Sulfuric acid storage tanks at a water treatment plant.

STORING SULFURIC ACID PRESENTS MAJOR PROBLEMS

By **Marshall Lampson**

Sulfuric acid is one of the most widely used chemicals, with millions of tons produced each year. It is used in a wide range of applications, including water and wastewater treatment, car batteries, dyes and pigments, mineral processing, fertilizer manufacturing, oil refining, and the manufacture of chemicals.

It is a highly corrosive mineral acid that challenges traditional chemical storage options. This pungent, colourless to slightly yellow viscous liquid is occasionally dyed dark brown during production to alert people to its hazards. The biggest challenge in working with sulfuric acid is that it is an aggressive oxidizer.

CHALLENGES

The highly corrosive nature of sulfuric acid tests the limits of today's storage systems. Any company that stores sulfuric acid needs to be acutely aware of the dangers that the chemical presents to equipment and personnel.

Sulfuric acid is extremely heavy and will test the mechanical integrity of a storage tank. Its inherent weight requires a strong material that can withstand the static load pressure constantly pressing against the bottom third of the storage tank. It is also an aggressive oxidizer, so safeguards are needed to prevent the tank's material from degrading, becoming brittle, oxidizing, and cracking, which could result in leaks or tank failure.

If sulfuric acid contacts water, it creates a toxic sulfuric acid aerosol fume or a potential explosion. It can create a highly flammable hydrogen gas if it is spilled on metals. Burns from sulfuric acid can be more serious than burns from other strong acids. Sulfuric acid dehydrates whatever it touches, and the heat caused by that reaction with water can create secondary thermal damage.

TANK OPTIONS

Steel tanks are good for storing 98% sulfuric acid. At any other concentrations, they will need to be protected with some form of internal lining/liner. A rotationally molded polyethylene lining system might be an option to protect your steel tank against the harshest chemicals and will give you broad chemical resistance alongside the strength of a steel tank.

Fibre reinforced plastic (FRP) tanks are available with numerous interior coatings and a structural layer comprised of chopped glass or filament wound fibre and resin.

Polyethylene or plastic storage tanks are either linear polyethylene or high-density cross-linked polyethylene. High-density cross-linked polyethylene, or XLPE, is a thermoset resin. It is specifically engineered for critical applications like chemical storage. Cross-linking is simply the formation of bonds between the polymer chains. These bonds, equal in strength and stability to the principal bonds along the polymer backbone, tie the polymers together, thus dramatically increasing molecular weight. In fact, the length of the polymer chains and, therefore, the physical properties, are much better than can ever be achieved without cross-linking.

The result is a plastic that possesses impact resistance, tensile strength, and resistance to fracture that linear polyethylene just can't match. These qualities make cross-linked polyethylene an excellent choice when tank integrity is critical. The structural integrity, heat resistance, and useful life in most cases are unparalleled.

CONSIDERATIONS

A few storage tank manufacturers are willing to provide 45,000 litre linear polyethylene tanks to store sulfuric acid. But time and experience have shown that this is not the safest or most durable solution.

Some chemical companies will install large fiberglass tanks, because they want to hold a railcar of sulfuric acid. While this may seem to be a convenient or cost-efficient solution, oftentimes it is the polar opposite. After the potential of losing 150,000 litres of sulfuric acid in

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an instant, many manufacturers and end users have made the switch from a large fiberglass tank to a couple of smaller XLPE tanks.

CHEMICAL COMPATIBILITY

Because it is an aggressive oxidizer, and reacts differently with various materials, choosing the right tank material for sulfuric acid is critical. One must consider its concentration, since it displays different properties depending upon the concentration being used. For example, at 80% the nature of the chemical may not have the same oxidizing effects. The three main concentration ranges that are used are 93 – 98%, 80 – 92%, and 80%.

MOLECULAR WEIGHT

At different concentrations, molecular weight also becomes a factor. At its highest concentration, the molecular weight of sulfuric acid is up to 2 kg per litre, nearly twice the weight of water and will test the mechanical integrity of any material. This chemical should be stored in a cross-linked polyethylene tank that has a 2.2 specific gravity wall thickness for safe, reliable use.

