



**Bell Performance, Inc.** tel 407-831-5021  
1340 Bennett Drive fax 407-331-1125  
Longwood, FL 32750  
[www.bellperformance.com](http://www.bellperformance.com)  
[www.WeFixFuel.com](http://www.WeFixFuel.com)

## **Protecting Stored Emergency Fuel: Best Practices For Success**

For those in charge of buying, storing and maintaining fuels, it's essential to ensure that the quality of that stored fuel to be used in an emergency is protected and maintained. Good quality stored fuel combusts properly without black smoke and adverse emissions and does not leave deposits inside of the engine, and the engines themselves run as well as they are designed to do.

These considerations are vital because if stored fuels for emergency purposes are not ready for use at the exact needed time, there can be big problems as a result. When a hurricane hits in Florida or a tornado happens in the south of the Midwest, public and private sector entities assume the emergency fuels set aside for these situations will perform their roles to power generators, emergency management equipment and other vehicles that perform the duties called for in the relevant emergency management action plan.

The same scenario applies with stored fuels powering essential vehicles and equipment in non-emergency situations. The expectation is that these fuels will function like they're supposed to. The expectation is \*not\* that generators on their monthly load-test will sputter and shut down at only 50% load.

Whatever kind of fuel you use in whatever capacity, there are best practice things that you as a fuel manager can do to ensure that the stored fuel is going to continue to be ready to use when you need it the most.

### **Keeping Stored Fuel Stable – Chemical and Mechanical Steps Worth Considering**

No matter if you use fuel in an emergency vehicle or heavy duty equipment or a backup generator, if the fuel quality is not within specification, then the vehicle or engine is not going to run properly or it may not even run at all when it is needed most. This fuel quality deficit is really caused by what ends up in the fuel that does not burn as well as the fuel itself. When you hear about fuel oxidation, gums, varnishes and fuel sludge, these are parts of the diesel fuel mixture that used to be soluble and in solution with the fuel blend, but which have undergone chemical reactions (with other unstable fuel agents) to form substances that are heavy enough to fall out as sludge. These substances don't burn very well when they are used by the engine.

The marketplace offers different solutions to help with fuel stability deficits. Fuel stability treatments are preventive treatments that aim to keep these substances from forming, instead keeping the fuel mix together so it burns as well as it is supposed to. Fuel "polishing" is a reactive (but sometimes necessary) mechanical step that provides value by removing existing sludge and asphaltene dropout from the fuel so that the fuel burns as it's supposed to. Both of these steps offer value points to the fuels professional worth considering, especially as part of a fuel preventive maintenance (fuel PM) program.

Of the common fuels in the marketplace – ethanol, diesel, bio diesel - these all have some common storage quality issues of that can all be addressed with simple solutions. So let's examine some of the issues that are inherent to the preservation of these different kinds of fuels, so you can be confident in their performance.

### **Diesel fuel – No Sulfur Means Microbial Growth In Storage Tanks**

Diesel fuel is not exactly like the diesel fuel that was in use 10 or more years ago. The big difference between diesel fuels now and diesel fuels then is the level of sulfur allowed in the diesel fuel. This difference



**Bell Performance, Inc.** tel 407-831-5021  
1340 Bennett Drive fax 407-331-1125  
Longwood, FL 32750  
[www.bellperformance.com](http://www.bellperformance.com)  
[www.WeFixFuel.com](http://www.WeFixFuel.com)

stems from requirements introduced to the Clean Air Act around the year 1990, which ushered in big changes on the removal of sulfur from the fuel. In the old days, diesel fuel could contain as much as 5000 ppm of sulfur. The Clean Air Act mandated a dramatic reduction in that sulfur content from 5000 ppm to 500 ppm. That's about a 95% reduction.

In 2006, the fuel's sulfur level was reduced even more drastically, from 500 ppm to just 15 ppm sulfur allowed in on-road diesel fuel. This new cleaner fuel is known as ultra-low sulfur diesel (ULSD) and it's the only kind of diesel you can get for virtually all on-road vehicles and engines. So, if you think about it, in the space of 15 to 20 years, we went from 5000 ppm diesel sulfur content to just 15 ppm sulfur content.

