Biodiesel Clears the Air in Underground Mines

Biodiesel has many advantages over petroleum diesel for people who live and work aboveground, but it is even more beneficial for those working underground. Because it produces less particulates when it burns, biodiesel fuel protects miners and helps mine operators meet air-quality standards.

Clearing the Air

Each year, vehicles and equipment in U.S. underground mines use up to 1 million gallons of diesel fuel per site. In fact, the nation's 34,000 underground miners can be exposed to more than 100 times the typical amount of diesel particulate matter (DPM) found in aboveground air. Because DPM exposure has been linked to numerous heart and lung diseases, the U.S. Mining Safety and Health Administration (MSHA) recently strengthened its underground mine DPM exposure standard.

Mines can meet this requirement through a number of strategies: improving ventilation, using vehicles with specially sealed and pressurized cabs, improving maintenance, installing emission control devices, and using biodiesel. MSHA found that a biodiesel blend of B35 (35% biodiesel, 65% petroleum diesel) or higher produced significantly lower DPM emissions than pure petroleum diesel.

Clean, Safe, Compatible

Biodiesel is produced from renewable sources such as new and used vegetable oils and animal fats. Although pure biodiesel has 7% less energy per gallon as compared to petroleum diesel, it is cleaner burning, nontoxic, and biodegradable. Highway diesel engine tests have shown that biodiesel reduces not only DPM, but also emissions of several pollutants compared with petroleum diesel. These reductions increase as the amount of biodiesel blended into diesel fuel increases. Biodiesel also has a higher flash point than petroleum diesel, which makes it less likely to ignite.

Stillwater Mine

Load-haul-dump vehicle in Stillwater Mine near Nye, Montana.

Biodiesel is compatible with most diesel vehicles and equipment. Several engine manufacturers approve B20 use so long as the biodiesel meets the fuel quality specification ASTM D 6751. Some manufacturers approve even higher blends.[1] In fact, a four-year U.S. Department of Energy study showed little difference in engine wear or maintenance costs between highway vehicles running on B20 and vehicles using petroleum diesel.[2] Likewise, MSHA has received no negative feedback from mines that use high biodiesel blends, including B99.

Some older diesel equipment should be upgraded before using biodiesel. Upgrades may include replacing hoses and gaskets and annually replacing rubber hoses and fuel pump diaphragms. Also, when biodiesel is first used, it can strip away buildup in the fuel lines and engine, which can clog engine filters. To prevent this problem, fuel tanks should be cleaned before using biodiesel for the first time. And, it may be necessary to replace the first filter after 30 to 50 hours of operation.

Common Mining Equipment and Vehicles

- Front-end loaders
- Haul trucks
- Scalers
- Face drills
- Roof bolters
- Graders
- Grease rigs
- Tractors
- Water, service, or explosives trucks

[1] Automakers' and Engine Manufacturers' Positions of Support for Biodiesel Blends. *www.biodiesel.org/resources/oems/default.aspx*.

[2] DOE, NREL, RTD, and Cummins, Inc. 100,000-Mile Evaluation of Transit Buses Operated on Biodiesel Blends (B20), 2006. *www.biodiesel.org/resources/reportsdatabase/reports/tra/20061001_tra-55.pdf*.

Air Quality Studies

For mines, biodiesel's greatest strength is its potential for air quality improvements, as documented in two MSHA studies of Carmeuse limestone mines in Kentucky[3]. In the Black River mine study, B35 use resulted in DPM reductions between 16% and 33%. Inside equipment cabs, where DPM concentrations are higher, the DPM reductions were between 40% and 55%. In the Mayfield mine study, B50 use resulted in DPM reductions between 49% and 71%. Since the studies were done, both mines have switched to using B99, with the help of the Commonwealth Clean Cities Partnership. "It's been well received by the guys who have to work down there every day," says Carmeuse mine manager Bob Mondron. Other mines using biodiesel, including a Barrick gold mine in Nevada, have reported similar improvements. Combining methods can further improve air quality. For example, the Stillwater palladium and platinum mine, Montana's largest biodiesel user, uses B70 in conjunction with emission control devices.

Business Case

Biodiesel usually costs more than petroleum diesel; for example, B100 averaged 75 cents per gallon more than petroleum diesel over the past several years. However, tax incentives and the avoided cost of other air-quality measures can make it an economical solution. A federal tax credit that runs until December 2009 lowers the cost of biodiesel blends by one cent per gallon per percent of biodiesel. In addition, the use of biodiesel can allow mines to meet the MSHA DPM standard without emission control devices or costly ventilation system modifications. Without the use of biodiesel, companies can pay thousands of dollars to retrofit and regularly clean emission control devices on each piece of equipment. Similarly, even though Stillwater Mine has paid up to 39% more for biodiesel than petroleum diesel, the mine reports that using biodiesel is still economically sound, as the ventilation modifications needed to achieve the same reductions would cost millions of dollars.

For More Information

See the Biodiesel Handling and Use Guidelines on the AFDC Biodiesel Web site (*www.afdc.energy.gov/afdc/fuels/biodiesel.html*) or contact CCCP Coordinator Melissa Howell (*kycleanfuels@insightbb.com*) or General Chemical's Dustin McGillvray (*dmcgillvray@genchem.com*).

Challenges and Solutions

Using biodiesel in mines does pose some challenges. High biodiesel blends can gel in cold weather, particularly biodiesel derived from non-soy feedstock. Although most mining equipment operates underground where the temperature is consistently 50° to 60°F, some mines do store certain pieces of equipment aboveground. During a cold spell, a General Chemical trona mine in Wyoming had B40 in 80 pieces of machinery gel, forcing mechanics to change filters until the gelled fuel was processed.

Mines can overcome gelling with methods similar to those used for cold-sensitive chemicals. Specially designed rail cars can be warmed with steam, and some biodiesel transporters already use this method. Mines can also store biodiesel in heated, indoor, or underground tanks. Other methods include moving biodiesel trains or trucks into heated buildings, installing heaters for fuel line filters, using additives that reduce cold effects, and switching between blends seasonally. The Stillwater Mine uses B70 for all vehicles in the summer and switches surface-parked vehicles to B20 in the winter.

In addition, biodiesel can grow bacteria or form deposits or acids, which can interfere with filters and fuel injection systems. Minimizing water in storage tanks, adding fuel additives, and using fuel within three to five months limits or eliminates these problems.

Clean Cities Assistance

The Carmeuse mines switched to biodiesel in part because they were a member of the Commonwealth Clean Cities Partnership (CCCP), which provided them with technical assistance. CCCP's Coordinator Melissa Howell spoke to mine managers regularly, learning about the industry and educating company leaders about biodiesel. Clean Cities coordinators can help mine operators connect with a reliable supplier, especially in rural areas that lack an extensive biodiesel distribution network. Coordinators may be able to provide advice on where to obtain training in biodiesel handling and blending. Coordinators can also supply operators with reports about the experiences of biodiesel users and help plan a vehicle test program.

[3] MSHA. Environmental Diesel Particulate Matter Investigation, 2003. *www.biodiesel.org/resources/reportsdatabase/reports/min/20030206_min-015.pdf* and *www.biodiesel.org/resources/reportsdatabase/reports/tra/20061001_tra-55.pdf.*

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