ANTIOXIDANT SYSTEM

When storing sulfuric acid, it is important to verify the hoop stress rating and understand the specific gravity ratings to make sure the resins used in the storage tank provide a margin of safety. Along with the weight of the chemical, its oxidative properties must also be considered.

Poly Processing Company's next generation OR-1000™ engineered resin system is made of polyethylene, specifically formulated to resist oxidation. Its outer surface is made of XLPE for superior strength. The two surfaces are molecularly bound together during the roto-molding process, creating a truly seamless bond between the XLPE and antioxidant resin system.

Engineered antioxidant systems improve long-term properties, minimize oxidation, increase environmental stress crack resistance, and increase the life of a cross-linked polyethylene tank. This gives the user a more cost-effective solution.

Secondary containment helps mitigate the risks and hazards associated with chemical spills and leaks.

SECONDARY CONTAINMENT

Secondary containment helps mitigate the risks and hazards associated with chemical spills and leaks. In this system, a secondary container or wall encompasses the primary container. Should the primary container fail and cause a chemical leak, the secondary containment prevents the chemical from spilling outside the system.

A properly engineered and manufactured double wall tank system, or "tank-within-a-tank" provides secondary containment and helps avoid damage to equipment and property, loss of chemical, and, most importantly, injuries to personnel in the event of a spill.

Properly designed double wall tank systems should:

- Provide at least 110% secondary containment.
- Equalize the liquid and allow the chemical to be used until it is convenient to repair the tank.
- Be ideal for chemicals like sulfuric acid that can have dangerous exothermic reactions to water.
- Eliminate the expense, cost and maintenance of secondary concrete containment.
- Minimize the system's footprint by providing secondary containment in a more compact way.

Containment is only as secure as its weakest link. If using a double wall tank system with a sidewall fitting, and a true contained transition fitting is not installed, there may be a weak link that could cause trouble.

The most likely potential for a problem is not the tank wall itself, but the drain or pump outlet (i.e., the fitting) on the lower section of the tank wall. Since the tank wall in most cases must be cut in order to install a fitting, that connection is more susceptible to pressure, vibration, and operating or maintenance errors. As such, it becomes a more vulnerable potential issue than the roto-molded tank wall itself.

Look for transition fittings that fully contain both the fitting and piping from the inner tank, through the outer tank, to the outlet. Many double wall tank systems lack this important safety component, and a fitting failure here could siphon the tank contents onto the ground.

TEMPERATURE

The storing temperature of the chemicals in the tank is very important. Check the temperature regularly to verify that it is within the temperature window it was designed for. If the tank will be subject to extreme temperatures, a specially designed tank with a thicker construc-

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tion may be required.

Avoid mixing or cutting chemicals in the same tank if the temperature will be negatively affected as part of the process. If you do mix chemicals that will affect the temperature, make sure the mixture is handled correctly (especially when dealing with higher concentrations and dilutions) and always check that the proper storing temperatures are not exceeded.

INSPECTIONS

Certain annual inspections should be performed to ensure that a tank is maintained properly. Make sure it is cleaned annually and inspected visually with a flashlight, looking for any abnormalities. Field service specialists have cameras and other specialized equipment, as well as the expertise, to make sure everything is functioning the way it should.

Performing inspections on the original installation, checking the chemical storage temperature, and conducting regular annual inspections will help the polyethylene tank reach its maximum lifespan and ensure that it is properly maintained.

BUILDING A SOLUTION

Proper tank design is crucial to successful and safe sulfuric acid storage. There are many storage solutions out there which is why it is vital to choose the proper tank configuration. Selecting the right tank configuration can impact the safety of employees, protect the environment, and the facility itself.

Some believe that if a tank can store water, it can store a chemical. Although a water tank could potentially store a chemical for a limited amount of time, its design falls short of preventing leaks and other dangerous situations. ■

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