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VSEP Nutrient Recovery Study

The British Colombia Ministry of Agriculture recently funded a study on nutrient recovery technologies as it might apply to dairy farms in British Colombia. A Vancouver company named Hållbar Consulting was hired to conduct the study.

The focus of the study was only on the recovery of the nutrients Nitrogen and Phosphorous and to compare the costs of recovery technologies as it compares to the value of the recovered nutrients. There was no analysis of effluent treatment, treated water quality, effluent discharge, or other similar issues. The study did report that because the take up of Nitrogen would be higher than Phosphorous in crops grown on land where manure is applied and that this can lead to over-fertilization of Phosphorous.

All of the studied technologies can recover nutrients, but have different effluent treatment capabilities. The study covered nutrient recovery from raw manure and digested dairy cow manure and all the technologies studied were sized for the same size dairy. The following is a description of the technologies studied:

1] Three different centrifuges were studied that produce about 25% dry matter solids. The Capex ranged from $100k to $300k. The liquid fraction would still need to be land applied and could not meet surface water discharge requirements.

2] A company called LWR from Alberta Canada supplies a treatment system that incorporates extensive pre-treatment prior to feeding the effluent to a spiral RO membrane. The pre-treatment includes coarse solids removal followed by polymer flocculants followed by media filtration such as a sand filter. Even with pre-treatment, the spiral elements are probably replaced very frequently. Capex is shown as $500k.

3] McLanahan provides a system using pre-treatment plus Microfiltration to capture suspended solids followed by an ammonia air stripper. Capex is $500k

4] New Logic's VSEP is included and they show a Capex of $320k.

5] Dorset Green Machines (DGM) supplies a belt dryer. The Capex is $300k. If waste heat is available the operating cost is low, but it is unlikely that many dairies have extra waste heat. Without waste heat, the operating costs would be high.

6] AL2 of Denmark supplies a belt filter press that uses polymers to capture suspended solids. Capex is $280,000.

7] DVO and Trident supply a flocculent aided DAF unit. Capex is $210k and $550k respectively.

8] Multiform Harvest supplies a fluidized bed reactor that precipitates Struvite (Magnesium Ammonium Phosphate). Capex is $175k

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9] The University of British Colombia has developed a microwave enhanced oxidation that is intended to precipitate Struvite. Capex is $300k

10] Regenis supplies a conventional Ammonia Stripper. Capex is $100k

	Estimated Operating Cost
Alpha Laval Centrifuge	$0.41/cow/day
DariTech Centrifuge	$0.41/cow/day
GEA Centrifuge	$0.37/cow/day
LWR Pre-Treatment + Spiral RO	$0.35/cow/day
McLanahan Pre-Treatment + UF	$0.43/cow/day
NLR VSEP	**$0.27/cow/day**
DGM Belt Dryer	$0.20/cow/day*
AL2 Belt Press + Flocculants	$0.33/cow/day
DVO DAF + Polymer	$0.31/cow/day
Trident DAF + Polymer	$0.67/cow/day
Multiform Struvite Crystallization	$0.29/cow/day
Victor Lo Microwave Oxidation	$0.68/cow/day
Regenis Ammonia Stripper	$0.45 cow/day
*Operating cost if waste heat is available	

All of the technologies studied harvest nutrients from manure, but only RO membrane technologies can capture all of the nutrients for recovery and make clean water that can be reused of discharged. It is interesting that VSEP can produce a far cleaner treated water and provide a complete treatment solution and yet the study concludes that the operating costs are less than the other technologies studied that only provide a partial solution. This study is found here:

https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/agriculture-and-seafood/agricultural-land-and-environment/waste-management/manure-management/evaluation_of_nrt_dairy_manure_digestate.pdf

Tradeshow Spotlight: Thai Water Expo

The Thai water festival, Songkran, is about cleaning, purification, and having a fresh start. It starts on April 13th and lasts for three days. It is an annual event marking the start of the traditional Thai new year. Houses are cleaned; Buddha statues are carried through the streets in a procession to be washed with flower-scented water. Elders are honored by respectfully pouring water over their hands.

Although the true Songkran tradition is to sprinkle water on people, travelers and locals alike don water cannons and buckets to take the "blessings" to another level! Dousing or sprinkling people with water signifies the washing away of bad thoughts and actions. It brings them good luck in the new year. Sometimes firehoses are used to *really* spread the good blessings!

