BIODIESEL MAGAZINE
The World of Biodiesel at Your Fingertips

The Bigger, the Better?

According to Biodiesel Magazine's plant construction list, 148 biodiesel plants are operating in the United States with an annual capacity of 1.75 billion gallons per year. The plants produce an average 11.8 MMgy. In contrast, the average size of the 28 plants under construction and three existing plants being expanded is 26 MMgy. As feedstock prices rise, will a trend toward bigger plants continue?

By Jessica Ebert

2007 marked the opening of four of the largest biodiesel plants in the United States. The 100 MMgy multifeedstock behemoth Imperium Renewables Inc.'s Imperium Grays Harbor plant in Washington state led the way followed closely by Archer Daniels Midland Co.'s 85 MMgy canola oil plant in North Dakota, an 80 MMgy soy oil plant in Indiana built by Louis Dreyfus Corp. and Green Earth Fuels LLC's 86 MMgy Texas plant, which processes multiple feedstocks. An additional eight plants with at least a 30 MMgy capacity came on line this year. Of these 12 plants, half use soybean oil as their sole feedstock while the others process alternative virgin oils, animal fats, recycled vegetable oil or yellow grease. "The worldwide biodiesel industry is starting to grow up," says Daniel Parker, president and CEO of Parker, Messana & Associates Inc., an engineering consulting firm based in Washington. "Our feedstock operational and distribution economics are warranting more and more large-scale production facilities capable of serving global markets with biodiesel made from multiple feedstocks," says Parker, who spoke at BBI International's Biofuels Workshop and Trade Show: Western Region in Portland, Ore., in October.

Grant Kimberley, director of market development for the Iowa Soybean Association, says this is a normal trend for manufacturing because—it's a lot less expensive to build larger plants as the cost can be spread out over a larger capacity. "Economy-of-scale is the name of the game and that's why a lot of companies are building these bigger plants after running the numbers," Kimberley says. "If you're going to be in the business, you might as well be in the business in a way that's as commercial and economical as you can be."

Building bigger allows for the installation of technologies and processes that aren't cost effective on a small scale. Energy savings systems can be integrated more effectively in larger plants and there are greater opportunities for recovery and utilization of byproducts and for synergistic pairings, Parker says. "Pairing a biodiesel plant with an ethanol plant or other types of facilities takes advantage of synergies of energy and materials between

the plants as well as the availability of financing," he explains. "More and more, financiers are asking for larger facilities. They want to see a larger scale of production."

For Imperium Renewable's founder and President John Plaza, making the jump in scale was a no-brainer. "We certainly are the first to build an industrial-scale biodiesel facility on a port that has tri-modal access to the U.S," he says. But more to the point, "our business model is differentiated enough that it really required scale to make it viable." The bottom line is that the company built the facility because of anticipated demand, Plaza says. A renewable fuels standard signed into law by Washington Gov. Christine Gregoire, requires at least 2 percent of the state's total diesel sales be biodiesel by Nov. 30, 2008. Furthermore, the company developed proprietary processes that have been improved at Imperium's original facility, Seattle Biodiesel, that give the company an advantage in the market. "We have a different technology than traditional biodiesel production facilities," Plaza says. "We consider this a next-generation biodiesel plant." The technology allows for the simultaneous processing of multiple virgin oil feedstocks and eliminates the need for a water wash. According to Plaza, the fuel contains nondetectable levels of glycerin, nondetectable levels of methanol and water content of 50 parts per million or less. "We create an extremely high-quality biodiesel that far exceeds ASTM and European standards," he says. "That really puts it on the same quality standard as petroleum."

Even with feedstock prices on the rise, Plaza and Imperium are looking to the future. "Efficiencies of scale apply to everything we do as a society so I think that in the future 100 MMgy facilities will be small in comparison to what they're going to be." Although he was not at liberty to discuss the company's future plans at press time, according to the most recent amendment to Imperium's registration statement with the U.S. Securities and Exchange Commission, when the company goes public it will use $230 million of the net proceeds from the offering to finance, develop and construct three new 100 MMgy biodiesel facilities in Hawaii, Pennsylvania and Argentina respectively. "We've seen biodiesel demand remaining high and feel confident that it will remain high for the foreseeable future," Plaza says.

It's the deeper pockets of these large-scale facilities that allow them to surf the more volatile seas of feedstock prices, Parker says. These companies are able to deliver larger volumes and are able to roll up volume contracts. "Large plants are showing good viability partly because of their ability to do the financial management and hedge their feedstock prices," he says.

