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Making more with less

Being open to new technologies and innovations can help ethanol plants to meet their sustainability goals and operate efficiently and effectively. A number of companies, including US bioethanol producer Pacific Ethanol, are using Whitefox Technologies' membrane solution to achieve their sustainability targets. Whitefox is a technology engineering company and it focuses on membrane technology. The company's main market is ethanol – including industrial applications, pharmaceutical and biofuels. It develops solutions to reduce the waste and environmental impact of production processes, helping its customers to reduce bottlenecks and increase efficiency.

During the traditional ethanol production process, millions of gallons of finished, dehydrated ethanol is flushed back through the process from which it just emerged, moving back one whole step. Producers do this because the traditional dehydration process (molecular sieves) for their post-distillation water/ethanol mix requires it. In layman's terms, the molecular sieves act like giant sponges (mainly via zeolite beads) which adsorb the water after distillation to get to final product specification (200 proof). The beads get saturated, so ethanol that could have been sold is sent back through the molecular sieve to suck out the water from the beads, but then it becomes water rich and that ethanol has to be recycled back through distillation, in what becomes a large recycle loop. This loop can be 20-30% of the entire plant's capacity.

All in all, you end up with a stream that is around 60% alcohol that goes back to the distillation column and gets distilled again.

In contrast, with Whitefox's solution you run it through a membrane instead of it going back to the column. Whitefox's integrated cartridge efficiency (ICE) technology requires no regeneration cycle, by virtue of its design and the specific attributes of its unique membrane. The technology relies on a collection of thousands of tiny tubes made entirely of a hydrophilic membrane. As a mix of ethanol and water pass through these tubes, water is absorbed into the wall of the membrane and a slight vacuum pulls the water through in a continuous separation process. The ethanol in the mix is retained in the membrane tube and exits as an extremely dry ethanol.

Here, *Liz Gyekye* catches up with the two companies using this innovative solution.

First up is Pacific Ethanol – a leading producer and marketer of low-carbon renewable fuels.

Neil Koehler, founder, director and CEO of Pacific Ethanol, found time to explain how Whitefox's technology helped his company.

Neil Koehler, founder, director and CEO of Pacific Ethanol

Tell me a bit about your background?

I have been working in the ethanol business since I graduated from college in the early 1980s. I co-founded an ethanol business called Parallel Products in the mid-1980s, which sells ethanol and feed products. In fact, it was California's first ethanol production company. That was a niche business taking residual materials from the food and beverage industry. We sold the business in 1998. I then started a marketing company called Kinergy Marketing – an ethanol sales and distribution firm.

During that period, California went from using no ethanol to 10% ethanol (E10) very quickly and Kinergy was able to grow with this market. I was there with Kinergy to form relationships with the Midwest producers and expand the markets outside the Midwest. Essentially, that really was the genesis to Pacific Ethanol. In 2003, we said "hey, we have this huge market out West and all the production in the Midwest, so, the manufacturing should migrate to where the markets are". It wasn't just the ethanol we looked at, but the feed. Corn was already grown here in California but most of it was coming from the Midwest to supply the largest dairy shed in the world, which is based in the Central Valley of California. So, we said "cattle and cars" those are our markets, let's build an ethanol plant here. At that time, we were the first US company to build multiple ethanol plants outside the Midwest and others have now emulated that. It is still a Midwest dominated industry but it has been valuable for us to be local to our markets. It has also given us a low-carbon based operation. We don't dry any of our feed, since it's all for local distribution.

We have some of the lowest carbon-scored product in the country. That is where Whitefox has come in and been helpful. It has not only given our plant more efficiency but reduced our energy use which has reduced our carbon score even further.

Pacific Ethanol owns nine ethanol production facilities, four in the Western states of California, Oregon and Idaho, and five in the Midwestern states of Illinois and Nebraska. The plants have a combined production capacity of 605 million gallons per year, produce over 1.5 million tons per year of ethanol co-products such as wet and dry distiller grains, wet and dry corn gluten feed, condensed distillers solubles (CDS), corn gluten meal, corn germ, corn oil, distillers yeast and CO_2.