Clean water is a symbol of renewal and vitality around the world. This year, New Logic's new representative in Thailand promoted the VSEP clean water technology at the biennial Thai Water Expo held at the beginning of June. Encotech's booth featured a Series B VSEP filtering colored water and attendees could not pass up the opportunity to watch the vibrating membrane in action.

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The event organizers suggested that there would be 500 exhibitors and up to 27,000 visitors from throughout Southeast Asia and 45 countries. Encotech's director, Terdsak W., met with many visitors with an interest in the new VSEP option for treating water. Potential projects are now being explored and discussed.

Get to Know New Logic – Trevor Crabtrey

Each month we will feature one of our excellent VSEP engineers. The quality of our people is really the reason for our durability and success for now 32 years. Our engineer of the month this time is Trevor Crabtrey. Trevor has been with New Logic for more than 16 years.

Trevor graduated from the University of California at Davis in September 2002 with a BS in Chemical Engineering and Managerial Economics. Trevor then applied for a Chem E position at New Logic and has been working for us ever since. During High School, Trevor worked for his Dad's company as a machine operator of industrial steam cleaning equipment. Trevor also worked his way through college at the local Ace Hardware store. Many people have never held a job until they graduate from college, but I was impressed that Trevor had worked from a young age and this contributed to his maturity and demonstrated his inherited work ethic. I was also impressed that he had achieved the rank of Eagle Scout in Boy Scouts. This is an accomplishment that I also have achieved and I know first-hand the amount of effort and the kind of commitment to a goal that this requires.

Trevor started in the usual way as a lab technician running bench tests for customers. He quickly moved through the ranks performing field pilots and then to installing and commissioning full-scale VSEP equipment. Trevor has traveled the world and installed several manure projects in Belgium and a gas plant effluent project in Kazakhstan. When it comes to miles flown, Trevor probably has more than any other VSEP engineer. I know he was working on one-million miles flown and he was close to that number.

Trevor is now the Senior VSEP Engineer and manages the engineering for us at our Nevada facility. Trevor has settled there with his beautiful wife and the two of them have recently welcomed an incredible baby girl who is now growing up fast. Trevor has saved the day on many occasions and is probably the best problem solver at New Logic. We appreciate his dedication and determination.

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Pilot Test – Raisin Wash Water

Sun-Maid Raisins in Kingsburg California pumps about 280 gallons per minute (64 m3/hr) of water from the ground to wash its raisin product prior to packaging. That volume of water is enough to fill Lake Tahoe three times per year. The central valley of California is one of the most productive agricultural areas in the world and huge amounts of water are used for irrigation and food processing. Depletion of the aquifer has been a concern and the ground level in the valley has actually been sinking in some areas due to the rapid rate of ground water pumping. Once the aquifer shrinks in size, the holding volume is reduced and cannot be recovered

The company has been operating at this location since 1912 and currently produces about 100,000 tons of raisins per year. This is about half the raisins produced in the United States. Only the country of Turkey produces more raisins. Other countries producing large amounts of raisins include China, South Africa, Chile, and Argentina.

Sun-Maid operates its 100,000 square foot facility on 100 acres and uses 45 acres of this land as an irrigation field where they grow Sudan grass and winter wheat. At 280 gpm, they are applying about 8,000 gallons per acre as irrigation water. This field basically acts as a percolation pond. In the winter during the rainy season, there is standing water on the field. Berms have been built surrounding the field to prevent water from running off property.

The company has recently been facing a couple of issues. First, the well water is now coming out with more sand and because of the increased amount of suspended solids, the wash tanks are now dumped every hour increasing the rate of water consumption.

The wash water contains about 5,000 mg/L of Biological Oxygen Demand (BOD) and about 50 mg/L of Nitrogen. Application of too much BOD can alter the oxygen transfer rate in the soil. It can also lead to formation of an organic film in the soil the reduces soil permeability. Down-gradient water wells have shown increases in conductivity and alkalinity. Local residents with water wells naturally will assume that Sun-Maid is to blame for any changes or issues with their well water. Even though the facility is located in what used to be a rural farming area, population increases around Fresno and moved more residential housing closer to their facility.

The well water pumped and the effluent discharged is free to the company except for the cost of pumping. So there is really no economic justification for recycling water or conserving water. But because of the issues above, Sun-Maid expressed interest in recycling its wash water to reduce the raw water consumed and the volume of effluent that is land applied.

