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ULSD AND TANK RUST

By Kaysha Ballentine-Wells

There has been a dramatic increase in the amount of fuel tank corrosion since the introduction of Ultra Low Sulfur Diesel (ULSD) in 2006. It has caused multiple cases of filter plugging, injector fouling, and equipment failure. ULSD is about to become even more prevalent with the mandate for its use off-road this year. In addition some states are expanding the requirements to heating oil.

Since 2007, there has been an increased amount of corrosion in underground storage tanks containing the ULSD. The Petroleum Equipment Institute (PEI) Forum started receiving an increase in reports of filter clogging, seals failing, and other problems with ULSD storage and dispensing systems. They met with oil marketers, additive manufacturers, and other members of the petroleum market at the EPA's Office of Underground Storage Tanks in order to discuss the increased reports of corrosion. At the meeting, a survey was developed to gauge the severity of the issues and what to do about them.

"...42% indicated an increase in corrosion problems since ULSD..."

Of the 1200 respondents to the survey, 42 percent indicated an increase in corrosion problems since the ULSD was introduced. Incidents were reported at almost 5,000 locations spread widely across the United States and Canada. Reported problems include filter plugging, column pipes wearing, gaskets and seal problems, premature failures, accelerated corrosion, rust, dispenser meters freezing, and operational problems.

In a recent interview, Lorri Grainawi, Director of Technical Services for the Steel Tank Institute gave some more specific examples of some of the corrosion issues occurring since the introduction of ULSD. She mentioned a Wisconsin operator who's filters were so packed with rust that his meters completely stopped up. One operator from California found meter failures at four out of five stations. Each was less than a year old, and one site even replaced three failed meters in six weeks. An Alabama company had deterioration in the sump pump so bad that "the metal is being eaten up. You can scratch the pipe and the metal falls off."

Chris Sands, who runs a repair shop at a multi-brand dealership in Atlanta has been finding an increase in rust issues since the introduction of ULSD. Trucks have been coming into his shop with low power issues, and at first Sands just treated the problem by changing the filters. When the same trucks were coming in with the same problem a short time after, he decided to dig into the problem. Sands discovered that rusting tanks, tanks that should not

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have been rusting in the first place, were the root of the issue.

Recently, two rescue vehicles in the Long Island area broke down on the way to the hospital, possibly due to problems with ULSD from a steel tank. The marketer claims to have been having problems with "particles resembling coffee grounds" clogging his dispenser filters. In order to remedy the problem, the station installed a larger filter with a smaller micron rating before the pump, as well as using two filters. They also change the diesel filters every four to seven days.

Robert Renkes of the PEI said "Our members have warranty issues. Things aren't supposed to rust inside a tank. A lot of our stuff in the tanks are leak detection components, if those metal components rust and fail to function, we have a problem with EPA."

According to the Virginia Department of Transportation, problems were found at one fourth to one third of the sites checked. Interestingly, corrosion was found both above and below tank fuel levels, instead of just at the fuel line as in most microbial corrosion cases.

Quick Trip, which owns a chain of travel centers has been fighting ULSD problems across the country. They believe that the ULSD allows more microbial growth than high sulfur diesels.

A marketer in Maryland has been having problems with ULSD in both steel and fiberglass tanks (fiberglass tanks have steel components). He has been finding coffee grounds type material clogging filters, even after the tanks are cleaned. He believes it will be difficult to pinpoint the source of the problem or to get anyone to take responsibility for it.

As you can see, these corrosion problems with ULSD tanks and equipment are occurring across the country. There seems to be no apparent pattern or source.

The cause of the corrosion is unclear. Manufacturers insist that they are making the same tanks and equipment out of the same materials as before the introduction of ULSD. The fuel suppliers point out that their diesel fuel meets regulation requirements and is not inherently corrosive. They seem to imply that careless handling causes contamination with water, which invites bacteria.

The odd thing is, corrosion is also attacking the top of the tank, above the fuel. Bacteria can produce a corrosive gas,

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By Blaine Ballentine

The adjoining article deals in the facts about fuel tank corrosion. This panel offers theory as to the cause.

The change to ULSD brought several changes to the fuel, which I think has created several problems.

Sulfur and other impurities were removed from diesel fuel to make ULSD. We know that these polar impurities were attracted to surfaces, where they interfered with wear, which is why we need lubricity additives now. I think those "impurities" that interfered with wear also interfered with corrosion, providing a small level of natural corrosion inhibition.

Combine ULSD's tendency to drop our more water with a lower level of natural corrosion inhibition, and you have a recipe for rust. Bacterial growth only makes it worse.

