Adsorbing It All

With a solid track record in oleo-chemical purification, The Dallas Group has entered the biodiesel industry with a synthetic magnesium silicate adsorbent that has changed the way some producers clean up their methyl esters.

By Tom Bryan

The Dallas Group of America Inc., a recognized leader in oleo-chemical purification technology, is arguably the only U.S. company actively marketing a commercial product for the adsorptive purification of biodiesel. The company's synthetic magnesium silicate adsorbent, sold under the trademarked name Magnesol, is an "adsorbent filter aid" that ensures biodiesel quality by removing contaminants within methyl esters. Subsequently, the removal of contaminants enables biodiesel producers to guarantee that the fuel they produce meets ASTM D-6751 specifications and other industry standards.

The Dallas Group broke into the North American biodiesel market with Magnesol only recently, but according to one producer, the adsorbent could be "a cure-all for most process upsets and impurity problems" that occur during biodiesel production. Multiple customers nationwide in the edible oils industry are already using the product. Bryan Bertram, director of industrial sales with The Dallas Group, believes the U.S. biodiesel market represents one of the next big opportunities for the product line. In an interview with *Biodiesel Magazine*, Bertram, along with Chris Abrams, business development manager, and Brian Cooke, product development specialist, discussed the company's ongoing efforts with Magnesol. Bertram said the product increases the oxidative stability of biodiesel and is used in conjunction with—or in place of—the water-wash treatment in the biodiesel production process.

After the glycerin separation process, methyl esters contain contaminant materials that are detrimental to the quality of the fuel and must be eliminated from the product. Reduction of the water-soluble contaminants, traditionally, is accomplished by water-washing the biodiesel. However, according to Bertram, the era of the biodiesel water-wash may be gradually ending. "The water-wash method does nothing to remove the water-insoluble impurities," he told *Biodiesel Magazine*. "And due to the resulting effluent water, it gives cause for environmental concerns."

> What is perhaps most attractive about Magnesol, is that it works simply and relatively inexpensively.

With Magnesol, the water-wash step can be eliminated, and so can the liquid separation and drying of biodiesel. "It can also replace other methods of removing chlorophyll, metals, and color from biodiesel," Bertram said. "If the processor is utilizing a costly distillation step on the tail end to remove metals or other contaminants, they could forgo that step also. In addition, Magnesol has a high affinity for methanol and water, so it will remove the last bits from methl esters.."

Purification with Magnesol also increases the oxidative stability of biodiesel, Bertram said, which is becoming increasingly important, due to the demands being placed on fuel producers by the auto manufacturing industry and government.

Magnesol, which can be used in either

batch or continuous processes, removes residual methanol, providing a cost savings in the stripping step. Magnesol is able to remove sulfur, which is especially important in light of impending U.S. EPA regulations that will limit sulfur in diesel fuel to 15 parts per million. Furthermore, the product significantly reduces a plant's need for heated and conditioned water. The traditionally employed water-wash method necessitates either the purchase of centrifuges or the gravity-separation of the water from biodiesel.

"After transesterification, you have methyl esters that need purification," Bertram said, explaining how water washing is typically used to remove contaminants from methyl esters.

Abrams said The Dallas Group believes the water-wash method has several limitations, including decreased yields due to methyl ester loss in effluent; high soap levels that cause emulsification; high effluent treatment and disposal costs; and the time and cost of drying methyl esters. High soap levels in particular may lead to poor separation, contribute to yield losses and require multiple washes to achieve specification, Abrams said. In some cases, 24 hours are required to effect a single separation.

Additionally, it is not uncommon for producers to end up with a methyl ester/water emulsion. "Without a water-wash, there are no such emulsions formed," Abrams said. "The disposal, and even permitting of, wastewater is difficult to impossible, depending on plant location. Magnesol greatly reduces dependency on water and resultant wastewater disposal issues."

