Low-Cost Biodiesel Production

As federal biodiesel policy uncertainty rises, low-cost biodiesel production with new technologies to allow processing of cheaper, lower quality feedstocks is paramount. Biodiesel Magazine provides a cross-section of new technologies being deployed.

By Ron Kotrba | January 02, 2014

While 2013 was a banner year for U.S. biodiesel producers, smashing production records and far surpassing the federal renewable fuel standard (RFS) volume obligation of 1.28 billion gallons by more than 400 million gallons, the end of the year brought with it anxiety, dismay and uncertainty. In a move no one foresaw, U.S. EPA proposed stalling this year’s biomass-based diesel RVO at 1.28 billion gallons, which, when considering the RIN carryover from last year, would be more like 1 billion gallons. If the final rule comes out at 1.28 billion, this could essentially mean an industry contraction of 700 million gallons, particularly if the $1 per gallon biodiesel tax credit is not reinstated early in the New Year. This would put elevated pressure on producers to be as efficient and low-cost as possible.

When EPA’s draft proposal was leaked prior to its official publication, Steve Bond with Blue Sun Biodiesel told Biodiesel Magazine, “One of the things we look at as the industry matures is, the more efficient plants are going to be able to stay near or at near capacity of 80 to 90 percent. So the impact will hit some plants that have been simply hanging on for the past few years, those that are either single feedstock or just less efficient—most of the impact will be felt by these plants,” he said. “In our Blue Sun Biodiesel plant in St. Joseph, Mo., we’ve invested a lot to make it efficient. But, it’s still a concerning issue. It’s clear the biodiesel industry can do more.”

Ramon Benavides, founder of Global Renewable Strategies and Consulting LLC, says if the RVO final rule remains at 1.28 billion gallons, he believes 4 percent of the market will be affected, meaning some plants will idle—those that haven’t realigned their facilities to prepare for such a policy catastrophe with the payout of the retroactive tax credit extension, which passed early last year retroactive back to Jan. 1, 2012, along with profits from this monumental year.

The largest U.S. biodiesel producer, Renewable Energy Group Inc., announced in mid-December it was acquiring renewable diesel technology firm Syntroleum Corp. along with its 101 patents and 50 percent stake in the 75 MMgy Dynamic Fuels plant in Geismar, La. When the official RVO proposal came out, REG President and CEO Daniel J. Oh said, “REG’s lower-cost multifeedstock business model, network of biorefineries and terminals, and strong position within the industry should allow us to continue to succeed as the markets inevitably adjust to reach a new equilibrium.” Benavides says while large, public biodiesel companies like REG’s stock may fluctuate with the uncertainty, they will “be OK.”

Clearly, the nexus between low-cost production and low-cost feedstocks, which can represent 80-plus percent of production expenses, is new technologies that allow effective conversion of low-grade, high free fatty acid (FFA) materials to quality biodiesel. Biodiesel Magazine has put together a sample cross-section of such technologies being deployed commercially today.
Menlo’s Clean Carbon Technology

Menlo Energy LLC, a subsidiary of Menlo Capital Group, began its biodiesel R&D work in 2007. “Our initial foray was into jatropha in India,” says Sunil Suri, Menlo Capital Group principal and managing member. Menlo funded R&D efforts in jatropha seed botany and, according to Suri, became the largest plantation owner and operator of jatropha with farms in excess of 100,000 hectares in several Indian states. The farms were commissioned in collaboration with certain village governments (“Panchyats”) in India. This work expanded into the manufacturing of biodiesel.

Menlo acquired the former Agri-Source Fuels plant in Dade, Fla., now called Menlo Energy Florida LLC. The company says it’s expanding the 12 MMgy biodiesel plant to 60 MMgy, and it continues to operate the on-site glycerin refinery. Menlo also has a 20 MMgy biodiesel project in Richmond, Calif., which the company says will be expanded to 100 MMgy. Two additional projects, one in Mansfield, La., and the other in Bakersfield, Calif., are under development.