What does this mean for diesel fuel storage in emergency management and other situations? Many aren't aware that the removal of sulfur from diesel fuel makes that diesel fuel far more likely to have bacteria, fungus, and microbial infestation problems emerge in storage. Sulfur content, historically, is what made the fuel environment less hospitable to microbes. Less sulfur means today's diesel fuel has virtually no resistance to fuel microbes. Fuel management professionals now find that they're far more likely to have a microbial infestation problem than in the past.

#### **Water Accumulation In Diesel Storage Tanks – An Additional Hazard**

This danger becomes compounded when you add water accumulation in storage tanks, resulting in the perfect recipe for the destruction of stored fuel quality. Water plays several roles in the destruction of stored fuel quality. The accumulated water builds up in fuel storage tanks that are vented to the outside. Temperature changes from day to night cause condensation to develop on the inside of the storage tanks; this condensed water rolls down the sides of the tank and sinks to the bottom of the diesel fuel, because water is heavier than diesel fuel.

Every fuel management professional knows it is common to find at least some water sitting at the bottom of every storage tank. This water enhances the possibility of microbial growth in that storage tank. Bacteria, fungi and microbes need a small layer of water interfacing with a layer of diesel fuel in order to get all the things that they need to grow and thrive inside of a fuel storage tank. Any time you have a layer of water in a storage tank, you have the enhanced potential for microbe growth and problems.

Another factor water plays with respect to stored fuel quality is its role in the chemical breakdown of the diesel fuel. Diesel fuel can undergo chemical breakdown over time by a number of avenues. Microbes that infest storage tanks produce acids and corrosive substances as a result of their biological processes. These biological byproducts accelerate the breakdown of the quality of the diesel fuel just as you would expect an acid to do. They're also strongly associated with corrosion damage of storage tanks themselves.



**Bell Performance, Inc.** tel 407-831-5021  
1340 Bennett Drive fax 407-331-1125  
Longwood, FL 32750  
[www.bellperformance.com](http://www.bellperformance.com)  
[www.WeFixFuel.com](http://www.WeFixFuel.com)

***Most fuel storage professionals have a protocol to control water in tanks.*** There are water coalescers, filters and centrifuges that can allow for the removal of significant amounts of water from tanks. There are also highly effective fuel treatment options that will absorb significant amounts of water and cause it to be locked into the diesel fuel for combustion. Water removal is also an essential element of a quality fuel & tank service program that typically involves removal of excess water in storage tanks coupled with the addition of both water controllers and biocide treatments to stop microbial problems before they start.

### **Biodiesel Presence Can Also Spell Trouble**

The blending of up to 5% biodiesel content into diesel fuel is now common practice across the country. This means virtually every diesel fuel user has been using biodiesel, whether they realize it or not. While biodiesel fuels have some positive attributes (high lubricity, renewable fuel), their inclusion in the diesel fuel supply does not help with fuel stability problems. To make a long story short, even low levels of biodiesel content increases microbial problems in stored fuel because microbes love to feast on it. In addition, biodiesel is hygroscopic, which means even low levels of biodiesel content can accelerate water accumulation in storage tanks.

### **Oxidative and Water Breakdown in Stored Diesel Fuels**

Biodiesel and regular diesel fuels are prone to what is known as oxidative stability breakdown. Water, oxygen, light or heat, and bacterial byproducts – all can be shown to chemically deteriorate and break apart diesel fuel and biodiesel blends. They all contribute to either providing the fundamental ingredients for the chemical reactions that causes a fuel's break down, or the acceleration of the oxidative breakdown of the fuel quality over time.

Exposure to water and oxygen in the air provide oxygen that is the essential ingredient in oxidation and hydrolysis chemical reactions. These are the chemical reactions that attack diesel fuel molecules, break them apart and turn them from stable molecules to unstable molecules that want to form sludge and deposits in stored fuel. Biological byproducts of bacteria and fungus in fuel tanks also lead to tank corrosion and the breakdown of stored fuel in the tank because of their acidic nature. Exposure to heat provides the energy catalyst needed to make sure that these harmful chemical reactions actually happen at a faster rate in the fuel.

