SPRING 2010

Alberta Biodiesel Association

"Advancing Biodiesel"

Quality fuel = Improved air quality

- Gemini Corporation thermal hydrolysis
- Milligan bio-diesel optimization plant
- Fame Biorefinery Airdrie pilot plant

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President's Message

The two big Alberta biofuels news items for 2010 hit the front page on March 24th with the provincial **Renewable Fuel Standard** and the extension of the 2006 **Biofuels Producers Credit Program** through to 2016. The government of Alberta has made a very significant commitment to biofuels and bioenergy and should be lauded for staying the course in a challenging economy. The RFS start date has been moved to April 1, 2011 and will require 2% average renewable content in diesel and 5% average renewable content in gasoline sold in Alberta. This will provide a domestic market opportunity for existing and prospective producers, but they will be competing with producers outside the province and internationally.

The producers credit extension will assist Alberta projects' competitiveness with imports, and will top up a federal credit for those who qualify. But plants still need to be built, and markets found, to tap these credits, and the state of global financial markets continues to be challenging for renewable fuel projects. Alberta's producers will have to continually improve their efficiency, while working within stringent fuel quality specifications.

Despite this, the longterm trend toward a higher pricetag on greenhouse gas emissions helps make biofuels increasingly relevant in a 'low carbon' future. The economic development impact of biofuels for agricultural producers only adds to the compelling reason to continue investments in biofuels, whether from conventional or advanced feedstocks.

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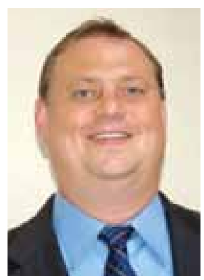

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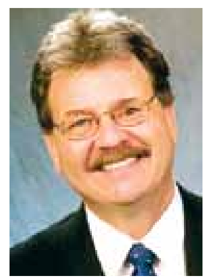

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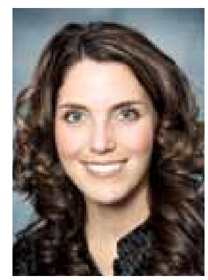

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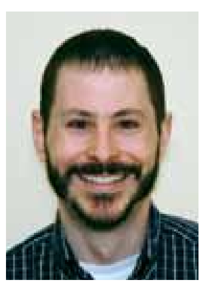

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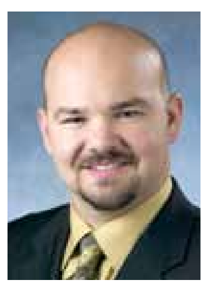

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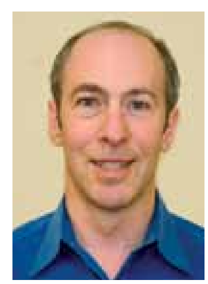

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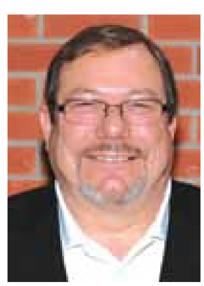

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FAME BIOREFINERY CORP.

Fame Biorefinery Corp. has commissioned its 1 million litre per year biorefinery pilot plant near Airdrie, Alberta, and is conducting test runs on a wide variety of distressed oilseeds. Fame has confirmed the plant's ability to produce ASTM D6751 quality biodiesel from heated canola seed, and is using its test run data to establish Western Canada's first regional biorefinery, which is scheduled to begin commercial production in fall 2011 with a nameplate capacity of 6 million litres per year. Fame has secured the Canadian technology rights to its core process technologies, including the Ageratec processor imported from Sweden for use in Fame's pilot plant (shown in attached photo). Fame's biodiesel production process uses no water, and produces no effluent, making it ideal for regional biodiesel production. For more information, contact Keith Jones at kjones@famebiorefinery.com" ❑

