



# It's in the Tank: Strategies for Maintaining Standby Generators Powered by Biodiesel

*By Eric Plebuch*

## Introduction:

In a contemporary marketplace where a continuous source of electricity is less a convenience than a necessity, most businesses recognize the value of investing in an emergency generator set. Not only do these standby power systems allow companies to minimize costly instances of downtime by supplying electricity to critical loads when the grid goes down, they also power systems vital to employee and customer safety during an outage, such as lighting and HVAC units.

Due to the risks inherent in storing large quantities of natural gas, most companies with large critical and emergency loads opt for diesel standby generators over gas units. While a diesel generator can be instrumental in protecting a business from the staggering costs of a grid outage, any generator can fail if it is not properly maintained. Invariably, facilities managers are aware of this hazard, and they perform routine maintenance on their generators to minimize the risk of failure. Unfortunately, many overlook the fact that generator fuel, like a generator itself, must be properly maintained.

While fuel maintenance is critical regardless of what type of diesel is being used, the introduction of biodiesel into the marketplace has made fuel maintenance particularly important. Not only is the shelf life of biodiesel signifi-

cantly shorter than that of standard diesel, its innate properties can cause problems that lead to generator damage if precautions are not taken. But the most startling aspect of biodiesel that eludes the knowledge of many operators of standby generators is the simple fact that biodiesel is already in their generator's fuel tank.

Many states have begun mandating biodiesel use, requiring that all diesel fuel sold within the state contain a minimum percentage of biofuel. Diesel sold in the state of Oregon has contained no less than 2% biodiesel since the implementation of House Bill 3463 in 2009. Because the bill originally required a 2% biodiesel minimum but did not require dispenser labeling for mixtures containing less than 5 % biodiesel, many operators of standby generators were unaware of the fact that they were filling their fuel tanks with biofuel. While House Bill 3463 was recently amended to increase the biodiesel minimum to 5%, requiring dispenser labeling for all biodiesel sold within the state, many consumers are still unaware of the risks of using biodiesel in standby applications.

While biodiesel can cause problems with generator sets that are far less likely with the use of standard diesel, there are precautions that generator operators can take to protect their standby units.

## Biodiesel: It's the Law

In 2009, the Oregon Legislature passed House Bill 3463, which stated, "A retail dealer, nonretail dealer, or wholesale dealer may only sell or offer for sale diesel fuel in Oregon containing at least two percent by volume biodiesel."<sup>1</sup> This bill not only mandated a two percent biofuel minimum for all diesel purchased in the state of Oregon, it also allowed mixtures containing as much as 20 percent biodiesel to be sold from standard diesel dispensers. Recent amendments to House Bill 3463 have increased the biodiesel minimum from two to five percent.

\*\*\*UPDATE\*\*\*

In 2013 the Oregon Legislature passed HB 3448 which states: "Exempts diesel fuel sold to facilities that store more than 50 gallons of fuel for use in emergency power generation from requirement to contain certain percentage of biodiesel or to contain other diesel with specified percentage of renewable component." Law becomes effective January 1, 2014.

What this means is that any facility or piece of equipment that stores more than 50 gallons of diesel is not required to meet the renewable standard initially set forth in the law of 2009.

This law change was a collaboration of both private sector interests and public entities to alleviate the inherent stability issues addressed in this white paper. This bill was signed into law by Governor Kitzhaber on May 15, 2013.

The percentage of biodiesel in a given mixture is indicated on dispensers by the letter *B* followed by the percentage of biodiesel in the mixture (e.g. B15 is fifteen percent biodiesel). It is important for consumers using biofuel for standby applications to be aware of the amount of biodiesel in their fuel as higher percentages will require more maintenance.

While the implementation of House Bill 3463 poses some challenges for operators of standby generation equipment in the state of Oregon, the regulation is prompted by the significant benefits that biofuels can offer.

Firstly, biofuels represent a renewable fuel source that could decrease the nation's reliance on fossil fuels.

Because biodiesel can be synthesized from organic material grown domestically while fossil fuels are largely exported from foreign sources (and are subject to significant fluctuations in price), the use of biodiesel could have a positive impact on the American economy. It should be noted, however, that while the U.S. Department of Energy is working to reduce the cost of biofuels, biodiesel is currently more expensive than standard diesel.

Secondly, according to a U.S. Department of Energy publication, the use of biodiesel represents "reductions in most emission components except for an increase in nitrous oxide."<sup>2</sup> Because biodiesel burns cleaner than standard diesel, its use could signify a positive environmental impact.