Why did you decide to employ Whitefox's technology in 2016?

I met Gillian (CEO of Whitefox) in Budapest three years ago and was intrigued by the technology. As a company we have always been innovative. We have always focused on reducing cost and reducing our carbon intensity. To find a technology that does both means we hit a home run. It is elegant and it makes sense. We also look at chemical treatments that improve yield. If you do this, you get a lower carbon score. Whitefox's technology fit the bill.

It did take a while to install. We needed to do a commercial demonstration (2015) with the technology and at the time it showed that it helped to reduce our energy costs.

Now, we have created a more stable environment for our distillation columns because we have taken a load off the molecular sieves, which means there is less recycling and this creates more stability in the distillation system overall. By taking a load off of the columns our cooling capacity has improved. This is very critical in the hot summer months in California, where you typically take a hit on capacity when it gets super-hot. This is because you can't keep up with the cooling requirements, which is fairly typical in the ethanol industry. Short of putting in new cooling towers, this has helped resolve that situation.

We have moved from the commercial demonstration to operating it and we are extremely happy with the results.

We are still fine tuning the process, but we are very confident of a minimum 5% reduction in our overall steam cost. We buy natural gas to produce steam. It doesn't impact the electrical so much. However, as we get more capacity out it marginally helps because you are getting more output with essentially the same electricity running the pumps and motors.

The 5% reduction contributes to our objective to continue to lower our carbon score over time. We will be able to monetise that score in the future. We are preparing now to submit for a new score based on this and other changes. A 5% natural gas reduction lowers our carbon score by about a point. In today's market, that's about eight tenths of a cent/gallon of premium value. On a 40m gallon plant that would be worth $320,000 a year. Together with natural gas savings our bottom line improves by over half-a-million dollars per year before considering the economics of additional capacity.

'This technology has helped with a half-a-million dollar advantage to the bottom line (between cost savings and carbon benefit)'

Neil Koehler, founder, director and CEO of Pacific Ethanol

California is leading the way on sustainability in the US. It has introduced the LCFS. Does this pave the way for these sorts of developments?

100%. If gasoline has a carbon score of 110, we are at 65/70 with ethanol. There are a number of ways credits are generated, but ethanol has generated around half of those credits to date. It's been the workhorse of the programme. As the programme gets more stringent and the reductions that are called for get greater, then the ethanol industry can continue to make a significant contribution. We are not sitting still – California is making inroads on its GHG emission reductions. We need to continue to employ technologies like Whitefox as they help drive our score down.

We are working with the state of California to implement higher level blends. In California we are capped at 10%, but if we could be 20-30% of the blend that low carbon product will go further and generate more carbon credits.

Has this technology helped your profitability?
Yes. You have to consider that you are able to run a bit more capacity and this technology has helped with a half-a-million dollar advantage to the bottom line (between cost savings and carbon benefit).

What other challenges do you face apart from environmental concerns?
Market access. The oil companies control the market and the distribution of liquid fuels including the ethanol blended into gasoline. They are not particularly interested in yielding more market share to the ethanol industry, especially beyond 10% blends.

We have the renewable fuel standard (RFS) at the federal level, which is intended to expand the market for renewable fuels. However, the US EPA has not taken an aggressive approach on this. Frankly, we feel that they have not been following the law and this was affirmed by the Federal Court of Appeals in a recent decision. So, there is a great opportunity here to get the RFS back on track to push the market access for more renewable fuels.

Bioethanol should have more than a 10% blend share. We do have retailers rolling out E15. It's starting to take hold, but it has been slow going because you have a major oil dominated market that is very resistant to that additional market share for something they do not control.

How do you see the rest of the year panning out?
We are optimistic. It was a rough start to the year for the ethanol industry. Incremental expansions and technologies like Whitefox have helped the industry to reduce bottlenecks and increase capacity. We have increased our capacity as an industry to over 16bn gallons.