BIOFUEL PRODUCTION UTILIZING HIGH TEMPERATURE, HIGH PRESSURE THERMAL HYDROLYSIS

by Dr. Rod Facey

Gemini Corporation seeks to employ high-temperature, high-pressure thermal hydrolysis technology for Specified Risk Material (SRM) disposal and as a pre-conditioning technology in biofuel manufacturing. Those feedstocks that are of particular interest are biomass materials and animal by-products. In case of biomass, Gemini Corporation is internally evaluating thermal hydrolysis as a pre-conditioning technology to breakdown difficult to process biomass materials to facilitate conversion and recovery of the material's energy content. In the case of animal by-products, Gemini is currently developing for Alberta several biogas commercial facilities that will enable these facilities to broaden the degree of waste materials that they are able to accept and process, changing significantly to the positive the financial feasibility of these facilities. The technology has the ability to pre-condition animal by-products, regardless of its composition, for maximum biological conversion in anaerobic digestion for the production of biogas. In addition, the technology is designed to operate at temperatures and pressures suitable for infectivity reduction of category II diseases to reduce the risk estimate to negligible. Its ability to significantly reduce the risk of disease related to biohazard waste materials allows the treated by-products of the process to be disposed of or further utilized in the production of value added products without restriction and at minimal cost.

The advantages this technology has to offer on an industrial scale are several. Firstly, high-temperature, high-pressure thermal hydrolysis is recognized as an accepted risk reduction technology for the treatment of TSE diseases. Secondly, high-temperature, high-pressure thermal hydrolysis process design allows for a number of value-added benefits such as:

- Biofuel Production: The conversion of difficult to process biomass materials will enable these feedstocks to be considered further for biofuel production.
- Biorefined Nutrient Fractions: The high temperatures and pressures under which thermal hydrolysis occurs allows for the fractionation and separation of the organic components into value added end products following further purification (amino acids, fatty acids, organic nutrient fiber and fine solid nutrients, for example). These components can be recovered from the effluent singularly for further value-added organic manufacturing in addition to biogas production.
- Reduced GHG emissions: The material denatured by high-temperature, high-pressure thermal hydrolysis is retained and not combusted nor landfilled. A reduced amount of GHG emissions is produced in contrast to other recognized SRM technologies.

Gemini Corporation seeks to be a leader in the industry in the development of renewable technology engineered solutions with the focus to enhance system value to both the client and to the environment. ❑

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RETURNING TO BIODIESEL PROFITABILITY

Retrofitting biodiesel plants with the latest technology

Certain aspects of a biodiesel plant can be optimized to achieve higher yields and greater feedstock flexibility.

Increasing capacity
The design of a production facility is based on many parameters such as feedstock quality, reaction technology (coping with specific challenges like very high FFA feedstock) and the quality of the main and side-products.

To increase the capacity of a biodiesel plant the bottlenecks first need to be identified.

These can result from:

- Inadequate design of process and/or equipment
- Installation of low cost equipment
- Changing production parameters or operation modes
- Changing feedstock properties

- Problems in fulfilling the requested biodiesel standards and/or purchasing requirements.

Higher yields

The plant yield is defined as the ratio between the amount of biodiesel (within specification) produced and the feedstock input stream (both based on mass). The input stream includes all fatty materials (tri)glycerols and free fatty acids (FFAs) convertible into biodiesel.

Yield losses are crucial for plant economics. Just 1% less output causes losses of over $1.1M a year, based on 100,000 tons a year (30 million gallons a year capacity at a biodiesel selling price of $3.77 per gallon – including the tax credit).

Improving product quality

Recent changes in major biodiesel standards, such as ASTM D6751 and EN 14214, provide an added challenge for biodiesel producers.

These include a reduction of the phosphorous content to 4 ppm, the introduction of new parameters (cold soak test, filter blocking tendency) and meeting low sulfur levels using tallow as a feedstock.

"Big Oil" and the petroleum industry are demanding an even higher quality product to meet their blending obligations. For example, they are typically specifying a maximum content of monoglycerides (0.3% or even less) and a water content of less than 300 ppm.

By-products

Glycerine, the main byproduct from a biodiesel production facility, is often treated as a waste or as a low value byproduct but it can increase the profitability of a plant when it is upgraded to pharmaceutical grade for example.

Feedstock diversification

Producers can cut costs dramatically by using technology that can process lower cost feedstock such as waste cooking oil or tallow.