ULSD also brought a requirement for lubricity additives. There are a variety of lubricity additives and we now have the biggest mixture of additives in the fuel system that we have ever had. I think the filter deposits that look like coffee grounds are the results of reactions between various additives.

For example, fatty acids used as pipeline rust inhibitors or lubricity additives can react with sodium to form a hard deposit (sodium carboxylate). They can react with a detergent (PIBSI) to form a gummy polymeric deposit. I think these types of interactions are causing at least some of the industry's filter plugging problems.

Further, I think that the extreme pressure and heat of a modern injection system will catalyze the reactions to form injector deposits, which also seem to be on the rise since ULSD was introduced.

Whether it was luck or skill, Cen-Pe-Co fuel additives have never used fatty acids or PIBSI detergents. Although the fuel problems are new and research continues, evidence indicates that Cen-Pe-Co fuel additives will prevent and remove deposits and inhibit filter plugging. The "nail test" demonstrates Cen-Pe-Co fuel additives' outstanding ability to stop rust.

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which would explain corrosion at the top of the tank, but bacteria causes rust concentrated at the fuel/water line. The recent problems with rust seem to be more evenly distributed throughout the tanks. Further, bacteria deposits a slimy material in filters, where a material like coffee grounds is being reported instead.

ULSD users should watch for dark or rust colored sediment, a strong rotten egg smell, or the need for frequent dispenser filter changes. Regardless of the root cause of the corrosion, it is apparent that corrosion has increased since the change to ULSD. People that use diesel storage tanks, or have steel vehicle tanks or fuel system components, should take steps to protect themselves from corrosion.

It is critical that ULSD users maintain excellent tank hygiene. They should employ fuel handling practices that prevent or remove water contamination, such as minimizing condensation and using water separating filters. Additionally, using a Cen-Pe-Co fuel additive to inhibit corrosion is important to protecting their tanks and equipment. Cen-Pe-Co fuel additives have demonstrated extraordinary rust inhibition in laboratory and field tests. ULSD users can eliminate the risk of corrosion with Cen-Pe-Co fuel additives.

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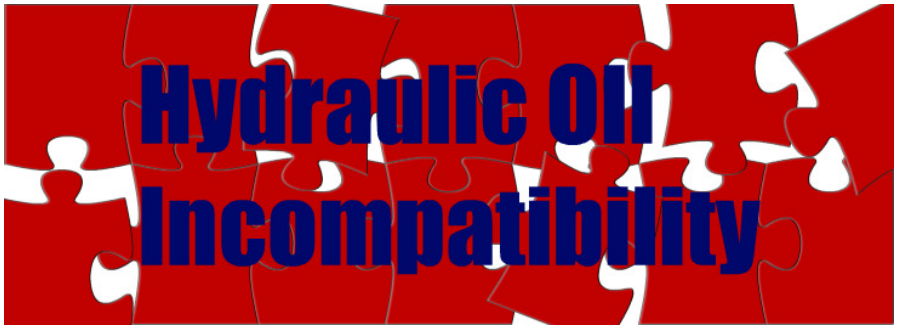

By Blaine Ballentine

Here is a big "heads up" for those of you calling on clients with John Deere or Hitachi Excavators. The factory fill for the hydraulic oil is not compatible with traditional hydraulic oils or tractor hydraulic oils.

Incompatibility

Incompatibility problems from mixing different types of oil are rare. Mixing different oils with different chemistries produces a mixture with unknown performance, but such mixtures are usually benign.

On the other hand, when additive chemistries are truly incompatible, a reaction takes place and a drop-out forms. Some of the additives are consumed in the reaction, and can no longer function to enhance the lubricant. The result is system deposits and faster wear rates. Such is the case when regular hydraulic oils or tractor hydraulic oils are mixed with the factory fill hydraulic oil in John Deere and Hitachi excavators. A gel forms and anti-wear performance is diminished.

Specifically

Since 2006, John Deere and Hitachi excavators have come with Hitachi Genuine Hydraulic Oil Super EX 46HN in the hydraulic system. The fluid contains a zinc-free additive that is incompatible with fluids that contain zinc additives. The reaction causes gel particles to form and anti-wear performance to suffer.

John Deere and Hitachi reference charts warn: "Avoid machine damage. Do not mix fluids. Complete system flush is necessary if factory fill is different than field service fill." Perhaps there is only one national oil company providing a hydraulic oil compatible with Hitachi Hydraulic Oil and they note that their product "is **not** compatible with zinc-containing hydraulic oils, and may cause residue, gelling, or filter plugging if mixed with such fluids."

We all understand draining and refilling, but flushing? It seems like a bit of overkill. One would think, the filter should remove any particles formed by chemical reactions.

