the filter modules have a single dimension and component slotability

A modular system design has no distinct lifetime and exhibits flexibility. Modularity is best defined by the dimensions effected or the degrees of freedom in form, cost, or operation. Modularity offers benefits such as reduction in cost, interoperability, shorter learning time, flexibility in design layout, easy expansion.

Most system designers are poorly trained in systems analysis and most process engineers are poorly trained in design. The design complexity of a modular system is significantly higher than a one-size platform system and requires experts in design and product strategy during the conception phase of system development. New Logic has been designing these modular systems now for 37 years. It can be difficult for engineers to leave the VSEP design alone and to focus on how it fits in an overall process. That phase must anticipate the directions and levels of flexibility necessary in the system to deliver the modular benefits. Modular systems could be viewed as more complete or holistic design whereas one-size platforms systems are more reductionist, limiting modularity to components. Complete or holistic modular design requires a much higher level of design skill and sophistication than the more common platform system.

The VSEP comes in many filter sizes and often a single module is enough for a project. But for many large flow rate projects, multiple 84" VSEP modules are used in parallel and in series to process the flow rate needed. Currently, our largest project installed has 42 VSEP modules in parallel to filter RO reject from a spiral system. New Logic is also currently negotiating an order for a 80 module system for a rare earth mine in Australia.

The benefits of the modular design with respect to VSEP include that the filters will decline in performance at different rates. So the replacement can be staggered and done one at a time as needed. It is also easy to exchange an entire module or to add more modules to the same system in the future.

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VSEP for Direct Lithium Extraction

Lithium can be found in hard rock ore, in clay deposits, or in brackish groundwater known as a brine. The Lithium found in aquifers is often found is regions where there is geothermal activity of ancient volcano expressions on the land. These areas can often be in very dry and remote areas where the aquifers are limited in size and scope.

Where these underground brines are harvested, the land footprint can be small and there can be many mining companies competing for the water rights to extract the necessary amount to make a project feasible. So, water rights are everything. Once the brine is pulled from the ground, it is left to sit in the large solar evaporation ponds. The process takes a year and a half where the brine is transferred to different ponds and left to evaporate. Different salts will precipitate at different times during the migration through the massive pond system. With little precipitation and a lot of sunlight, these mines rely on evaporation to get a more concentrated solution. That salty solution is eventually piped to a nearby processing and production facility, where it ends up as a white lithium powder.

A new process known as direct lithium extraction (DLE) is a closed-loop system whereby brine would be pumped from the aquifer, processed and put back in the ground. If successful, some industry observers hope the direct extraction process could speed up lithium processing using a smaller water footprint, with an estimated 80 percent of the water recycled back into the aquifer. This would speed up the processing time and would allow the mine to produce more product using less water and requiring less water rights

With the conventional evaporation pond method, the Lithium concentrations can be fairly dilute (~1200 mg/L or 0.12%) and must be evaporated so that the Lithium Chloride concentration reaches about 6%. This represents a 50x concentration. So vast amounts of water are evaporated to extract a relatively small volume of Lithium rich brine. With Direct Lithium Extraction (DLE), the product mineral can be extracted without removing all that water from the aquifer. Instead of evaporating the water, DLE separates the water and the product mineral so the water can be reinjected into the Aquifer. The current methods being considered for DLE include adsorption, ion exchange, solvent extraction, and membrane technology. Ion exchange and solvent extraction would require large amounts of acid and chemicals resulting in safety concerns and environmental risks as well. Adsorbents involve a complex process of regenerating.

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Membranes provide a pure molecular separation without the addition of chemicals. Nanofiltration can be used as a primary step to remove multivalent ions such as Magnesium. Then Reverse Osmosis membranes can be used to concentrate the Monovalent Lithium Chloride. VSEP offers a membrane solution for difficult brines that would normally scale conventional spiral RO membranes. The VSEP can actually work like a membrane crystallizer and can exceed solubility limits that would normally prevent the use of spiral membrane. With a VSEP membrane system, the brine water can be treated to extract the Lithium in minutes and the Lithium depleted water can be returned to the aquifer. There would be no need to wait a year and a half to get the Lithium. Additionally, the aquifer is not depleted and a healthy groundwater ecosystem can be maintained.

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