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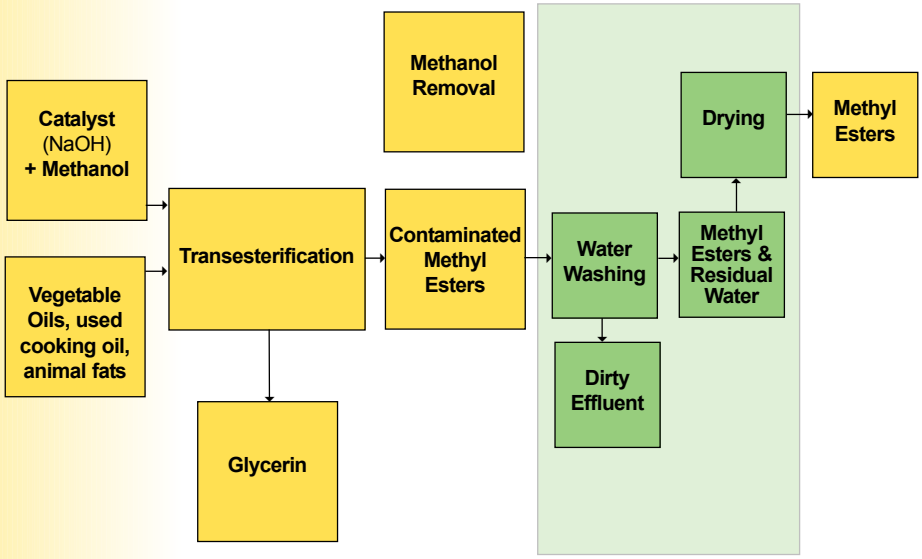
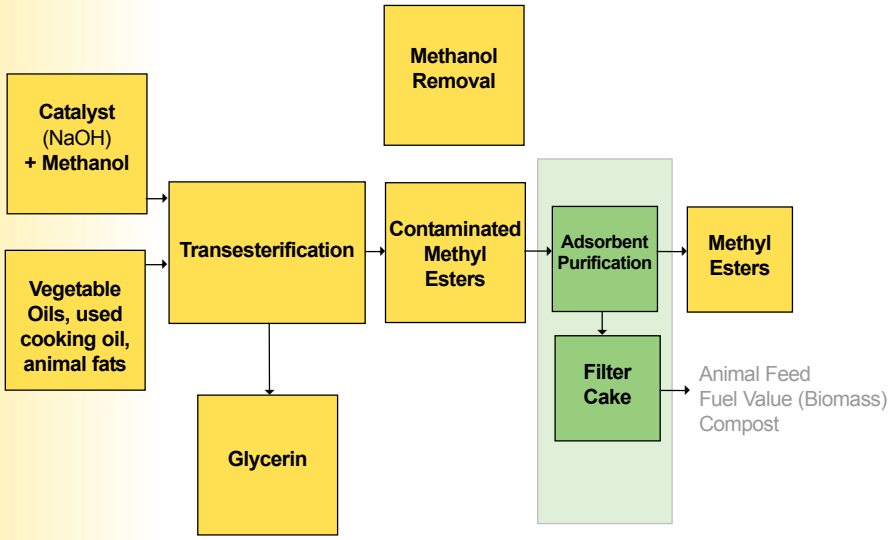
Cooke shared information about Magnesol at the 2005 National Biodiesel Conference & Expo in Ft. Lauderdale, Fla., in early February. His presentation—essentially a detailed explanation of how biodiesel can be purified by using the company's trademarked adsorbent—covered the basic biodiesel process, the technology of filtration (passive and active), the results of a pilot

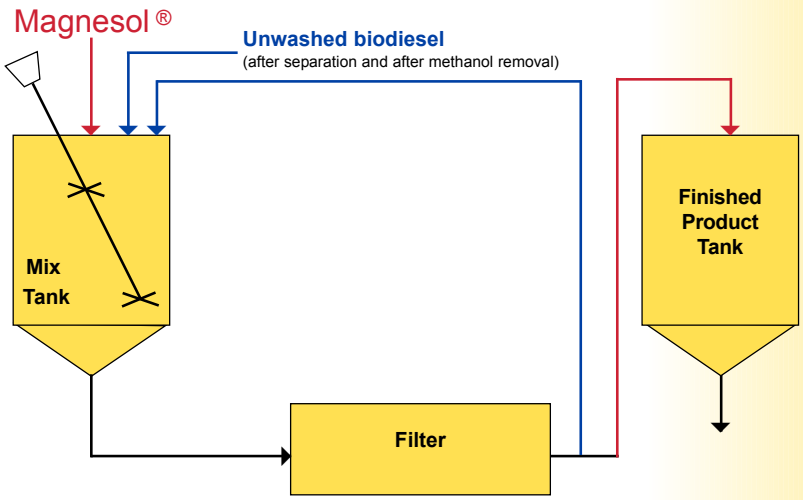
Biodiesel Production with a Water-wash Treatment



Biodiesel Production with Adsorbent Purification



Biodiesel Purification Process



Benefits of treatment with MAGNESOL ®

- ✔No water-effluent stream
- ✔No emulsification
- ✔Improved oxidative stability (OSI)
- ✔Minimal yield loss
- ✔Minimal capital expenditure
- ✔Allows for continuous operation
- ✔Expedites the purification process
- ✔Adsorbs residual water

plant trial that involved the product, and a brief look at replacing the water-wash step with the company's magnesium silicate treatment.

Cooke explained that Magnesol could be used by biodiesel producers as a "total replacement" of the water wash step, or a "polishing step" used to round out the water wash treatment.

In a standard biodiesel production process, Magnesol—a fine white powder—is mixed with unwashed biodiesel in a mixing tank (for five to 10 minutes) after glycerin separation and after methanol removal.