Unfortunately, flushing may be needed, particularly if the excavator is going to continue on Hitachi Hydraulic Oil . Just 5% cross-contamination from a zinc containing hydraulic oil can significantly affect anti-wear performance. Because the reaction by-product is a gel, it can squeeze through the tightest filter, which has been verified in the laboratory with "particle counting."

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An Ounce of Prevention

Preventing the co-mingling of hydraulic oil types can be a challenge from a fleet management point of view. If a hydraulic hose breaks, or seal leaks, or fluid needs to be added for any reason, the correct type of hydraulic oil must be added. Generally, all the equipment at the job site uses hydraulic oil containing zinc, except the excavator. If a worker adds the regular hydraulic oil to the John Deere or Hitachi excavator, or if he adds Hitachi Hydraulic Oil to anything else, it creates a problem.

The challenge is compounded in a fleet with different brands of excavators, or even a fleet with a new John Deere or Hitachi excavator and an old one (manufactured prior to the change to Hitachi Hydraulic Oil). If one of the excavators picks up a hammer, thumb bucket, or some other attachment that was previously used by the other excavator, the fluids co-mingle, causing gel to form and fluid performance to head south.

Correcting the Problem

As you can imagine, some fleets already have a mixture of hydraulic fluid types in some of their units. If so, the system should be completely drained, flushed, and refilled. Either type of hydraulic fluid can be used, and the drain interval may need to be adjusted accordingly, but steps should be taken to assure the two fluid types are not mixed again. Of course, an easy way to administer cross-contamination control is to have only one hydraulic oil for the whole fleet.

When the excavator's hydraulic oil change interval is reached, or a repair is made that requires a significant amount of hydraulic oil to be added, the owner has the option of which type of hydraulic oil to use. He may want to switch the excavator to a zinc containing hydraulic oil that is compatible with the rest of his fleet. If he wants to switch from Hitachi Hydraulic Oil to a more conventional hydraulic oil, the system should be completely flushed prior to refilling.

Practical Practice

We try to be realistic about the maintenance tasks customers are willing to perform. It is probably only a small minority that is willing to make a complete drain if it involves partially disassembling and draining individual components. Even fewer will attempt any type of flush.

Our biggest concern with cross contamination is the reduction in anti-wear additive. We do not like particles of gel floating around in the hydraulic oil, but they do not accelerate wear rates like insufficient anti-wear performance. So, a practical solution is to drain the hydraulic system as completely as convenient, and refill with a fluid containing additional levels of anti-wear additive. That way if the anti-wear performance of the residual fluid was lost to chemical reaction, there is enough anti-wear additive in the new fluid to compensate.

Using zinc as an indicator of the level of anti-wear additive, here is how Cen-Pe-Co oils stack up. A price competitive hydraulic oil can have less than 300 ppm zinc. A premium hydraulic oil meeting industry standard HF-0 can have around 430 ppm. Cen-Pe-Co Hydraulic Oil typically has 575 ppm zinc. Cen-Pe-Co Multi-Purpose Hydraulic & Wet Brake Oil typically has 1575 ppm zinc.

You can see, particularly with Cen-Pe-Co Multi-Purpose Hydraulic & Wet Brake Oil, how anti-wear protection can be restored, even if 10% or more cross-mixed fluid remains in the system after draining.

Cheap Hydraulic Oil	290 ppm zinc
Premium Hydraulic Oil	430 ppm zinc
Cen-Pe-Co Hydraulic Oil	575 ppm zinc
Cen-Pe-Co Multi Purpose Hydraulic & Wet Brake Oil	1575 ppm zinc

Conclusion

Cen-Pe-Co Hydraulic Oil and Cen-Pe-Co Multi-Purpose Hydraulic & Wet Brake Oil are excellent choices for use in John Deere and Hitachi excavators. However, like practically every other hydraulic oil on the planet, they are not compatible with Hitachi Hydraulic Oil and should not be mixed with it. After draining and flushing the Hitachi Hydraulic Oil, Cen-Pe-Co Hydraulic Oil or Cen-Pe-Co Multi Purpose Hydraulic & Wet Brake Oil will provide superior wear protection and performance compared to other products of their type, and they are compatible with other hydraulic oils typically found in construction equipment. If the factory fill fluid has already been contaminated with a traditional hydraulic oil, its lack of anti-wear performance puts the hardwear at risk. A practical solution is to drain and refill with a hydraulic oil, such as Cen-Pe-Co Multi-Purpose & Wet Brake Oil, that has enough anti-wear additive to overwhelm the residual oil mixture and provide anti-wear protection.