



FOCUS ON...

Biodiesel Research Shifts into High Gear

1999 is proving to be a good year for biodiesel. This fuel is an effective substitute for and additive to diesel fuel in compression ignition engines, and because of its environmental benefits has found niche markets in some heavy-duty fleets, marinas, and national parks.

Advantages of Biodiesel

- It can be used in most diesel engines without modifications or retrofits.
- It reduces greenhouse gas emissions.
- It can help reduce air pollution and related public health risks.

Disadvantages of Biodiesel

- It is much more expensive than petroleum diesel.
- It is more sensitive to cold weather than petroleum diesel.
- It apparently increases nitrogen oxide (NO_x) emissions in most engines.

DOE-supported researchers are working with the U.S. Department of Agriculture and the National Biodiesel Board (NBB) to address some of biodiesel's commercialization challenges and set some research and development priorities. Earlier this year a Biodiesel Research Coordination Meeting was held in Chicago to address topics such as emissions, engine performance and technologies, and processing methods for biodiesel. Short-term research priorities include developing and demonstrating process technologies that use low-cost oil and grease sources, and developing NO_x emissions reduction technologies.

Additionally, the National Renewable Energy Laboratory's (NREL) Biodiesel Project and NBB are sponsor-

What Is Biodiesel?

Biodiesel is a domestically produced renewable fuel that is made by reacting alcohol (usually methanol or ethanol) with vegetable oils, animal fats, or recycled cooking greases. It can be used neat (pure) or in blends (the most popular is a 20% biodiesel blend) with any type of diesel fuel.

Biodiesel has 90%-95% of the energy content of #2 diesel fuel. It contains no aromatics or sulfur, has a high cetane number (which gives it good ignition capabilities), and is a superior lubricant. It reduces emissions of many exhaust pollutants such as carbon monoxide, sulfur dioxide, and particulates. A recent life cycle assessment, *Overview of Biodiesel and Petroleum Diesel Life Cycles* (available at www.ott.doe.gov/biofuels/pubs.html), indicates that net emissions of carbon dioxide and other greenhouse gases are very low.

ing a series of five educational workshops this summer to familiarize people with biodiesel and its benefits. The 1-day workshops are designed to provide access to high-quality information on biodiesel feedstocks, production, economics, operational issues, and emissions to fleet managers, local air quality regulators, Clean Cities stakeholders, and the public. With the recent release of the alternative fuel vehicle credit for fleets using B20 (see article on p. 4), part of each workshop is devoted to explaining the nuances of the new rule. Workshops were held in Bloomington, Minnesota, on May 17 and 18; College Park, Maryland, on June 16; and Diamond Bar, California, on July 20. Future workshops will be held in Providence, Rhode Island, on August 25, and Chicago, Illinois, on September 15. For more information, contact Cricket Pierce at 303-275-4326.

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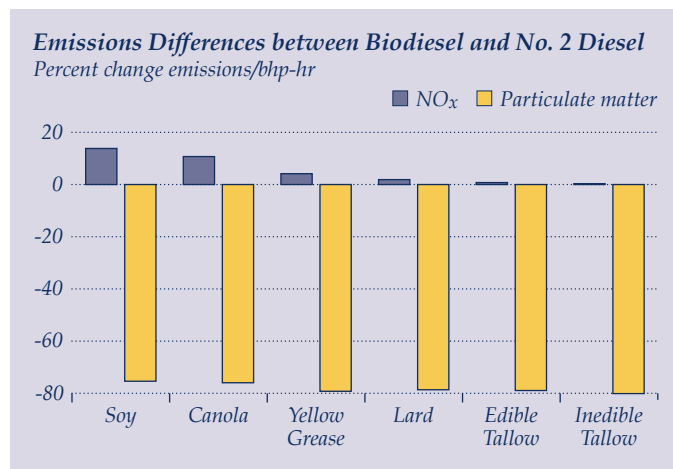


Biodiesel-powered 24-foot Zodiac "Sunrider," which sailed around the world in 1994.