But the quality of the end product cannot be compromised. Alternative types of feedstock demand a completely different feedstock pre-treatment and methyl ester purification technology when compared to traditional vegetable oil based biodiesel plants.

Therefore knowledge of each individual alternative feedstock, as well as extensive experience about the interaction within the process – in particular the effects on trans-esterification, purification and side-product preparation units – is essential for a successful retrofit.

Reducing operating materials, energy consumption and waste

Choosing the right purification technology is crucial. Many water free methyl ester purification technologies have the disadvantage of very high operating costs combined with a high amount of solid waste. Water free purification may also reduce the biodiesel quality when using yellow grease or tallow.

Low value side products are often destroyed as waste, which incurs an extra cost. Upgrading these streams by extracting valuable components offers a double benefit: saving operating material consumption and avoiding waste. Therefore a modern process design will close operating loops by recycling methanol, FFAs (split soaps) and water.

Plant automation

Operating all the plant's devices in ideal conditions requires electronic support. Similarly to motor racing the perfect car, a powerful engine and the best driver have to be fine tuned to each other using mathematical models, simulations and telemetric systems.

Advanced process control (APC) is a model-based, second layer control and online process optimization system. Every minute it calculates the optimized settings for single devices to meet the final goal – quality biodiesel at the highest productivity level but the lowest cost.

Is it all worthwhile?

Retrofitting of an existing plant is only worthwhile if the limitations of the current operations are identified through a careful and detailed analysis. If deemed suitable a retrofit can take place in months, rather than years, leading to significant profit increases – a necessity in today's low margin, highly competitive biodiesel industry.

For more information:

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BIODIESEL WASHING TECHNIQUES – SMALL SCALE PRODUCTION

SAIT Polytechnic has been producing biodiesel since late 2008. This applied research project was developed to convert the culinary schools waste cooking oil into biodiesel to demonstrate campus sustainability. As demand for the quality biodiesel product grew, so have the various sources of used vegetable cooking oils. Due to the significant variety in waste cooking oil feedstock, various production techniques and process improvements have been investigated to help achieve an efficient and economical process which produces consistent high quality fuel.

One area of research has been into the purification of the biodiesel after the crude separation of glycerine. Glycerine is easily separated due to its immiscibility with biodiesel. The raw biodiesel after the reaction and separation is contaminated with methanol, catalyst, soaps, glycerine and water. Today the main ways to purify the biodiesel are either using water washing or dry washing techniques.

Water washing has been used traditionally in biodiesel production for decades. It's inexpensive and does a fantastic job in purification. The technical term for the unit operation being performed is liquid-liquid extraction. Water is mixed with the biodiesel dissolving all the previously listed impurities. After sufficient agitation the mixture is allowed to settle which forms two distinct layers, on top biodiesel and contaminated wash water on the bottom. This water can then be drained off leaving wet biodiesel. The biodiesel will then need to be dried using one of various drying techniques.

Even though water washing will achieve fantastic results there are some challenges to overcome. Firstly what is to be done with the waste water? If methanol recovery is not performed on the biodiesel (as it sometimes isn't in small scale production) the wash water will become a toxic methanol contaminated waste stream. The residual caustic will increase the pH of the waste water whilst the glycerine and soaps will increase the chemical and biological oxygen demand. Various treatment methods exist for treating the wash water, however for the small producer this will likely make the process uneconomical.

Another challenge water washing can create is the formation of emulsions. The remaining mono and di-glycerides have a polar and non-polar end which will form an attachment between the water, soap and biodiesel making a mayonnaise or chicken soup looking mess. Below is a picture of an emulsion.

Of course emulsions can be reduced by using highly converted fuel, gentle agitation, salt water, acidic water (has some implications), heat etc.

At SAIT Polytechnic we have recently moved away from water washing primarily to eliminate the formation of a contaminated waste water stream. In its place we have opted for using dry wash techniques. Dry washing is generally performed using an ion exchange media. However, it is not without its challenges which are summarized below.

Firstly the capital cost outlay for the equipment and especially ion exchange media can be expensive. Dry wash will increase the treatment cost per liter by approximately a cent or two. The methanol must also be removed/recovered before the biodiesel can be dry washed as the media will not reduce methanol content to the applicable ASTM flash point level.