Fuel preventive maintenance practices will try to take all of this into account. Little can be done to prevent light and heat exposure. But water and bacterial presence can be successfully addressed by a good fuel and tank housekeeping program. Some agencies have these programs in place, while others utilize the expertise of partners in the industry to stay on top of the stored fuel quality for them.

### **Stored Ethanol Blends**

Ethanol blends, in the grand history of fuel storage use for emergency management, are a relatively new player on the horizon. Ethanol in gasoline became common around 2005 and 2006 when a previous fuel additive called MTBE was phased out of the national gasoline supply because of fears of ground water contamination. Ethanol alcohol became the new oxygenate of choice across the country. Oxygenates add



**Bell Performance, Inc.** tel 407-831-5021  
1340 Bennett Drive fax 407-331-1125  
Longwood, FL 32750  
[www.bellperformance.com](http://www.bellperformance.com)  
[www.WeFixFuel.com](http://www.WeFixFuel.com)

more oxygen to a gasoline mixture, helping the gasoline to burn with fewer harmful emissions that affect urban air-quality.

Ethanol blends have a much more compressed storage life than diesel fuels do, which makes them more difficult to store for backup use. They attract water quite easily, a big problem for ethanol fuel blends when stored for any significant length of time. This water accelerates oxidation and breakdown of ethanol fuels, contributes to the same type of microbial infestation problems in ethanol blends, and causes phase separation of the fuel. Stored ethanol gasoline that has phase-separated is going to be useless – its octane rating and combustibility will be shot and there’s no way to put it back together again. So the only solution to protecting stored ethanol gasoline is to make sure the fuel doesn’t reach that point.

### **What Are The Best Practices For Protecting Stored Fuel?**

When it comes to maintaining stored fuel and protecting its quality for the needed time, the best practices will fall into two camps – chemical and mechanical practices. Both of these camps have their value and also their limitations. It’s important to realize what these are.

#### **Chemical Treatments – The Good**

“**Chemical practices**” center on adding effective chemical treatments to the stored fuel to either fix an existing problem or prevent a possible future problem from developing. The important chemical treatments to consider are fuel stabilizers, water controllers, biocides and sludge dispersants.

Fuel stabilizers are typically antioxidant packages that prevent the chemical reactions from starting that cause fuel quality to break down over time. Oxidative chemical reactions in diesel fuel are a chain reaction; this means that the process is started with a few chemical reactions that lead to more chemical reactions, eventually leading to widespread breakdown of that diesel fuel. Oxidative fuel stability ingredients, like **Bell Performance Dee-Zol Life**, function by stopping these first chemical reactions in the process. If you stop the first chemical reactions in the chain reaction, you stop the rest of the chain reaction and, in this case, this means preserving the fuel quality of the store diesel fuel.

Water control ingredients are essential to control the buildup of water that happens in stored diesel fuel and stored ethanol fuels. Bell Performance manufactures a number of single function and multifunction fuel treatment products (**DFS Plus** and **Ethanol Defense**) that absorb water buildup in ethanol and diesel fuels. Bell Performance multi-function treatments, such as **Dee-Zol**, also provide combustion improvement and detergency functions in addition to their water control features.

Biocides are essential weapons in the fuel manager’s arsenal for making sure that stored fuels stay free from bacterial infestation and the headaches that these infestations cause. Bell Performance **Bellicide** is a dual phase biocide that works in both the petroleum and the water phases of stored fuel, including gasoline, ethanol, diesel and biodiesel.

Sludge and biomass dispersants have recently come to the forefront of best practices because they can keep stored fuel tanks clean of problematic sludge buildup while also dispersing microbial biomass formations. This enables the storage tanks to stay cleaner while enhancing the effectiveness of any biocide that is used.



**Bell Performance, Inc.** tel 407-831-5021  
1340 Bennett Drive fax 407-331-1125  
Longwood, FL 32750  
[www.bellperformance.com](http://www.bellperformance.com)  
[www.WeFixFuel.com](http://www.WeFixFuel.com)

## **Limitations of Chemical Treatments to Protect Stored Fuels**

All this having been said, chemical “fuel additives” cannot do everything, despite what fuel additive companies tell you. The most relevant limitations that should be considered are:

- Water controllers can effectively control limited amounts of water but are not designed to make large amounts of water disappear.
- Fuel stabilizers need to be added when the fuel is fresh, before signs of instability become apparent. Once fuel sludge has developed in a fuel and its storage tank, a stabilizer will not put it back together again.

