BIOdiesel TechNOTES

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HANDLING AND STORAGE OF BIODIESEL

Biodiesel can be blended with petro-diesel and in some cases it is used as a drop-in replacement. In many ways it is a superior fuel for diesel engines with its excellent lubricity, high cetane number, biodegradability and lower tailpipe emissions. However, there are some unfavorable differences. In general, biodiesel has a higher cloud point, a shorter shelf-life and is more hygroscopic (water absorbing) than diesel. Hence, it should be handled and stored accordingly for maximum performance.

First, all tanks, fittings, hoses and gaskets must be made of biodiesel compatible materials. Materials in contact with biodiesel must avoid containing zinc, copper and brass. Buna-N, nitrile, and natural rubber hoses and gaskets will soften and degrade. See our Technote #30 (Material compatibility) for more information.

The ASTM D6751 standard developed for biodiesel dictates certain properties or characteristics the fuel must meet in order for it to be called biodiesel and certified. To meet these stringent conditions, the fuel must be produced properly and, in most cases, must also be additized (the addition of a performance product) to comply. See our Technote #29B (ASTM tests explained) for more information.

Post production, each lot or batch of biodiesel is generally stored in one or more tanks while samples are tested for certification before it can be shipped out or dispensed for use. These tanks must start-out clean and dry and be well maintained to keep out water and oxygen. This can be done with small tanks by keeping them full and sealed. Large tanks can employ a floating lid and/or a nitrogen blanket that effectively keeps the moisture and oxygen away from the stored fuel as the level drops.

There are many products that can enhance certain qualities of biodiesel. To improve shelf-life, an antioxidant should be added to meet the oxidative stability specification. See our Technote #12 (Comparison of oxidative stability additives on biodiesel) for more information.

When ambient temperatures are below the cloud point, an anti-gel should be added to keep the fuel flowing. The cloud point of biodiesel varies with the feedstock used to make it but is generally 30 to 32°F. The cloud point for petroleum diesel ranges widely from -31 to 23°F.

Anti-gelling agents tested here at the University of Idaho have showed minimal effect on the cloud point but much more promise in lowering the pour point of biodiesel; in some cases, more than a 30°C improvement. As long as the temperature is at or above the pour point, the fuel can still be pumped from one place to another but ideally storage tanks as well as vehicle tanks should be maintained at a temperature above the cloud point for optimum operability. Alternatively, winterized diesel can be blended at a rate that suits the environment. See our Technote #3 (Impact of additives on cold flow properties of biodiesel) for more information.

In order to assure quality, especially in conditions of high humidity and widespread temperature variations, a biocide can be used as added protection against microbial growth. This was found to be particularly helpful for the Washington State Ferry system during their transition to a B20.

Once the biodiesel is ready to be moved from the production facility to the ultimate end user it is subject to contamination as it moves through the distribution and storage system network. As improvements to diesel engines require tighter tolerances, fuel suppliers needed to improve their systems. Otherwise, poor fuel performance may be blamed on biodiesel.

Corroded metal from distribution and storage system networks, which is typically iron, may liberate rust and other particulate. Filtration should be implemented between all fuel transfers. Water is the most common contaminant and can lead to many problems if not controlled. All tanks should be constructed with adequate water removing capability and have active tank water management.

B100 should be stored at temperatures at least 5°F to 10°F higher than the cloud point. For biodiesel made from soybean oil, that is 37 to 40°F. Below ground tanks generally keep temperature above 45°F. Otherwise, storage tanks should be insulated and heated to 5-10°F above the cloud point. Protection from cold includes fuel pumps, lines, and dispensers. If crystals begin to form, they will go back into solution as the fuel warms.

If blending biodiesel with diesel, consider blending as soon as practical. Some companies that provide biodiesel blends store biodiesel as B50 and formulate the various blend levels from that starting point. This strategy has the advantage of added stability and better cold weather protection.

Although blending biodiesel with diesel is a major concern to some, it is relatively easy and blending in the fuel industry is common. The fact is fuel suppliers have successfully been blending ethanol, additives and dyes for years and blending biodiesel is essentially the same.

The blending process is generally done by in-line blending, where biodiesel is added to a stream of petro-diesel as it flows through a pipe, or splash blending. In-line is the best and most common method at terminals because the computers do most of the work. Splash blending is also common at terminals and elsewhere. There are several variations of splash blending. The bottom-loading fuel trucks at terminals easily make a homogeneous blend. It is much like breaking the yolk on a sunny-side-up egg. Once the yolk is broken it is difficult to have anything but scrambled eggs.

Splash blending is particularly common with biodiesel because it is an emerging industry and there are many operations that cannot afford industry blending equipment. Biodiesel is slightly heavier than petroleum diesel (specific gravity is 0.88 compared to 0.8) and they easily and completely mix. Splash blending does require some math; like when fueling a partially full tank.

Extra care needs to be taken when blending in cold weather. Additional steps need to be taken when putting biodiesel into an empty and cold tank or blending in petroleum diesel that is below the cloud point. Agitating the two fuels by using the dispenser pumps to recirculate the fuel in the tank is very effective. Agitation also helps dissolve any crystals that may have formed.

Regardless of how or where biodiesel is used, there are some precautions that should be followed. Older diesel fuel tanks generally have a layer of sediment that can be dissolved by biodiesel due to its excellent solvent ability. This can lead to partially dissolved diesel sediment then filter plugging for a period of time after the tanks are filled with biodiesel. Users should be prepared to change the fuel filter if it becomes clogged. Older flexible fuel hoses may also deteriorate with biodiesel and should be carefully monitored and replaced with compatible lines if they start to soften and leak.

High blend level users should be aware of the cloud point of their fuel and take necessary measures to avoid getting stranded during cold weather operation of biodiesel use.

For more detailed information, please consult the document of Biodiesel Handling and Use Guide prepared by NREL.