National Biodiesel Board/PX07616

Nitrogen Oxide Emissions

Biodiesel is thought to increase NO_x emissions in diesel engines, possibly because of its oxygen content. But according to Shaine Tyson, manager of the Biodiesel Project, this may not be the case. A program that started last year indicates that not all types of biodiesel increase NO_x to the same degree. "Preliminary results are very promising," says Tyson. "Biodiesels from different feedstocks affect emissions differently. Vegetable oil-based biodiesel caused higher NO_x emissions than did fuels composed of animal fats and recycled grease, and all the fuels had about the same oxygen content—10%–11%. Very low NO_x emissions appear to be associated with very large particulate matter reductions."



Low-Cost Solutions

Biodiesel has limited market potential until its cost can be reduced. Several producers and academic groups have offered to share their information on biodiesel processing technologies with NREL in a joint effort to find low-cost solutions to biodiesel production. DOE has responded to this issue by releasing a request for proposals that identifies the research targets for a new oil crop that can produce larger supplies of low-cost biodiesel feedstocks. Selection criteria outlined in the request state that the crop must:

- Be inedible and have no value as an industrial feedstock.
- Be produced for less than \$0.09/lb at the farm gate and have the near-term potential to reduce costs to less than \$0.07/lb.
- Yield 2,000 lb/acre, with the potential to produce more than 2,400 lb/acre.
- Have an oil content of 25%–40%; the non-oil fraction (which should already have a large or diversified market) should have a market value of at least \$0.13/lb.
- Have high levels of oleic, erucic, and palmitoleic acids, and less than 5% levels of other fatty acid compounds.
- Be able to support the production of 3 to 10 million acres over time.



IN THE SPOTLIGHT

Diesel plus Ethanol: A Marriage Made in the Midwest



GMC WIM-64T ethanol powered heavy-duty truck.

It's called oxydiesel, and it's a blend of 80% diesel, 10% corn-derived ethanol, and 5% proprietary blending agents and additives that prevent the two fuels from separating.

This fuel, developed by Pure Energy Corporation of New York, is being demonstrated in two separate projects:

Archer Daniels Midland is testing two Mack trucks (with a third control truck that runs on standard diesel fuel) for 1 year and 100,000 miles; and Chicago Transit Authority is testing it in 15 urban transit buses. Both projects use oxydiesel in unmodified diesel engines, which will undergo extensive evaluation for durability and wear following the test period.

Preliminary results indicate that oxydiesel can reduce

"The additive... represents a significant breakthrough in blending two very different fuels such as ethanol and diesel. We will be able to take full advantage of the benefits of each fuel to create a new cost-effective, low-emission diesel fuel that can be used in both new and existing diesel engines."

Irshad Ahmed, Senior Vice President and Chief Science Officer, Pure Energy Corporation





FUELING THE ENVIRONMENT

Voluntary Biodiesel Demonstration Program a Success

Beginning in early 1998, the Medford (New Jersey) Township Public Schools voluntarily started a 4-year demonstration program for B20 (made from soybeans). In its fleet of 40 buses, 20 are operated on B20; the rest are diesel controls. Most of the program cost is covered by DOE, which paid to install a new fueling tank and for the incremental cost of the fuel. The State of New Jersey has made in-kind contributions.


"There was plenty of skepticism about the program at first," says Joe Billuck, maintenance and operations manager. "Drivers did not want to relinquish the comfort level they had with petroleum diesel. But with B20 they didn't have to. The vehicles operate the same way, there are no engine modifications, no special infrastructure requirements, and (after 18 months) no fuel-related operational problems. So far everyone is positive about the fuel, and likes the fact that exhaust from these vehicles does not have the same bad odor as petroleum diesel."

The fleet also conducts dynamometer tests to document emissions changes on these vehicles. The final results are more than 2 years away, but preliminary data

Initial Criticism Turns to Praise

The bus fleet includes a very important vehicle—a bus that transports mentally and physically handicapped children ages 3 to 12 to and from school. Early in the program, its driver told Joe Billuck that he had made an unwise decision to use B20. After all, he was under no federal or state requirement to use it, and there was no monetary gain associated with the program. A couple of months later this driver apologized. She explained that, during the winter months, the children in wheelchairs have to wait for the lift near the exhaust pipe to load onto the bus while the engine idles to keep the cab warm. The fumes from diesel fuel were quite noxious; the B20 fumes have a much more pleasing odor and less toxicity. "These kids have so much to deal with already," said Billuck. "I'm glad we can make their bus trips a little easier."


suggest reductions in total hydrocarbons, particulate matter, carbon monoxide, and nitrogen oxides. There is a slight increase in tailpipe carbon dioxide emissions.