Now that the limitations of chemical fuel additives (they can’t do everything) has been brought to light, we consider that mechanical fuel treatment processes have a great deal of value in filling in the gaps to protect stored fuel quality. “Mechanical processes” is another name for fuel polishing.

## **Mechanical Fuel Treatment – The Good**

A good mechanical process will involve the use of filters and water separators to mechanically remove particulates and water from the fuel and its storage tank. Mechanical filtration is very useful for taking fuel that is out-of-spec and bringing it back into specification – a great advantage for facilities that are legally required to keep their backup fuel ready for emergency use. Mechanical processes are also the best way to handle the sizable amounts of water that many fuel storage tanks accumulate over time if they are not diligently watched.

## **But Mechanical Processes for Stored Fuel Have Their Limitations, Too**

The biggest limitations that fuel filtration and similar processes have in protecting stored fuel quality are that they do nothing to keep fuel problems from coming back. Fuel polishing removes from the fuel what’s not supposed to be there.

If you manage stored fuel of some type, you may even have had this scenario play out where you are. You engage the services of a fuel polisher, who may come out and do an admirable job of cleaning up darkened fuel and turning it clean and bright, just as it supposed to be. Yet, once the mechanical process is concluded, there’s nothing to stop the fuel from darkening again. Or developing a repeat microbe problem within a couple months. Mechanical fuel processing addresses current problems, it does not prevent future ones.

## **The Hybrid Approach to Fuel PM Addresses Both Issues**

Given the limitations of either side, the best practice recommendation for protecting stored fuel is to use a combination of both methods.

The best practice is to start with the use of periodic mechanical fuel and tank servicing to clean up and remove existing water, sludge, asphaltene dropout and microbial growth. This is combined with the addition



**Bell Performance, Inc.** tel 407-831-5021  
1340 Bennett Drive fax 407-331-1125  
Longwood, FL 32750  
[www.bellperformance.com](http://www.bellperformance.com)  
[www.WeFixFuel.com](http://www.WeFixFuel.com)

of quality chemical fuel treatments that both enhance the effectiveness of fuel polishing (water controllers to scavenge leftover water, sludge dispersants to remove hard-to-reach asphaltene collections) and prevent these problems from returning (biocides, fuel stabilizers) for long periods of time than would be possible without their use.

### **Fuel Testing: The Forgotten Aspect**

Not to be left out of the discussion, it is important to also incorporate periodic fuel testing among the recommended best practices of protecting stored fuel quality. Fuel testing gives an essential diagnostic picture of the condition of the fuel, without which, it is much more difficult to compile an accurate picture of how healthy the stored fuel is and to know which specific fuel quality problems need the most attention.

The idea of fuel testing can be, for many fuels professions, both daunting and confusing. Unless they're under the directives of specific testing requirements by a regulatory agency, it may be difficult to know which of the many tests for stored fuel are good ideas and which are not needed. It is not difficult at all to throw money away on tests that don't mean what we think they mean, if you don't know which ones are really needed and which are not.

### **Fuel Preventive Maintenance Programs & Taking Advantage of Partnerships**

All of these afore-mentioned best practices are also essential aspects of fuel preventive maintenance programs that are recommended for anyone with a substantial stake in ensuring their stored fuel quality is protected. But many of the entities that need to do this the most find themselves with neither the time nor the human capital resources (personnel) to effectively implement such an important program. If you find yourself in that boat, it would be a good idea to partner with a fuel & tank services company who can bring all of these best practice recommendations under your umbrella. These partners will typically handle all of the testing, assessment, remediation and preventive treatment of your stored fuels and storage tanks. And some of them will also provide certain guarantees on the on-going condition of your stored fuel that's under their care.

Engaging the expertise of a fuel & tank services partner may be something to consider if you need to know your stored fuel is protected for future use but you feel you may be lacking in the time and money needed to properly ensure this. If this sounds like you, **Bell Fuel & Tank Services** provides these essential fuel PM elements that may be worth your consideration.