Methanol acts like a co-solvent between biodiesel and other impurities in the crude biodiesel. By removing the methanol it allows these impurities to settle out of solution – which in turn prolongs resin life. Resin manufactures generally recommend soap concentration of less than 500 parts per million in order to fully utilize the resins life. Used cooking oils from kitchens often are high in free fatty acids (depending on which kitchen your source you oil from). These fatty acids react with the catalyst further increasing soap production. High soap levels in biodiesel are one of the biggest factor in saturating your resin and shortening its service life. At SAIT we have found that after methanol removal, overnight settling and finally filtration we can reduce soap concentration to as low as 200ppm, depending on catalyst selection.

Currently at SAIT we are researching woodchip purification. Using saw dust or wood chips (hard woods work particularly well) from the carpentry school, ASTM

(Picture courtesy Utah Biodiesel Supply) biodiesel can be produced. The benefit of using this media is that it is inexpensive (even free) compared to expensive ion exchange resins. Table 1 below shows the sulfated ash and soap concentration of biodiesel both before and after being allowed to soak in woodchips for a 24 hour duration. Although the results are very preliminary and not scientifically conclusive they look very promising. ❑

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Table 1 – Preliminary Results

	Sulfated Ash (mass%)	ASTM limit for Sulfated ash	Soap (ppm)
Crude biodiesel	0.028	0.02 mass %	1650
Biodiesel after being soaked in woodchips	0.002	0.02 mass %	30

Given the above, more research needs to be performed on the following areas:

1. Service life of the wood chips. How much biodiesel can it process and at what impurity levels can be effectively treated before replacement is needed?
2. Mechanism involved in the purification (Absorption, tannic acid neutralizing soaps?)
3. Possibility of resins and saps leaching from wood to fuel. What may be their effect?
4. Flow rates and residence time. How much contact time and at what flow volumes does a certain quality of biodiesel need with the wood chips to reach acceptable levels?
5. How effective would various types of woodchips (pine, oak, maple, sawdust vs chips etc.) be or is there difference between the absorptive capacity?

MILLIGAN BIO-TECH'S TOP QUALITY BIO-DIESEL PRODUCTION FACILITY NOW OPERATING & EXPANDING

July 23, 2009 saw the Grand Opening of Milligan Bio-Tech's Bio-diesel Optimization & Crushing Facility in Foam Lake, SK. Incorporated in 1996, Milligan has grown into an international company through years of research in partnership with Agriculture & Agri Food Canada and the University of Saskatchewan. This research has determined that top quality bio-diesel with superior cold flow (to -14°C) could be made with low quality canola that cannot be used in the food industry. "When we started the company, we couldn't use the standard equipment for crushing No. 1 canola, so with our partners, we developed our own proprietary cold crushing technology," says Zenneth Faye, Executive Manager.

The Grand Opening was attended by over 400 people including dignitaries and media. The Bio-diesel Optimization Plant has a capacity of 10 million litres annually which will require 30,000 metric tonnes of non-food grade Canola. The average percentage of crop that is off-grade is 10%, providing 900,000 tonnes of off-grade canola.

Other milestones were also celebrated during the day, including the presentation of Milligan's ISO 9001:2008 certification and the announcement of the opening of a Calgary Office right in the heart of the Petroleum District.

Further expansion, research and development plans are in the works. The co-products that Milligan sells in the retail market at over 2,000 Canadian retail outlets; Milligan's Diesel Fuel Conditioner and Penetrating Oil as well as Road Dust Suppressant, Canola Oil & Meal that can be purchased directly from the Foam Lake plant, are helping to further those plans. Plans that include a 150 million litre Bio-diesel Plant for 2012 to correspond with the federal mandate of 2% renewable diesel content in all on-road diesel. As well, their hub-and-spoke strategy which includes opening multiple canola crushing sites across the Prairies. The off-grade canola would be crushed on site with the oil being shipped to the bio-diesel plant in Foam Lake. The benefits to this system are numerous. "It's cost effective to just ship the oil, leaving the canola meal in the community for the local farmers to use as a protein source," explains Faye. "With this system, we are able to ensure quality control over our bio-diesel production at the Bio-diesel Plant in Foam Lake. We believe this model promotes regional sustainability and we are looking forward to putting it into action." ❑