According to Cooke, magnesium silicate has a strong affinity for polar compounds, thereby actively filtering out excess methanol, free glycerin, mono and di-glycerides and metal contaminants, in addition to free fatty acids and soap. These materials are then removed from the process through filtration. Note: Glycerin is a polar molecule, and thereby susceptible to the adsorptive abilities of magnesium silicate. That's why Magnesol is added to the process after the glycerin separation step.

Explaining the difference between "passive filtration" and "active filtration," Cooke said Magnesol has "charged sites" on its surface (areas that attract the afore mentioned unwanted polar compounds).

"Adsorptive sites may have either acidic or basic characteristics," he said, before explaining the testing methods used to measure the number—and strength—of adsorptive sites on a given amount of adsorbent matter such as Magnesol.

Cooke said testing has shown that synthetic magnesium silicate has high numbers of acidic and basic adsorptive sites, as opposed to passive filter-aid-type materials like diatomaceous earth, which "did not have any active filtration sites."

With the use of Magnesol, Cooke said, the producer is left with a potentially valuable "filter cake" rather than dirty effluent. Clients of The Dallas Group are currently exploring a variety of markets for this filter cake, and the company believes the byproduct has potential value as an animal feed supplement, a form of biomass fuel, fertilizer or compost.

The BECON study

The Dallas Group has over 30 years experience in the purification of various chemicals, including esters and the resulting byproducts of those processes. In addition to its own in-house work on biodiesel (with outside lab confirmation), the Biomass Energy Conversion Facility (BECON) at Iowa State University performed trials comparing the traditional water-wash method to biodiesel purification with Magnesol. Results from this study were discussed by Cooke in his presentation and also by Dr. Jon Van Gerpen during a special technology session at the National Biodiesel Conference. Van Gerpen, a respected authority on the subject of biodiesel, directed the pilot study at the BECON facility. He has since taken a position at the University of Idaho as department head of Biological and Agricultural Engineering.

In that study, methyl esters were produced in 40-gallon batches from both degummed soybean oil and yellow grease

feedstocks in BECON's pilot plant reactor. In both cases, the methanol was removed from the methyl esters, but not initially water-washed.

First, 20 gallons of the soybean methyl esters were water-washed and dried, while another 20 gallons were treated at 77 degrees Celsius with 1-percent-by-weight Magnesol. After 20 minutes of mixing (longer than is probably required in a commercial plant setting, Cooke said), the purified methyl ester was filtered. The resulting biodiesel from both methods passed all specifications of ASTM D-6751. According to the study's authors, Van Gerpen and Kirk Menges, the Magnesol-treated biodiesel contained a lower soap and sodium content than the water-washed and dried sample. Furthermore, the Magnesol-treated biodiesel showed a significant improvement in oxidative stability when compared to both the original methyl esters and the water-washed and dried sample.

In a second trial, 20 gallons of the yellow grease methyl esters were water-washed and dried and 20 gallons were treated with at 77 degrees Celsius with 2-percent-by-weight Magnesol. After 20 minutes of mixing, the purified methyl ester was filtered. Like the first test with soy methyl esters, the Magnesol-treated sample of yellow grease-derived methyl esters passed all ASTM specifications while the waterwashed and dried sample did not. The Magnesol-treated biodiesel contained a lower soap and sodium content than the water-washed and dried sample. Again, the Magnesol-treated biodiesel showed a significant improvement in oxidative stability when compared to both the original methyl esters and the water-washed and dried sample.

During his presentation, Cooke concluded that the benefits of treating methyl esters with Magensol are multi-fold. He reiterated Bertram's claims about the product: With Magnesol, there is no water effluent, no emulsification, improved oxidative stability, minimal yield loss and minimal capital expenditure, all through an application that "expedites the purification process and allows for continuous operation."

Fielding questions from attendees, Cooke said the cost of using Magnesol is in the range of 1 cent to 10 cents per gallon of finished biodiesel, depending on the starting contaminant level. However, he reminded attendees that the filter cake could potentially be used as an animal feed. "It has a certain nutritional value," he said.

According to Bertram, the capital costs of transitioning a biodiesel facility to Magnesol are relatively low. That's because only a low-tech filtering system is required. In addition to potentially eliminating the drying step and the requirement for a wastewater treatment system, the use of Magnesol could replace a centrifuge, yielding additional savings of capital, time and maintenance costs.

There are less obvious savings, too, Bertram said. "Magnesol actually offers the biodiesel producer a lot of latitude in running their process," he said. "It adsorbs glycerin, free glycerin, metals, soaps, chlorophyll, residual free fatty acids, odors, color, methanol and water. Since Magnesol adsorbs such a wide range of impurities, it compensates for upstream upsets in the process, offering clean and more stable biodiesel." ■

For more information about Magnesol visit www.dallasgrp.com.

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BIODIESEL MAGAZINE

This article was printed in the 2005 March issue of *Biodiesel Magazine*.