We are producing more than the 10% blend rate is absorbing but exports have been growing to maintain a reasonable supply demand balance. The last few weeks have been a better margin environment. We need a level of discipline in keeping that supply and demand balance. We are confident the last half of 2017 will be stronger than the first half.

Brüggemann Group's Peter Tippelt

Peter Tippelt, production manager for ethanol for the Quality and Environmental Management Systems at the Brüggemann Group, also found time to explain how Whitefox's technology has helped his company.

Tell me about Brüggemann Alcohol and what you do?
Brüggemann is a small-to-mid-sized company and we have 180 employees. We were founded in 1868 and we will be celebrating our 150-year anniversary next year. The business started out specialising in ethanol and focused on chemicals later. Our business is based on three pillars: industrial chemicals, plastic additives and ethanol. In the field of industrial chemicals, we trade worldwide. In relation to this, we specialise in reducing agents for the textile industry and for polymers. These are not products you can buy in a store. We buy agricultural-based ethanol from the sugar industry or the starch industry. We buy this, rectify it and dehydrate it. Subsequently, we sell it mainly to the pharmaceutical markets.

We produce 20 million litres of ethanol per year. The dehydration process produces 12 million litres.

Tell me about the specific technology that Whitefox has provided you and how this has benefitted you?
We use a capillary membrane system from Whitefox, which is a very simple technology. Essentially, you only need an evaporator, some modules, a vacuum unit, a few pumps, and heat exchangers. This gives you simple control of your plant. You don't need a lot of personnel to supervise it and it runs really smoothly. As long as you provide stable steam and cooling water you have a stable plant and controls.

Maintenance is confined to the mechanical part of the plant (pumps, heat exchangers) and little maintenance is required on the modules.

The first Whitefox membrane installation we installed was back in 2002. The second installation of a membrane plant at Brüggemann was in 2006 with a new generation of modules. The durability of the membranes is very good. They last a long time, about five years in our case. Two years ago, we installed new membranes which still have good performance.

The Whitefox technology can integrate well into ethanol plants. When you have a plant that produces 85-90% crude alcohol that is directly dehydrated, you do not have to rectify your crude up to 96.4% and then dehydrate it. You can use less energy to rectify the ethanol up to 85% and go directly to the membranes. This is a great benefit in terms of energy consumption. This is not possible with our system because we have to go up to 96.4% to have the pharmaceutical quality that we need and then dehydrate. However, if you don't need this pharmaceutical quality you can dehydrate a lower percentage of ethanol.

'We produce 20 million litres of ethanol per year'

Peter Tippelt, production manager for ethanol for the quality and environmental management systems at the Brüggemann Group

How different is this technology compared to what you were using before?
The previous technology we used was the same, but the membranes were completely different. Previously, we used the plate and frame technology. We had problems with its reliability; we often got holes in the membranes and had to change them frequently. We stopped using it after six years.

In regards to Whitefox's technology, it's a development. We started in 2002 and advanced it further and further together with Whitefox. Since then, we have been very successful in developing it.

How can new technologies help producers improve their sustainability footprint and profitability?
In terms of the dehydration process with the membrane system from Whitefox, the main feature is the selectivity of the membranes for better yields. The more products you can get out of your feed, the better your profitability and the less energy consumption you have.

What is your vision for the future – particularly in relation to the technologies you are using?
At the moment, we are not planning to invest in more ethanol plants. In addition to our plants, we hope to go into the recycling business in relation to recycling used ethanol. The product from this system will be azeotropic ethanol (ethanol with 96.4 volume%). ●

whitefox

Produce More. Waste Less.

For more than a decade Whitefox engineers have worked with producers to improve ethanol production.

Whitefox ICE™ is a bolt-on solution to debottleneck distillation and dehydration, allowing producers to increase output and reduce energy, emissions & cooling water.

Together, making more from less.

Whitefox ICE™ – transforming ethanol plants

Whitefox is speaking at Biofuels International 2017

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