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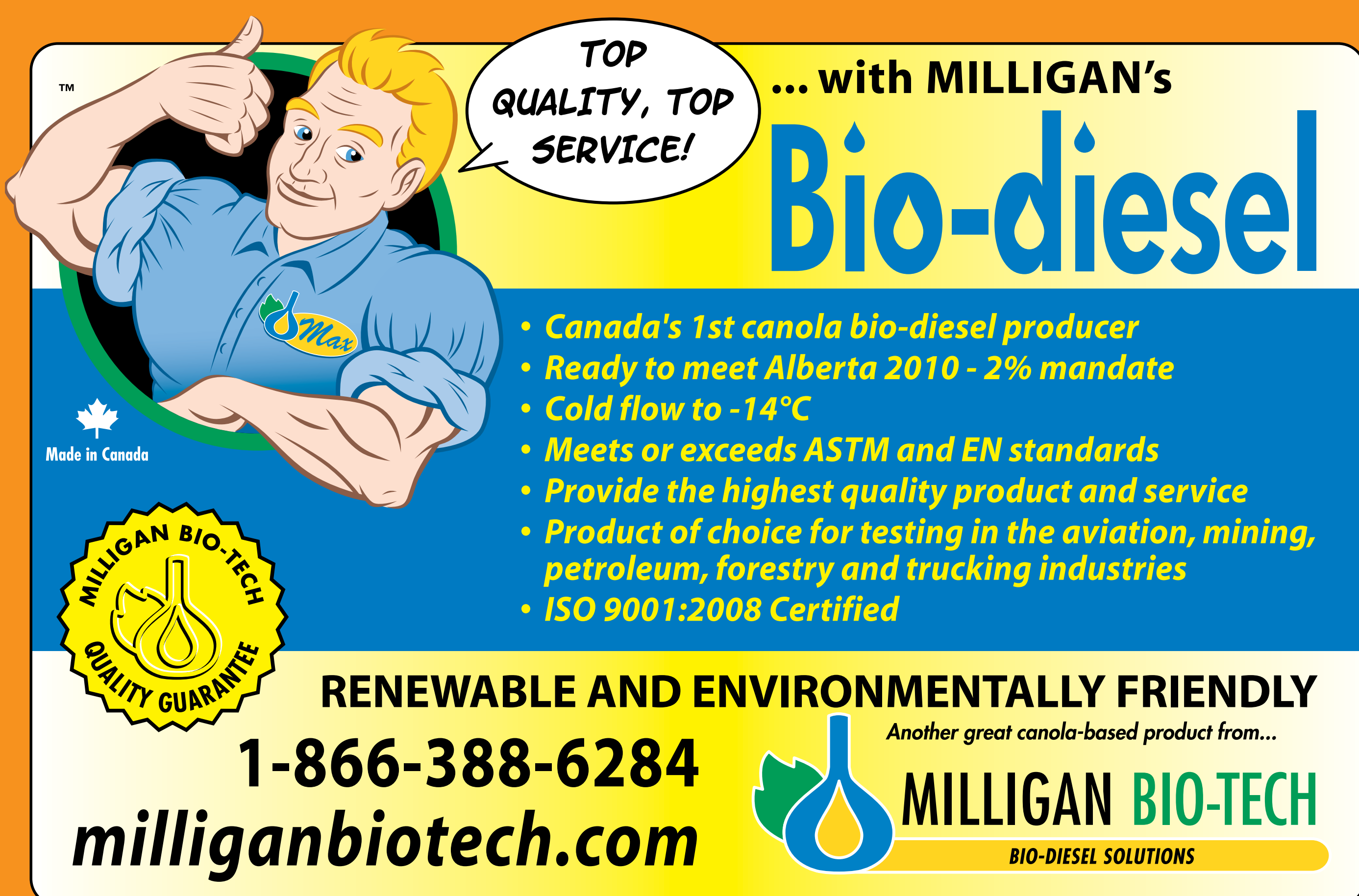
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