In addition, smaller plants that have the ability to take a lot of variability in feedstock prices are surviving especially when they are located close to the supply. "Where we're seeing a lot of issues now is with the middle-of-the-road plants that are tied to a single feedstock, in particular virgin oil type feedstocks," Parker explains. "These facilities are not able to control pricing. They don't have the volume to secure those large-volume contracts and lock those prices in."

Market Mayhem

It's not just the middle-of-the-road plants that are hurting. "The dramatic rise in feedstock prices is the market's attempt to stabilize and ration the amount of usage to make sure all the markets that are currently served by these feedstocks get served," Kimberley explains. In response, some biodiesel plants are producing below their potential capacity and even plants capable of processing multiple feedstocks are cutting back production. "Now that the demand has gone up so far so fast, it's pulled soybean and other perceived higher-quality feedstocks higher and in turn it's pulling everything else [feedstocks that have historically been cheap] higher too," Kimberley explains. Compared with soybean oil, which comprises the vast majority of the vegetable oil used and grown in the United States, the volume of alternative feedstocks is relatively small, and when the plants that can handle these alternate virgin oils or animal fats switched, prices rose. "The pool they had to pull from was not big in the first place so all of a sudden that shot those prices up," Kimberley explains. "Now the market is pricing all these feedstocks closer together so it's hard to make the switch and make money."

Reducing capacity should provide time for the market to adjust and prices to eventually drop thereby allowing for another expansion of the industry and for the cyclical nature of this commodity business to continue. To ease the side effects of this vicious circle will be technology advances that improve crop yields and/or the efficiency of the biodiesel production process.

One of the advances to aid in the latter will be the development of a solid catalyst, Parker says. "Every conventional plant at this point is using a homogeneous catalyst but we're all hoping that the heterogeneous catalyst will be developed." At least two companies have made strides in this direction. One, Catilin Inc., a startup created to commercialize nano-sized spheres for the catalyzed production of biodiesel from numerous feedstocks, was featured in "Nano-Style Biodiesel Production" in the October 2007 Biodiesel Magazine. A second company called Benefuel Inc., recently announced it would build the world's first industrial-scale biodiesel plant leveraging the company's solid acid catalyst for the conversion of vegetable oils and animal fats to biodiesel.

The solid catalyst, which was developed at the National Chemical Laboratory in Pune, India, can process cheaper feedstocks that are high in impurities called free fatty acids with no pretreatment. "The FFA get converted directly into methyl esters so it's a very efficient and compact refining process," Benefuel Chief Executive Officer Rob Tripp says.

The main reaction takes place in a fixed-bed reactor packed with millions of pieces of the catalyst, which are each about one-eighth of an inch long. Methanol and feedstock are pushed through the vertical column and the surface area of the catalyst creates the reaction that forms the methyl esters, which come out at the end of the column. "When you limit the process to those two ingredients [plus the catalyst] everything else is much cleaner and more pure," Tripp says. Because no caustic or liquid catalyst is left in the fuel stream after the reaction takes place, the requirement to wash the biodiesel is eliminated, which saves money and simplifies the process. Additionally, the quality of the glycerin is higher. "We can expect our glycerin to be at 98 percent or higher," Tripp says. "We're working toward a pharmaceutical-grade glycerin." Alternatively, Benefuel has the

technology for converting glycerin into an oxygenate, which can be blended with biodiesel to improve its cold-weather characteristics.

The technology is not limited to methanol as the alcohol reactant in the transesterification reaction; longer-chain alcohols like ethanol can also be used. These alcohols can be used to convert triglycerides into an oil or biolubricant. “That’s where we’re unique in the market,” Tripp says. “We have a compelling technology platform because we don’t just improve biodiesel, we’re creating a new market for lubricants and a new market for oxygenates.”

Benefuel has tested the technology at a pilot-scale plant in India and has teamed with an investment company, Seymour BioFuels LLC, to build a 10 MMgy plant in Seymour, Ind. The collaborators will break ground soon, Tripp says, and startup is expected by late summer or early fall of 2008. Although the technology can easily be scaled by increasing the size of the reactor and subsequently the amount of catalyst in the reactor bed, Tripp likes the model of small, local biodiesel plants scattered across the country. “The large centralized model works in certain locations,” he says. “But there’s a good opportunity for this distributed model where you take advantage of the distributed nature of feedstocks and make it work to your advantage.” That model might be a good fit for current market conditions, Kimberley says. “I think the pace of this rapid expansion is going to slow and I don’t think we’re going to see a lot of 100 MMgy or 60 MMgy plants being built from this point forward over the next year or two,” he says. “I think over the next five to 10 years we’ll see more of those being built.” That said, Kimberley cautions that it’s difficult to make predictions about trends for an industry that’s so young. “A lot of people predict what will happen in the future by looking at the past and that gives you trends, it’s hard to do that when you don’t have much to look back on.”