FUEL ADDITIVES: PART III

In Parts I and II of this series we discussed evaluating fuel additives, the claims made by their manufacturers, and differing approaches toward mitigation of the most common fuel contaminant: water. In this third segment, we'll look at lubricity improvers and why they may be worth considering.

Lately, there's been a great deal of publicity, some would say hype, about diesel fuel's lubricity—its slipperiness component. The reason the worry level has increased of late is related to the decrease in sulfur mandated for on-road diesel starting in 2007. At that point, most on-road diesel had to meet a 15-part-per-million (ppm) standard (lowered from 500ppm).

Myth buster fuel factoid: sulfur is not a lubricant. I cringe whenever I read or hear this from a self-styled expert or salesman. Rather, the process by which sulfur is removed from diesel fuel, using steam and called hydro-treating, collaterally removes some of fuel's lubricity as well. Rest assured, however, engineers who spec fuel quality and operate refineries are well aware of this issue and they have in place protocols to deal with the decreased lubricity; they simply add lubricity agents at the fuel "rack," where fuel is dispensed.

Herein lies the problem, and not to sound too alarmist, but mistakes can happen when it comes time to add these agents. In fact, according to the folks at Power Service (www.powerservice.com), an additive manufacturer that operates its own testing lab, approximately 40 percent of the "ready for sale" fuels obtained in North America during 2010 did not meet the 520 HFRR (more on what that means in a moment) maximum specifications when tested at Power Service's lab (81 of 202 samples). Fifty six of the samples exhibited an average wear scar of 624 microns, sobering numbers to be sure. As a point of clarification, the 15ppm requirement for on-road diesel does not apply to fuel purchased off road, i.e., for use in boats. However, most fuel distributors are unable or unwilling to stock and distribute both low sulfur diesel, 500 ppm, and ultra-low sulfur diesel (ULSD), 15ppm. Therefore, ULSD is likely being shipped to many off-road retailers, including fuel docks.

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Other than visible water and sediment, just by looking at it there's no way to tell if diesel fuel has the right characteristics, especially lubricity.

Lubricity is important because of the fine tolerances of the components within the fuel injection system, some of which are measured in ten-thousandths of an inch. If the fuel's lubricity is too low, fuel injectors and high-pressure pumps will be improperly lubricated, which will lead to their untimely demise. They will essentially grind themselves to death. What's most insidious about this type of failure is that there are typically no outward symptoms—the engine runs just fine, there's no smoke or knocking, and fuel economy remains normal until the engine becomes difficult to start or the injection pump fails, by which time the damage is done.

HFRR And What It Means

Diesel fuel sold within the United States is required, technically, to meet an ASTM standard, D975, which as of 2005 includes a lubricity standard. The lubricity is measured using a device called a High Frequency Reciprocating Rig or HFRR. This testing tool essentially places a load on a bearing for 90 minutes and uses fuel as the lubricant. After the test is complete the size of the wear scars on the bearing are measured. The ASTM standard limits the size of such scars to 520 microns. A micron is pretty small, a millionth of a meter, however, considering the duration of the test, just 90 minutes, it's telling (the larger the scar, the poorer the lubricity). If the fuel meets that standard all should be well, sort of. You see, some engine and fuel injection system manufacturers don't believe the rating is conservative

enough. John Deere, for instance, calls for fuel that is slipperier, making 450-micron or smaller wear scars, which would require the use of a lubricity additive to lower the HFRR number. Interestingly, an HFRR of 460 is in line with the European standard for diesel fuel, EN590. The Europeans run a heck of a lot of diesel-powered automobiles and trucks (60 percent of their passenger cars are diesel-powered) and thus, in my opinion, this tack is worthy of our attention. And, as was detailed above, it's possible that some fuel may indeed not meet the minimum 520-micron requirement at the pump.

An Expert's Point Of View

I posed the question of out-of-spec fuel lubricity to a colleague, Rick Chapman. My fuel answer man for some time, Rick recently retired from BP after 30 years, ultimately as a senior quality product advisor and now he's industry liaison manager for Innospec (http://www.innospecinc.com/fuel-specialties.html), the largest dedicated fuel additive manufacturer in the world. Here's what he had to say: "Because ASTM D 975 Standard Specification for Diesel Fuel requires that diesel fuel meet a minimum lubricity of 520 microns HFRR, every gallon of diesel fuel sold in the United States theoretically gets the proper amount of lubricity additive put in at the terminal rack. However, lubricity is typically not monitored at the terminal (or only in an 'after-the-fact' way) and things can go wrong once in a while. If a customer feels that they want to have extra protection, they can always add more. Synthetic, non-acid type lubricity improvers are preferred because they prevent interactions with other additives or contaminants that may cause filter plugging and fuel system deposits."

As you can see, there's ample reason for concern regarding lubricity. Considering that, adding a lubricity improver is probably not a bad idea, particularly for high-pressure common rail engines, as they place a greater burden on fuel for lubrication of injection components (they operate at 25000 to 30000psi).

In the next installment of this series we'll continue the discussion on choosing lubricity improvers along with discussing performance enhancing additives and cetane boosters.—Steve D'Antonio