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A Quarterly eBulletin from the people who bring you the Innovations in New Product Development and Marketing Executive MindXchanges

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Reducing Energy Costs: Vision for the Future

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The price of crude oil has reached stratospheric levels, crossing $145 a barrel early in July. Such record high oil prices have reignited interest in alternative, clean and renewable sources of energy as well as in new technologies that allow industrial process to be more energy efficient. One of the pioneers in this area is the Quebec, Canada-based Vaperma Inc., which has developed a breakthrough polymer membrane technology that drastically reduces the energy costs and the carbon footprint for a wide variety of industrial processes. Although it has broad potential for application, currently this innovative technology is targeted primarily for dewatering fuel ethanol where it offers a potential energy savings of as much as 40% compared to conventional techniques.

On June 11th, 2008, Girish Solanki from the Technical Insights division of Frost & Sullivan sat down with Dr. Christian Roy, VP of Business Development at Vaperma Inc. to talk about his company's recognition with Frost & Sullivan's Award for Technology Innovation, its priorities, and its vision for the market in view of current trends.

Vaperma has been recognized for the development and manufacture of breakthrough polymer membrane technology designed to reduce the energy costs and carbon footprint for industrial processes. What was the origin of the research that led to your advanced membrane-based technology, Siftek™, for the highly selective separation of water from gas mixtures?

Dr. Roy: The idea was born in the early 1990's, around 1991. I was then a professor of chemical engineering at the Université Laval in Quebec City and was working on the vacuum pyrolysis of biomass, which is the thermal decomposition of biomass in the absence of air. We were looking at the pyroligneous aqueous phase treatment in the gas phase instead of the liquid phase, and wanted to develop a way to segregate water from the tens and tens of harsh oxygenated chemicals present in the vapor phase, chemicals such as acetic acid, phenolic compounds and alcohols. My doctoral student Richard Cranford, who later co-founded Vaperma with me, picked-up on the idea I had proposed. Through collaboration with Prof. Takeshi Matsuura at the University of Ottawa, the concept of water separation in the vapor phase was born. The project was developed in a stepwise approach. So really the basic work took place over a period of several years since the 1990's before Vaperma was founded in 2003 and the product was rolled out.

Where was Vaperma's Siftek™ technology validated?

Dr. Roy: In terms of technology validation, we tested the proof of concept in-house from 2003 to 2005. We started out with flow rates of 0.5 kg/h (~1 lb/h) and gradually went up to 5 kg/h onto 50 kg/h. Then in 2006-07 time frame we launched field testing with a pilot installation at Greenfield Ethanol Inc. (GFE) Tiverton facility, which is close to London, Ontario.

What is Vaperma's current market focus? And, plans for future markets?

Dr. Roy: Right now our focus is on ethanol dewatering and dehydration. There are opportunities as well for plant molecular sieve unit (MSU) retrofitting and ethanol plant expansion. Then are international opportunities particularly in Brazil with brand new plants. Another priority area for Vaperma is methane recapture and the elimination of volatile organic compounds (VOCs) and green house gas (GHG) emissions at natural gas glycol dehydrator sites. Finally, another market opportunity is for water- bearing chemicals such as methanol, isopropyl alcohol (IPA) and ethyl acetate.

What is the current commercial status of Vaperma's proprietary membrane-based Siftek™ module?

Dr. Roy: Industrial demonstration of Vaperma's technology is going to be accomplished at GFE Chatham plant in Ontario, where a world class SiftekTM membrane system with a capacity of 2 MGal/year (20 000 L/day) has been installed. Project commissioning has been officially announced on June 18th at the 2008-Fuel Ethanol Workshop

(FEW-08) in Nashville, Tennessee.

In Brazil, where are just launching a partnership with Dedini Industrias de Base, a leading technology provider and constructor in the country. Vaperma and Dedini will make an official announcement of their common objectives at the Sixth Simtec-08 Exhibition in Piracicaba/SP in July. Industrial demonstration of the technology in Brazil will be achieved later this year. In the near future, we expect commercial contracts in US, Brazil and France.