Thirdly, biodiesel has a more consistent energy output than standard diesel. According to a document released by Purdue University, "The energy produced by domestic biodiesel is similar regardless of oil source...whereas the energy output produced from #2 diesel fuel can vary from source to source by up to 15%."<sup>3</sup>

Lastly, biodiesel has a higher cetane number than #2 diesel. "The higher the cetane number, the shorter the ignition delay and the higher the ignition quality."<sup>4</sup>

## Challenges with Biodiesel in Standby Applications

Though the increase in biodiesel usage may eventually lead to considerable economic and environmental benefits, there are significant problems both with the innate properties of biofuels and with the laws that regulate their usage that render biodiesel imperfect for standby applications.



### 1. SHELF LIFE

While the shelf life for #2 diesel is twelve to eighteen months, the shelf life for biodiesel that has not been treated with preservatives is no more than six months in optimal conditions. Not only does biodiesel separate and congeal as it ages, it is also especially susceptible to degradation caused by various environmental factors. When a biofuel mixes with oxygen, for example, sediment can form, which can damage a unit's fuel system. Biofuels made from unsaturated fats (i.e. vegetable oils) are particularly vulnerable to oxidation. Biodiesel is also hydrophilic,

<sup>1</sup> "Biofuel Renewable Fuel Standard." *Oregon.gov*. ODA Measurement Standards Division, 22 Feb. 2011. Web. 11 Mar. 2011. <[http://oregon.gov/ODA/MSD/renewable\\_fuel\\_standard.shtml](http://oregon.gov/ODA/MSD/renewable_fuel_standard.shtml)>.

<sup>2</sup> Hofman, Vern. "Biodiesel Fuel." *NDSU Agriculture*. North Dakota State University, Feb. 2003. Web. 11 Mar. 2011. <<http://www.ag.ndsu.edu/pubs/ageng/machine/ae1240w.htm>>.

<sup>3</sup> Conley, Shawn P., and Bernie Tao. "Biodiesel Quality: Is All Biodiesel Created Equal?" *Renewable Energy: Bio Energy*. Purdue University, Dec. 2006. Web. <<http://www.extension.purdue.edu/extmedia/ID/ID-338.pdf>>.

<sup>4</sup> *ibid*



and as it accumulates water from the air or from condensation inside the delivery system, it creates acid that can damage the fuel's storage container. Finally, heat and sunlight can expedite biofuel degradation.

If degraded fuel is run through an engine, filter plugging, injector problems, sticking or breaking piston rings, and engine lubricant degradation can occur. While the shelf life of biodiesel can be increased with additives and fuel enhancers, biodiesel that has begun to degrade cannot be remedied and should be disposed of.



## 2. COLD WEATHER CHARACTERISTICS

In cold temperatures, fuel freezes into a paraffin wax, and this process of waxing is expressed in three measurements: cloud point (CP), cold filter plug point (CFPP), and pour point (PP). A fuel's cloud point is the temperature at which solid crystals begin to appear in the fuel. The cold filter plug point is the temperature at which a fuel has waxed enough to cause an engine filter to plug. The pour point is the lowest temperature at which a fuel can be poured from container to container. The cold filter plug point is the most useful measurement of a fuel's cold weather characteristics as the use of fuel at the CFPP or below can cause engine damage.

The use of biofuel in cold temperatures can be problematic for two reasons. Firstly, "Compared to petro-diesel, biodiesel tends to have a much narrower range of temperatures between the cloud point and the pour point."<sup>5</sup> In some biodiesels, this range is only a few degrees, so a biofuel can quickly become useless after it reaches its cloud point. Secondly, biodiesels derived from different sources (e.g. soybean oil, corn oil, animal fat) have different freezing points, so it difficult to determine the CFPP of a biodiesel if the feedstock is unknown.

While "low blends of biodiesel tend to perform the same as diesel fuel in cold weather,"<sup>6</sup> higher blends can reach the cold filter plug point at much higher temperatures. So for operators of standby generators, it is important to know both the percentage of biodiesel in their fuel and the feedstock from which their biodiesel is derived. With the use of biodiesel that has a high CFPP, heaters can be affixed to fuel tank to prevent waxing. There are also additives available that decrease the CP temperature.

Running an engine with a biofuel that has reached its CFPP will cause filters to plug and may lead to engine

damage. Once a biodiesel has waxed, it cannot be used and should be disposed of.