Clean Carbon Technology is what Menlo calls its continuous flow, heterogeneous catalyst multifeedstock biodiesel process. Suri, the inventor of the process, says, “No one has been able to make a solid catalyst to execute both esterification and transesterification and also use a single catalyst for an extended period of time, and also to keep the cost of the catalyst very competitive.” “He says it’s both a fixed-bed solid catalyst and a recoverable granular catalyst, “as we execute esterification and transesterification differently but off one stream.” Suri says while the company began experimenting with crude jatropha oil, it has since moved to investigating working with waste fats, oils and greases (FOG) and municipal solid waste. “We have no foreseeable scale-up issues, as we have executed a full commercial-scale plant, albeit not for ourselves where we own it 100 percent,” he says, “but very soon, this year, we will have several plants placed into commercial production.” He says Menlo is engaged with several counter parties, all sovereign, in Canada, the U.K., Italy, Austria, Saudi Arabia, Indonesia, Australia and Japan. The company has applied for 17 patents, five have been issued, “and others have been allowed,” Suri says.

Suri explains the core elements, or novelties, of the CCT approach are that it involves no acids, chemicals or water; puts out no effluents; is mass-balanced; has “the lowest carbon footprint known to man;” operates at ambient temperature and low atmospheric pressure; can process feedstock with any FFA or moisture, insolubles or unsaponifiables (MIU) range; removes sulfur, for instance, from brown grease; generates 99.7 percent pure colorless glycerin; requires a 4-hour residence time; uses all stainless steel; and is fully automated, continuous flow, 24/7—“No down time ever,” Suri says.

“Our work is such that we do not need any form of assistance or subsidy,” Suri says of a future where federal mandates and incentives are in question. “Our business is profitable without any such largesse.”

Benefuel’s Ensel Technology

Flint Hill Resources and Benefuel made headlines in May when they announced a joint venture partnership, Duonix LLC, to develop biodiesel projects in the U.S. based around Benefuel’s registered Ensel process technology. The first project: the former Beatrice Biodiesel plant, a 50 MMgy facility in Beatrice, Neb., that was built several years ago with Axens solid catalyst technology but never became fully operational. The acquisition was a natural fit, with Benefuel developing several of its own proprietary heterogeneous catalysts for esterification and transesterification, for industrial chemical, biodiesel and biolubricant production.

Rob Tripp, Benefuel’s CEO, says the Ensel process combines both esterification of FFA and transesterification of triglycerides into a single process—“a long sought technological advantage for the biodiesel and oleochemical industries,” he says. “[Transesterification] can occur without catalysts at very high temperatures, or with alkaline or acid catalysts at varying temperatures,” Tripp says. “The weakness of the conventional biodiesel process lies in its application of alkaline catalysis—liquid or solid, like Axens.” They, of course, cannot convert FFA into biodiesel, but instead make soaps that must be removed, resulting in a yield loss.
In 2011 and 2012, Benefuel validated its Ensel technology at two 1-ton-per-day, fully integrated demonstration plants with its current equity partners, Flint Hills Resources and Itochu Corp., using a broad range of commercially available, low-cost feedstocks. “Feedstock costs drive biodiesel process economics,” Tripp says, “contributing 75 to 90 percent of total processing costs. Benefuel’s efficient use of low-cost feedstocks means superior economics to current processes.” Tripp also says Benefuel’s capital cost structure, in general, will be similar to or lower than a conventional esterification and transesterification refining process. To put it in perspective, a company like REG spends $20 million to upgrade a 60 MMgy soy biodiesel facility (Albert Lea) to be able to process high and low FFA.

“There were a number of attractive features of Beatrice,” Tripp says. “Namely its low acquisition cost and location for accessing feedstocks.” He adds that while the project at Beatrice has not officially been approved, it is moving through a full project review process. “We are excited and optimistic that it will receive final funding approval during the second quarter of 2014,” Tripp says. The Duonix JV that Benefuel has established with Flint Hills Resources has exclusive rights to the U.S. market and has plans to grow beyond Beatrice. Tripp says retrofit and greenfield construction are both viable options and will depend on the opportunity.