Many 2000-gallon wash tanks are used to process the raisins after sun-drying. The wash water is currently dumped about once per hour. If this tank time could

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be extended to two hours, the water consumption rate would be cut in half. Due to the high solids and organic materials, conventional membranes were not considered and Sun-maid contacted New Logic to see about the feasibility of VSEP to treat this water. They proposed to treat roughly half the water volume used per day, or about 140 gpm. So New Logic designed a test procedure to study the use of VSEP using Ultrafiltration (UF) membranes to remove sediment from the wash water.

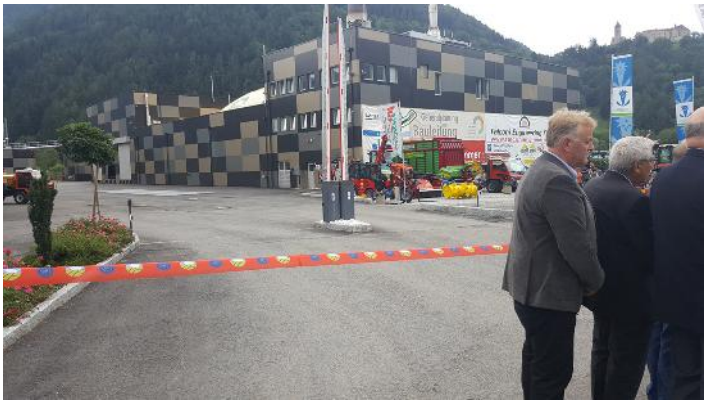
New Logic tested four different UF membranes and selected a Teflon membrane with a pore size of 0.05 microns. Pre-screening was done to remove larger sand particles. To extend the wash tank retention time, it was only necessary to remove sediment and turbidity. The Teflon membrane was very effective at this.

The VSEP pilot test unit with Teflon membrane installed was able to achieve a 43 gfd (73 LMH) flux rate and operated at 99% recovery operating at about 75 psi (5.2 Bar). Even at the end of the concentration study after a 100x concentration, the flux rate was still at 26 gfd (44 LMH). Cleaning with a standard alkaline surfactant cleaner restored the flux rate to like-new.

New Rep Spotlight: OB Impianti

Three years ago, New Logic began its distributor relationship with a fine engineering company named OB Impianti. OB has a lot in common with New Logic and was started 30 years ago and is owned by two bothers, Ivano and Sandro Brunelli. The company is located in Orzinuovi in the province of Brescia in Northern Italy. The brothers have been very successful in building a strong company in a tough industry. They have developed a wide range of products for several different markets giving them diversity and the ability to survive the ups and downs of economic cycles.

OB has an excellent engineering staff and can provide individual components or provide complete turn-key installed projects. They have a fabrication shop with a skilled crew of craftsman. They are experienced in many kinds of water and wastewater treatment systems including membranes.



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Their chief engineer is Ms. Elena Bonadei. Elena was born and raised in a small village in the Italian Alps. Mountain people are self-reliant and creative. And Elena has brought these natural abilities to the engineering trade. She is one of the most skilled engineers I have known in my long career. She speaks six languages.

Sandro Brunelli, Greg Johnson, Elena Bonadei

One of the unique things that OB does is to install drinking water systems in remote poor communities around the world. It is truly stunning how many people in the world don't have safe drinking water and the deaths that occur from this are saddening and completely preventable. OB works with government and non-government organizations that fund these projects, and then OB takes them on to provide turn-key solutions for these desperate communities. What is incredible is that Elena not only oversees the engineering for OB, but she has personally installed drinking water systems all over the world including in South Africa, Angola, Peru, Cape Verde, Libya, and Lebanon. She told me once that when she goes to these remote locations, she need to pack everything possible that she could need including food. The world is a better place because of her efforts.

About three years ago, OB decided to add VSEP to their line of products. They have incorporated VSEP into a treatment process for Biogas Effluent that they call "Slurless" and for a landfill leachate treatment process that they call "Leachless" Beginning with a pilot machine three years ago, they have already installed and commissioned two biogas effluent projects with VSEP in Italy. One of these is the Wipptal project in South Tirol near the Northern Border. This project is owned by a cooperative of dairy farmers where the manure is brought and digested to generate biogas. VSEP is used to treat the digestate for discharge.

OB has completed two successful VSEP projects and has many more projects in the pipeline. We thank them for their efforts and appreciate the opportunity to work with such a fine company.

