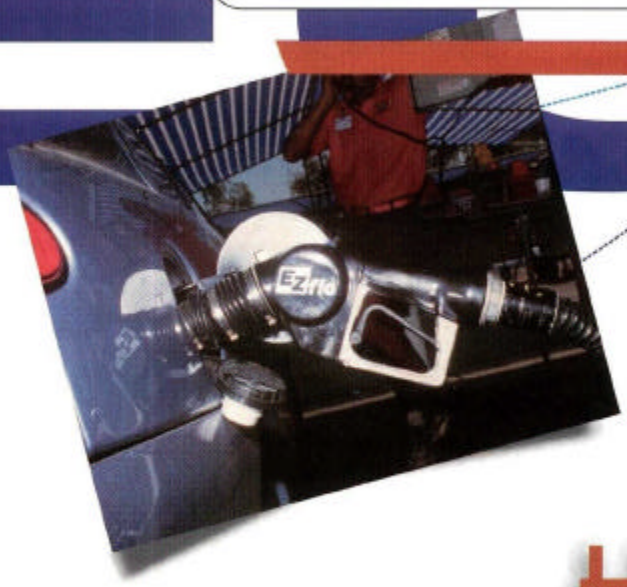
PETROLEUM EQUIPMENT



Preventive Measures Head Off Fuel Tank Corrosion

By Jerry Fritzke

We all know about the external corrosion problems that have occurred in underground storage tanks, but we seldom talk about internal corrosion, which also can occur in both underground and aboveground fuel storage tanks.

One of the main contributing factors which causes internal corrosion is water. Corrosion can hardly occur without water. Water, which is also called the universal solvent, can extract enough chemicals from diesel or gasoline to start corrosion. Water can create the right environment for certain bacteria, which can also cause corrosion.

The way to prevent internal corrosion in tanks is to stop water from entering, the tank in the first place. Tanks should constantly be monitored for the presence of water. Monitoring and control of water can lead to a long tank life. Not doing so can drastically reduce the useful life of the tank.

Eliminating water will increase tank life.

The accumulation of water in the bottom of fuel storage tanks and fuel handling systems is a common problem throughout the industry. Water can be brought into a system by the following means:

• The bulk fuel supplied by a fuel jobber may contain water. It is important to check for water before and after refueling. This is one way to tell if the fuel jobber is bringing water to the system with his fuel.

• Another way of getting water into a tank is through the air. During the fuel dispensing process, air is sucked into the tank to fill the space left vacant by the fuel. Air is also drawn into the tank by the normal breathing process of the tank. The outside air that enters the tank contains moisture. The moisture condenses into water droplets as it cools down inside the tank. Inflow of water through the breathing process can be minimized by installing pressure vacuum vent caps (PVV) on the normal vents.

• It is also possible for rainwater to get into the fuel tank through open or improperly sealed tank connections.

Since water is heavier than fuel, it settles at the bottom of the tank. Pure water does not corrode the steel, but other products mixed with water start the corrosion process.

Here are some of the more common internal corrosion problems of steel tanks:

• **Oxidation.** Water in conjunction with free oxygen dissolved in water oxidizes (rusts) the steel. The oxidation process will continue as long as there is free (dissolved) oxygen present in water. Rainwater and water condensation from air can continuously supply the water with needed oxygen to oxidize the steel, especially the bottom plate.

• **Acid carryover** from fuel processing. During the processing of fuels, acids can be used as extracting/neutralizing agents as well as reaction catalysts. Sulfuric/hydrofluoric acids

are used as reaction catalysts in the production of high-octane gasoline alkylate fractions. Refiners typically wash acid-processed fuel with water or caustic to remove the acid. However, the remote possibility still exists for some acid to carry over with water into downstream operations. If acid remains, the likelihood of fuel system corrosion is markedly enhanced in steel.

• **Microbiologically influenced corrosion (MIC).** Active microbiologically influenced corrosion of metal due to bacteria is quite complex. It can involve several species of microorganisms and is affected by temperature, pH and other factors. Water in combination with the hydrocarbon fuel can serve as a medium to support the growth of various microorganisms.

Examples of bacterial species which are associated with MIC are described below:

• *Anaerobic bacteria* can survive in the oxygen-free environment existing at the fuel water interface of the storage tank. These microbes utilize the oxygen bound up in compounds for their metabolic oxygen needs rather than relying on the free oxygen dissolved in water. Some bacteria specifically utilize oxygen bound in the sulfate complex of a compound. As a result of this metabolic activity, sulfur is reduced to hydrogen sulfide, which is a very strong acid. These microbes are called sulfate-reducing bacteria (SRB). They can tolerate temperatures as high as 176 degrees Fahrenheit and acidic/basic environments from about pH 5 to pH 9. Many of these anaerobic, SRB species possess the ability to utilize hydrocarbon fuel compounds as a nutrition source. These species are termed hydrocarbon utilizing microbes or HUM. Fuel can be metabolized by these microbes through the oxidation process.

Source: EPA

External corrosion is not a tank's only problem. Corrosion can occur internally as well.

• *Aerobic (oxygen-tolerant) bacteria* oxidize various sulfur-containing compounds such as sulfides to sulfates and produce sulfuric acid as a metabolic byproduct.