When asked how important he thinks low-cost biodiesel production and technology are when faced with the possibility of a lapsed federal tax credit and a stalled biomass-based diesel RFS, Tripp says, “In a commodities market, it is always beneficial to be the low-cost producer. In the biodiesel market, the flexibility across feedstocks while maintaining strong operating yields is key to ensuring a low cost of production. Benefuel and its partners have spent more than seven years working to bring this technology to a commercial scale, and we are excited with the opportunity of leveraging this work to position ourselves as a low-cost producer here in the U.S., as well as abroad.” Internationally, Benefuel is working with partner and investor, Itochu Corp., particularly developing opportunities in Asia.

**Jatrodiesel’s Super Process**

In late November, Patriot Holdings LLC announced that its board of directors approved formation of a new subsidiary—Patriot Fuels, Biodiesel LLC—to build a 5 MMgy biodiesel production facility adjacent to the Patriot Renewable Fuels LLC ethanol plant in Annawan, Ill. The plant will use distillers corn oil from the 40 million bushels a year of corn PRF processes. While co-location of biodiesel production at ethanol refineries has long been a much-discussed concept, implementation has been slow—until just recently. Adkins Ethanol in Lena, Ill., also announced earlier that month it was using WB Services to build a biodiesel facility co-located next to its ethanol plant. The Patriot Fuels, Biodiesel LLC plant will be the first commercial installation of Jatrodiesel’s new Super process, a supercritical biodiesel technology under development for five years.

“We built the first lab-size process in 2008-’09,” says Jatrodiesel President Raj Mosali. “We built a bench-top model in 2010 that was 2,000 times the lab size, and we built a large pilot model in 2012.” The pilot plant was scaled at 350,000 gallons per year, or about 2,000 times the bench-top size. “We have tested quite extensively to check yields, any discrepancies between various sizes—energy, yields—and tested the equipment, metallurgy, scalability, safety and other aspects of the process. Over the years, we have refined the process quite a bit to be able to address various things, including the changes in ASTM specifications.”

The Super process can handle any level of FFA without use of acid or base catalysts. Mosali says its advantages are savings in catalyst costs because no catalyst is used, simplicity of the process, true multifeedstock capability and high-quality glycerin. The supercritical process, does, however, use more energy than traditional technologies. “But all in all, if you do normalized comparisons between traditional processing”—esterification/transesterification, or glycerolysis or enzymatics—“to our Super process, you have between 12 and 18 percent savings overall considering utilities, chemicals, operational expenses and more,” Mosali says. “If you consider soft costs such as training the operators, the savings are even higher.” The pretreatment involves only filtration to remove MIU in the feedstock. “The Super process,” which is fully continuous, “will take over at this point,” he says. Glycerin purity is upwards of 92 percent. The biodiesel is
water-washed and then distilled to remove any color. He says the yield is 98 percent by weight and is comparable to traditional processing.

“Our turnkey costs for a Super process are about 15 percent higher than the conventional process,” Mosali says. “The payback on the cost increase is less than six months of operations, so the cost increase is minimal on the construction end as compared to the operational savings it brings.”

He says Patriot has been following Jatrodiesel’s progress in this technology development for some time. “They were checking up on our progress a couple of times a year,” he says. “Patriot and its management are incredibly forward-looking in their decision to choose this market-changing and paradigm-shifting technology.”

Concrete and foundation work at the Patriot biodiesel plant are expected to begin in December, and it’s scheduled to begin operations by third quarter 2014. “As far as we know, this is the first time a fully scaled supercritical-based technology that does not use any catalyst has been used for biodiesel,” Mosali says. “We think our expertise in using supercritical temperatures and pressures, and our ability to design the processes and reactors that are economical, greatly helps us to diversify as a technology company into other fields.”

On the importance of technology and low-cost production in a time of uncertain federal policy, Mosali says, “Having the flexibility in your process plus being a low-cost producer from the operational-cost perspective, with the ability to use low-cost feedstocks, is very important. This new process perfectly fits both. Having said that, I do think this is a temporary setback in the policy, but in the long run, there is really nothing from the science or political perspective that’s going to impede the growth of alternative fuels. If you ask the question, will we be burning fossil fuels with no restrictions two, three, five or 10 years from today, the answer is no. So the future looks bright for biodiesel.”

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