

Contribution



PHOTO: BDI-BIODIESEL INTERNATIONAL

Extensive research and development is required to keep up with the latest biodiesel feedstock challenges.

## Returning to Biodiesel Profitability

Finances willing, retrofitting biodiesel plants with the latest technology is one route to squeezing more out of a company's returns.

Earlier this year, the European Biodiesel Board reported that about half of EU biodiesel capacity is idle. The National Biodiesel Board gave a similarly discouraging outlook—production had fallen to 2006 levels. While much of this can be attributed to changes in regulations, volatile feedstock prices and a drop in demand for fuel, it is not all doom and gloom. Certain aspects of a biodiesel plant can be optimized to achieve higher yields and greater feedstock flexibility.

The design of a biodie-

sel production facility is based on many parameters, including feedstock quality, reaction technology—coping with specific challenges such as very high free fatty acid (FFA) feedstock—and the quality of the fuel and coproducts.

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, the changing of production parameters or operation modes, varying feedstock properties, and problems

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

Using the wrong equipment, control problems and inadequate control systems are the most likely causes for unexpected halts in production, which lead to downtimes and a reduction in capacity.

### Higher Yields

The plant yield is defined as the ratio between the amount of on-spec biodiesel produced and the feedstock input stream, with both based on mass. The input stream includes all fatty

materials (tri)glycerols, and FFAs, convertible into biodiesel.

Yield losses are crucial for plant economics. Just 1 percent less output causes losses of more than \$1.1 million a year, based on 100,000 tons a year, or 30 MMgy at a biodiesel selling price of \$3.77 per gallon (including the tax credit).

Basic biodiesel technologies can only convert feedstock with an FFA content of less than 0.1 percent, but those premium feedstocks are only available at a high price. Valuable FFAs are then lost during

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BDI-BioDiesel International, which headquarters in Grambach/Graz, Austria, has been in the biodiesel business since 1991.

the upfront refining process, or neutralization, of the crude oil.

Critical yield losses can also occur due to the poor design of the transesterification unit as well as the subsequent purification steps. Missing internal recycling of all fatty material sidestreams is the main cause of this.

The practical integration of FFA conversion and internal recycling for maximum yield needs to be carefully designed, taking into account the effect on other process units (e.g., existing materials of pipes and vessels), as well as the influence on overall plant efficiency.

### 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 parts per million (ppm), the

introduction of new parameters such as the cold soak filtration test to reduce the filter blocking tendency of some contaminant-laden biodiesel, and meeting low sulfur levels using such feedstocks as tallow.

“Big Oil” and the petroleum industry are demanding an even higher quality product



PHOTO: BDI-BIODIESEL INTERNATIONAL

Distillation is an efficient way to meet current and future quality requirements.



PHOTO: BDI-BIODIESEL INTERNATIONAL

For maximum process efficiency, quality equipment and components must be used during retrofit projects.

to meet their blending obligations. For example, they are typically specifying a maximum content of monoglycerides (0.3 percent or even less) and a water content of less than 300 ppm.

### Byproducts

Glycerin, the main byproduct from a biodiesel production facility, is often treated as a waste stream, or as a low value

byproduct, but it can increase the profitability of a plant when it is upgraded to pharmaceutical grade, for example.

Other valuable byproducts include fatty materials: all soaps from the transesterification reaction can be split and transferred into methyl esters to gain a 100 percent yield, a process patented by BDI-BioDiesel International. Excess methanol from the reaction process can be distilled

and reused, water can be separated and purified for recycling in order to minimize fresh water consumption, and when using potassium for the transesterification process, the residues can be transferred into a valuable fertilizer.

### 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 pretreatment 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 transesterification, purification and side-product preparation units—is essential for a successful retrofit.

Distillation, for example, can be used to fulfill the ASTM cold soak filtration test. Distillation can easily be integrated in an existing plant, but it cannot cure all deficits caused by improper design of the previous process steps.

Additionally, producers should recycle the distillation sidestreams into the process in order to achieve the best yields and plant economics.

### Reducing Materials, Energy 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. Waterless 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

#### What are the missing pieces to bring your smile back?

##### BioDiesel Quality

Does ALL your Biodiesel production meet ASTM D6751 / EN 14214 standards or are there any negative impacts on yield, capacity and feedstock flexibility?

##### 100% Yield

Is your plant able to convert 100% of the feedstock or are you losing valuable Triglycerides and FFAs?

##### Nameplate Capacity

Do you reach the capacity you paid for or are you not getting the full potential from your investment?

##### Feedstock Flexibility

Do you need highly refined and expensive vegetable oil or can your plant deal partially or even exclusively with cheaper high FFA feedstock like Trap/Brown Grease, Yellow Grease/Used Cooking Oil, Tallow/Animal Fat, PFAD?

##### Saleable By-Products or Waste

Does your plant produce waste (filter material, soap stock, etc.) or can you earn maximum additional income e.g. with high quality Glycerine?

##### Plant Safety

Is your plant meeting the latest safety standards and regulations?

**If one or more of the above applies to your plant, we can help you smile again!**



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.

Where waste streams are unavoidable, anaerobic treatment of various residues, organic wastes and sidestreams substantially increases the plant's efficiency.

Energy consumption usually has the least impact on the profitability of the biodiesel production process. However, when referring to glycerin treatment or the distillation processes for methyl ester production, an economical energy-saving design is essential.

### 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.

The APC solution works integrated in the distributed control system and the guidelines of this process optimizer are executed by established proportional–integral–derivative controllers.

The technology can help optimize single units such as recipe handling, demethanolising, biodiesel distillation and glycerin separation.

Missing online quality measurements (FFA content, neutralization number, etc.) are substituted via soft sensors; a model-based online calculation of actual quality values. The process models can also be used for offline process simulations, especially for operator training.

APC can be added to a plant with very little effort or investment. The installation

does not impact daily production and the results can guarantee a payback within a few months.

### Is it All Worthwhile?

Retrofitting 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. ■

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