• *Slime-forming bacteria* are aerobic. Some species produce extra cellular, gel-like polysaccharide capsule which acts to protect and shield the organism. When in combination with other metabolic by products, bacteria and water, they form slime-like films and deposits on surfaces exposed to the air. Sulfate-reducing species and acid formers frequently can be found in high concentrations beneath these slime layers. Also, slime layers can form masses large enough to plug filters and strainers.

Different forms of bacteria can thrive in fuels containing water and, as a result of their metabolism, different chemicals including sulfuric and hydrogen sulfide acids are formed which cause severe corrosion in steel tanks. Colonies established by microbes on the sidewalls and bottoms of fuel storage tanks are called plaques. These plaques can often be the sites of MIC of the underlying metal. Even changing materials to stainless steel won't help here. A one-eighth inch thick 304 stainless steel plate has been observed to perforate in less than a month when bacterial corrosion occurs.

Prevention

Most owners of steel tanks first learn of corrosion when a leak occurs. With proper preventive maintenance, these tanks can last for a long time. Water should be constantly monitored and removed. Long-term prevention of problems associated with water in fuel is best accomplished by:

• Obtaining fuel from reputable suppliers capable of providing high-quality fuel.

• Fuel tanks should be kept well filled and normal vents should be fitted with PVV caps to minimize condensation.

• If water is detected in the fuel tank, it should be removed. Small, hand-held pumps called thief pumps or reverse osmosis devices that absorb water can be used. Many tank owners use sticky substances on the end of a dipstick when testing for water. This substance changes color when it contacts water. Unfortunately, recent research has found that these substances can also stick to the bottom of the tank and initiate corrosion so their use is not recommended.

• There are chemicals that will stop the corrosive action of water and render bacteria harmless in this environment. Major oil companies offer various products as part of their petroleum products. Depending on the manufacturer, purpose and function of these chemicals, they might be called fuel additive, fuel conditioner or corrosion inhibitor. Most of these "additives" are added to the tank immediately prior to filling the tank to assure proper mixing with the fuel.

• Some additives in addition to their other functions, disperse the water in the fuel and thus prevent the water from settling at the bottom of the tank.

• Some additives are biocides. They are normally added to the fuel when the fuel is already infested with bacteria. Both water soluble and fuel soluble biocides are available for fuel treatment. Tank owners should prevent bacteria infestation as much as possible, but once the tank is infested, they should eradicate the bacteria immediately. Some anaerobic bacteria might form protected colonies which are very hard to get rid of once formed.

• There are local companies that can help the tank owners with testing the tanks for the presence of water, fuel conditioning and bacteria eradication.

Unfortunately, once a leak has been noted, there is no good method of restoring the integrity of the tank. For every one leaking hole, there will be 100 deep pits that are just ready to burst through. So, the only real means to prevent this problem in the first place is for the tank owner to understand the problem and to take an active part with preventive actions.

Jerry Fritzke, a member of the National Association of Corrosion Engineers, is a registered metallurgical engineer and a registered corrosion engineer in the state of California. Fritzke has worked with more than 400 attorneys as an expert witness and has worked on corrosion problems all over the world.

New CARB Rules Could Affect Stage I Vapor Recovery

In late August, the California Air Resources Board (CARB) held another in a series of workshops to discuss possible to requirements for Enhanced Vapor Recovery, covering on-board vapor recovery (ORVR) vehicles and other air pollution prevention strategies. Don Leininger, technical liaison manager for OPW Fueling Components, Cincinnati, OH, attended the workshop and shares some of CARB's concerns and his thoughts.

New **CARB** requirements could also hit current Stage I rules, which, depending on the changes, could affect both jobbers and individual station owners.

"The main thing they're talking about is Stage II, but they're also going to include work on phase one systems," according to Leininger. "It's the first time they've done that in quite some time. How that will sort out is yet to be determined."

One possibility is that CARB will raise testing standards, requiring certification tests to show that equipment is perhaps 98 percent effective rather than 95 percent effective.

"Stage I hits traditionally been effective at the time gas is delivered to storage tanks," he says. "It may be attained already, [test] statistics just didn't show it."

But even though that level of effectiveness may already be met by most equipment, Leininger says, the question is whether old tests will be good enough. It's uncertain whether manufacturers will have to retest equipment to ensure it meets a higher standard.

There are also equipment change recommendations under consideration by the Air Resources Board. One of the main goals is reduce the induction of air into the tanks.

One possible equipment change affects fill hoses and whether they can keep a good seal at the tank during fill-up.

"The long hose acts as a lever and puts torque on the pipe:' Leininger says. The result can be a poor seal and vapors leaking into the atmosphere.

CARB wants something—one current solution is a swivel fitting—that ensures the weight of the hose won't damage the seal and allow vapor to escape into the atmosphere.

CARB also has questions about spill containers around drop tubes that have valves that allow spillage to be dropped into the tank. The board is concerned that over time valves could become dirty and not seal properly, Leininger says, which again would allow vapors to escape into the atmosphere.

As with Stage II changes, official recommendations are still a couple of months away, and approvals, if any, are still uncertain.

"Both dealers and carriers could be affected by phase I if it requires new equipment," Leininger says. "If [the board] requires changes on the UST level, then the independent dealer will be affected. If it's fittings on the truck, the deliverer would be affected."