So why use B20? Because it works. Because it reduces odors. Because it reduces emissions. Because there may soon come a time, speculates Joe Billuck, when school bus fleets may be subject to federal and state air quality requirements, and being ahead of that game can only be a good thing. 

"The successful blending of ethanol and diesel fuel will reduce harmful emissions from trucks and buses, and stimulate the agricultural economy and the ethanol industry in Illinois and across the nation."

Illinois Governor Jim Edgar

particulate and nitrogen oxide emissions from heavy-duty vehicles by as much as 40%. It is readily biodegradable, has lower ash and sulfur contents than diesel, and performs well at low temperatures. Initial cost estimates indicate that oxydiesel will cost only a few cents more per gallon than conventional #2 diesel fuel.

According to Archer Daniels Midland, if oxydiesel were to achieve the same market penetration as ethanol-blended gasoline (currently 12%), the additional demand for ethanol would exceed 486 million gallons annually. 

The ASTM Provisional Standard for Biodiesel

In December 1998, the American Society for Testing and Materials (ASTM) approved a provisional standard for biodiesel used as a transportation fuel. For more information, contact Steve Howell at the National Biodiesel Board (800-541-5849, or visit the web site: www.nbb.org).

This standard (ASTM PS 121) distinguishes fuel-grade methyl esters (the chemical name for bio-diesel) from industrial-grade methyl esters, and can be used for as long as 2 years while the precision and accuracy data for each test method are generated to support the final standard.



ON THE FEDERAL FRONT

A Breakthrough for Biodiesel: An Interim Final Rule on B20

In May 1999 DOE issued an interim final rule on B20. This rule appears to offer some very low-cost options that can save money for federal and state fleets. A fleet may receive one alternative fuel credit for every 450 gallons of biodiesel used during a compliance year. There is no limit to the number of credits a vehicle can generate. The basic components of the rule are:

- A covered fleet may use any heavy-duty or diesel vehicle that weighs more than 8,500 lb.
- The fleet must use 450 gal of pure biodiesel at 20% blends or higher during the compliance year.
- The fleet receives no credit for the diesel fraction of the fuel.

The limitations of the rule are:

- A fleet cannot use B20 to satisfy more than 50% of its alternative fuel vehicle (AFV) purchase requirements.
- The credits may not be sold or traded.

- The credits are good only for the year they are generated, unless the fleet uses B20 for 50% of its requirements and purchases additional AFVs (above and beyond its requirements). In this case, the extra AFV purchase credits carry over into following years, and may be sold or traded.

The B20 AFV credit option meets the Energy Policy Act's (EPACT) objective of reducing our dependence on imported petroleum by requiring fleets to purchase fuel if they select the option. According to the National Biodiesel Board, B20 vehicles will displace more petroleum than will light-duty EPACT passenger vehicles because diesel engine vehicles consume more fuel.



"Although biodiesel is more expensive than conventional diesel fuel, agencies could save money if they chose to use biodiesel fuel mixtures... because agencies would incur no additional capital costs.... Such savings would average about \$10 million a year."

Congressional Budget Office



DID YOU KNOW?

Upcoming Conferences and Events

4th Biomass Conference of the Americas

August 29–September 2
Oakland, California
www.nrel.gov/bioam

10th International Rapeseed Congress:

New Horizons for an Old Crop

September 26–29
Canberra, Australia
Phone: +61-2-6257-3299
email: rapeseed@acts.ccmil.com
compuserve.com

3rd European Motor Biofuels Forum

October 10–13
Brussels, Belgium
Phone: +31-30-6933-489
Fax: +31-30-6917-394
email: info@europoint-bo.com