I will also mention that we already have an installed Siftek membrane module manufacturing facility in Quebec City. These modules can also be employed for other applications such as natural gas projects.

What are the main advantages of using the Siftek™ process over traditional distillation and molecular sieves that are used to dewater ethanol.

Dr. Roy: First and foremost, the Siftek process provides significant energy savings – 35-50% - at both the distillation and MSU sections of the plant. And because the process is energy efficient, it consumes less fossil fuel, produces less GHG, and has a low carbon footprint. It has no liquid waste stream and water can be recycled to the front end of the plant. It entails smooth, continuous feed treatment; furthermore, it is easy to add more modules in parallel to enhance capacity. In sum it features greater flexibility and easier scale up.

Many of the features can be related back to the properties of the membrane material itself- i.e. polyimides- that is chemically stable and provides high temperature resistance. It can withstand a wide range of process conditions in terms of water content, temperature and pressure of feedstock. Finally, as a result of all the above, the process is capital cost competitive and entails low maintenance costs.

Historically membrane technologies have had some challenges due to membrane stability. What do you see are the challenges facing users of Siftek™ technology?

Dr. Roy: First, polyimide membranes are known to be more chemically resistant than other types of polymers. As a result, SiftekTM PI membranes have a lifespan of at least 3 years, a distinct advantage over other brands of polymeric membranes. To us, the main challenge is in terms of the adoption of a novel technology by a relatively conservative end user sector. It is getting users to understand the value proposition and embrace new technology. In that respect Vaperma is well placed because unlike others it is not simply a module manufacturer but rather a technology provider in its own area, i.e. ethanol dehydration. Our engineers talk with the best experts in the field to support their R&D. And we have very strong R&D and engineering teams with approximately 30 chemical and mechanical engineers, which is very highly regarded by the user sector. All this has helped us so far in achieving major milestones, for example the alliance with Dedini in Brazil and the GFE Canadian rollout.

What are the requirements for an ethanol producer to incorporate the Siftek™ process in the production of fuel-grade ethanol?

Dr. Roy: We will have a good fit with clients who wish to expand their plants. For instance this can be ethanol dehydration or even debottlenecking of beer columns. Siftek technology can permit simultaneous capital and operating expense (CAPEX and OPEX) savings especially when compared to alternate solutions.

Siftek technology can also be employed in Greenfield plants. This is particularly relevant to the US as lower OPEX is a must with increasing price of oil. On the other hand, in countries such as Brazil thermal energy savings are less of an issue as bagasse is readily and cheaply available. Over there the value proposition is converting energy savings (steam) into more electricity sold to the grid, which can generate additional revenue for the producer (for example, 4 MWe of electricity sold to the grid for a 500 m3/day plant).

In Europe the focus traditionally has been on low CAPEX solutions although increasingly OPEX is getting into the picture too. In addition, higher levels of EtOH purity are necessitated in Europe and Siftek is well suited to cope with such higher specification requirements, that is, a maximum of 1500 ppm of residual water in the end-product.

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How do you see the market demand for Vaperma's technology developing in the next couple of years? In the long term, say in ten years or more?

Dr. Roy: Within the short term, say the next two to three years, our target is to generate revenues of approximately C$25-30 million. In the longer term, we see about 200 new EtOH plants being constructed. Vaperma would like to capture 50% of that market, and generate C$ 75-100 million annually.

In the natural gas sector, the potential is even larger. Here Vaperma's technology could potentially have a major impact in terms of improved (existing) process sustainability and carbon footprint. We see a market of about C$400 million per year over the next decade if we were able to equip all existing glycol dehydrator units with Siftek systems. Finally, we foresee applications of our membranes for the dehydration of industrial solvents and chemicals such as ethyl acetate, methanol, IPA, acetone and a few others.