

Washington State University Extension Energy Program

Fuel/Water Emulsions

Diesel/water emulsions combine about 80 percent diesel, 20 percent water and about 1 percent surfactants and additives. The additives are included to maintain the emulsion, enhance the lubricity, inhibit corrosion and protect against freezing. The presence of water in the emulsion reduces both particulate matter (PM) and nitrous oxide (NOx), by lowering the combustion temperature and altering the combustion pattern to more completely burn the carbon in the fuel.

The primary producer of diesel/water emulsions is the Lubrizol Corp. Lubrizol calls its fuel PuriNOx, which is a diesel/water emulsion in which the diesel fuel is the continuous phase and the water is emulsified. These components are mixed in an electronically controlled, automated blending unit to produce a stable, finished fuel. During the blending process the special additive surrounds the water droplets to prevent the water from separating out of the mixture. The encapsulation prevents the water from contacting any metal engine parts, thereby allowing the fuel to perform in a similar fashion to conventional diesel. Lubrizol states that its PuriNOx fuel can be used in existing new and old diesel engines, with and without after-treatment add-ons and without engine modifications or replacements. Potential applications include centrally fueled on and off-road uses including school bus and transit fleets, construction and agricultural equipment, as well as coastal marine ships and stationary power generators.

Emissions

The California Air Resources Board (CARB) has verified PuriNOx fuel's ability to reduce both NOx and PM emissions and issued the Lubrizol Corp. an *Interim Verification of Emission Reductions for Alternative Diesel Fuels*. In their letter to Lubrizol, CARB staff determined that the use of PuriNOx fuel reduces PM emissions by 62.9 percent using the interim procedure.(1) The Port of Houston is using PuriNOx fuel in its mechanical cranes and docking equipment.(2) PM reductions ranged from a high of 82 percent for a tour boat powered by a 1984 DDC V12 72 engine, to a 3.8 percent increase in a 1958 DDC 4 71 generator engine. The average PM reduction for the emission tests conducted by the Port was 43 percent. The baseline fuel was off-road diesel No. 2.

The San Francisco Bay Water Transit Authority recently completed a pilot program using PuriNOx in one of its ferry vessels. Emissions testing of the vessel after a period of operation revealed a 42 percent reduction in particulate matter. (3) CARB's recognition of the emission reduction potential of PuriNOx fuel has made it eligible for clean air funding programs in California. The Lubrizol Corp. is in the process of registering PuriNOx fuel with the U.S. Environmental Protection Agency.

Cost

PuriNOx fuel is delivered on-site as a complete fuel product. The Massachusetts Turnpike Authority reported a cost premium for PuriNOx of 15 cents per gallon above No. 2 diesel. The San Francisco Bay Water Transit Authority paid from 14 to 18 cents per gallon more for PuriNOx fuel (3).

Other issues

The presence of water in emulsion fuels decreases the volumetric energy content, which causes a reduction in fuel economy. The San Francisco Bay Water Authority (WTA) reported a 15 percent decrease in fuel economy when using PuriNOx fuel (PC), and a power loss of 8 to 12 percent. The WTA also noted that PuriNOx fuel will "clean out" the fuel delivery system and attention to fuel filter clogging needs to occur during the early phases of use. (3)

The State of Texas is currently investigating the use of PuriNOx in over 500 pieces of on-road and off-road equipment. Early indications are that they are experiencing power losses of as much as 20 percent for some equipment. (4)

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PuriNox is produced by the Lubrizol Corp. and is delivered pre-mixed to the end user. The company has three blender/distributor partners in North America. There are no confirmed reports of PuriNox fuel being used in Washington State.

References

1. California Air Resources Board, Emissions Verification letter to Lubrizol, January, 31, 2001.
2. Lubrizol Corporation, *Final Test Report-In –Use Air Emission Sampling, Analysis and Reporting for the Port of Houston Authority*, Houston, Texas, December, 2001.
3. Personal Communication, Mary Culnane, Manager, Marine Engineering, San Francisco Bay Area Water Transit Authority, September, 2002.
4. Personal Communication, Don Lewis, Fleet Manger, Texas Department of Transportation, October, 2002.