## 3. ALGAE BLOOMS

Any diesel fuel expands and contracts, and during contraction, room is left in the fuel tank for condensation (i.e. water accumulates inside the tank). Because water encourages microbe growth and because biodiesel naturally collects water, biodiesel is much more susceptible to algae blooms than standard diesel. Once a microbial bloom becomes large enough, it clogs injectors and fuel filters. Antimicrobial additives can help to discourage algae blooms in biodiesel.



## 4. CORROSIVE PROPERTIES

Biodiesel is a natural solvent, and it can eat through rubber rings and connectors in an engine. While fuel mixtures that are low in biodiesel are not likely to cause significant corrosion (though corrosion can still occur), corrosion can occur relatively quickly with the use of mixtures that are high in biodiesel. Facilities managers that are using such mixtures may need to replace rubber fittings with stainless steel.

Biodiesel will also eat rust that forms on the inside of a fuel tank when condensation occurs. Though this keeps the fuel tank rust free, sediment can accumulate in the fuel, which can cause engine damage. To prevent the accumulation of sediment, rust should be treated with an algacide or rust remover when the tank is empty. If rust is removed during every fuel change, it is not likely that enough will accumulate to cause sediment in the fuel.



## 5. LACK OF TESTING AND REGULATION

While stringent governmental regulations ensure the quality of standard diesel for consumers in the United States, the regulation of biofuel is still relatively lax. A fuel labeled as B5, for example, could contain as much as eight percent biofuel due to contamination or storage issues on the part of the supplier. Though House Bill 3463 does outline requirements for accuracy in the labeling of biodiesel, this accuracy is verified by fuel suppliers and is not tracked by the state. Furthermore, suppliers are not required to include their fuel's feedstock (e.g. corn, soybean, etc.) in labeling intended for consumers. Because fuels produced from different sources have different cold filter plug points, this lack of regulation is problematic.

In addition to a lack of regulation, the effectiveness

<sup>5</sup> Nowatzki, John, Dev Shrestha, Andrew Swenson, and Dennis Wiesenborn. "Biodiesel Cloud Point and Cold Weather Issues." *Extension.org*. Extension, 09 Dec. 2010. Web. 11 Mar. 2011. <[http://www.extension.org/pages/Biodiesel\\_Cloud\\_Point\\_and\\_Cold\\_Weather\\_Issues](http://www.extension.org/pages/Biodiesel_Cloud_Point_and_Cold_Weather_Issues)>.

<sup>6</sup> *ibid*

of biofuel has not been tested extensively. It is still unknown, for example, which feedstock produces the most efficient biofuel. There is virtually no data on the use of biofuels in standby applications.

## How Can Operators of Standby Generators Use Biofuels Effectively?

The selection of a trustworthy fuel supplier is instrumental in the effective use of biodiesel for standby applications. A knowledgeable supplier can provide critical information pertaining to their fuel such as the feedstock used for production, the exact percentage of biofuel in the mixture, and the additives and preservatives with which the fuel has been treated. By knowing the feedstock that produced the fuel and the percentage of biodiesel in the mixture, consumers can more accurately determine a cold filter plug point and decide whether or not measures such as fuel tank heaters should be implemented. This information can also help consumers determine the likeliness of severe algae blooms, sediment accumulation, and corrosion. Finally, a fuel with the appropriate additives can increase shelf life, discourage microbe growth, and decrease the waxing temperature of a fuel mixture.

Additives and preservatives can be added to a biofuel after purchase, but the process can be time consuming and expensive; furthermore, a trustworthy supplier should include the additives necessary to maximize the performance of their fuel. A consumer can often save

money by paying a little more for a quality biofuel instead of purchasing a cheap fuel that needs additional treatment.

Operators of standby generators can also benefit by partnering with a provider of generator maintenance and service that offers fluid analysis. Not only can a service provider perform regular tests for issues such as algae blooms and sediment accumulation, they can offer periodic fuel changes, rust removal, and general maintenance as well.

Finally, standby generator operators should know the warranty of their equipment in regard to biofuel use. The use of biofuel or a biofuel mixture over a certain percentage may void the manufacture's warranty for some generator sets.

## Conclusion:

Biodiesel may prove to be an efficient, consistent, and renewable fuel source in the future; however, its innate properties, as well as inadequate regulations pertaining to its usage, renders its use in standby applications problematic. Facilities managers can use biodiesel successfully in their standby generators by being aware of biodiesel's drawbacks, knowing the specific properties of the biodiesel they are using, obtaining their fuel from a trustworthy source, and performing fuel maintenance appropriately.

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