First VSEP Project Installed by OB

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New Case Study: Phosphoric Acid Filtration

New Logic has just put a new case study on our website for the Nanofiltration of Phosphoric Acid. Nanofiltration (NF) membranes are made in the same way as Reverse Osmosis (RO) membranes where a thin layer of Polyamide material is used as a top layer. NF membranes are often referred to as loose RO membranes and will allow more salt passage. However, the increased salt passage mostly applies to monovalent salts or very low molecular weight dissolved solids. Phosphoric Acid has a molecular weight of about 94 Daltons. NF membranes typical are sized to have rejection capabilities of between 150 and 800 Daltons. Ionic charge is also a factor in the rejection. So NF membranes will have good rejection for Divalent and Trivalent ions, especially metals and hardness.

New Logic has deployed its VSEP technology many times to study the performance during filtration of Phosphoric Acid. Each case has had different objectives. In one case, the desire was to remove organics (TOC) as an alternative to calcination.

	500 da NF Rejection	250 da NF Rejection
Aluminum	77%	93%
Calcium	33%	60%
Cadmium	42%	82%
Chromium	70%	87%
Magnesium	74%	93%
Manganese	68%	91%
Nickel	58%	78%
Phosphoric Acid	0%	2%
Vanadium	63%	80%
Uranium	45%	65%
Zinc	47%	83%

In other cases, the desire was to remove heavy metals and toxins to improve the quality of fertilizer products. Another possible use is to remove Uranium and concentrate it to the point where recovery using selective ion exchange can be a method of Uranium recovery and production.

Multiple passes through the same NF membrane may results in additional reductions. However, the use of membranes cannot reach the purity level required for food grade. NF membranes can be used though to increase the purity of lower grade acids and can make the mining of poor phosphate deposits more economical. Some ore deposits may not even be suitable for processing as the lowest grade Phosphoric Acid due to impurities. However, with NF filtration, these deposits can be processed.

Asian Market Update

The Charoen Pokphand Group, or CP Group is Thailand's largest private company and is one of the world's largest conglomerates. They operate in agribusiness, food, and retail operations as well as Telecom business with investments in 30 countries and employ 300,000 people.

The company is a true success story and example of what hard work can do. Two brothers, Chia Ek Chor and Chia Siew Whooy started a small seed company in Bangkok during the reign of King Rama VI. At the beginning, the brothers were virtually penniless. Growth in the early days was difficult and hard-fought.

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In 1969, the company had turnover of only $2M USD. Today, the company has turnover of $120 Billion USD. When China opened up its economy in 1978, the CP Group was the very first foreign investor in the country. Today, the company is the single largest investor in Mainland China and controls one-fifth of the entire food market. Their corporate registration number was "0001". The company operates many subsidiary companies in China. One of these is Chia Tai Group Agro-Industry and Food Business. New Logic's market managers for Asia, Edwin Wong and his assistant "Sky" Zhang Bing, recently attended a meeting hosted by Mr. Bai Yu Fei, the Senior Vice Chairman of the CP Group's China division. Mr. Bai Yu Fei summoned about 20 people from the organization heading up the swine and poultry operations in China for the VSEP orientation.

During the meeting, Sky presented VSEP and explained in detail as to how the vibration and the shear forces from the vibration prevents clogging of the RO membranes while the system separates solids from the waste stream. VSEP is a 100% physical technology to do liquid separation. All these concepts were quickly learned and accepted by the audience.

Attributed to the fact that the owner of the CP Group in Thailand has long been advocating advanced technology as the means to achieve productivity and operational efficiency that would eventually benefit the company in terms of positive corporate image and profitability while at the same time benefiting the Country and the Society where CP operates, the senior management of CP China, represented by Mr. Bai Fei Yu, was very receptive to VSEP. A dinner was hosted in the evening by Mr. Bai with heads of CP swine operations from different provenances. It is interesting to note, these important operational people are all accountable to their own bottom line and operational efficiencies. These young men are at their 40s at most and each and every one of them have worked for more than 20 years with the CP Group as their first job out from school. Their devotion and commitment to their duties is the foundation of CP's success. They work and live in the farm for a prolonged period (2 months at a stretch). CP management provides them very clean and comfortable home at the farm which is very crucial to keeping the stuff of excellence, and to achieve operational excellences, CP Group is now proceeding to look at possible locations for VSEP installations to treat swine manure

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.

www.vsep.com
info@vsep.com

Headquarters
2567 Business Parkway
Minden, NV 89423
775-783-7600

California Office
5040-A Commercial Circle
Concord, CA 94520
510-655-7305

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