

Preventing Above Ground Storage Tank Failures

A storage tank that appears to be in robust condition can, upon close inspection, be found to be very fragile and susceptible to both gradual and catastrophic failure. Since tank failure can result in staff endangerment, significant product loss and environmental damage, tank owners and operators are advised to implement appropriate precautions to reduce the likelihood of storage tank failure.

Failure by Design

A tank's design must be compatible with materials stored within it; there are specific design requirements for tanks storing acids, bases, peroxides and flammable materials. The introduction of a material into a tank that is not designed for that material or lacks appropriate safety equipment may result in an explosion or unintended release. This scenario can easily occur when facilities are retrofitted. In such cases, a facility operator or contractor may store materials within a tank without ensuring that the tank's design and construction are suitable for the new material. Accordingly, when changing the use of a tank, or before using an older tank, it is best to hire a qualified professional engineer to insure that the tank's design is appropriate for the intended use.

Tank Supporting Structures

The manner in which tanks are supported should be reviewed and inspected. Wooden timbers support some outdoor tanks. However, wooden timbers should not be used to support a tank unless the tank is placed within one foot of the ground surface at the tanks lowest point. While wood is often treated to prevent rotting, the wood can eventually rot and cause the tank to collapse or fall. Wooden timbers can also easily catch fire if an adjacent building or tank is burning. In addition, temporary wooden cribbing should never be used to support a filled tank, as wooden cribbing is not designed to support the weight of the tank.

Steel structures used to support a tank should be treated with retardant material and corrosion protection to prevent structural failure from adjacent fires. Alternatively, fire fighting water cannons can be installed to prevent buckling of steel structures during nearby fires.

Among the best supports for tanks are reinforced concrete structures, which should be regularly inspected for cracks or other signs of structural failure. Also, tanks should not rest directly on the support structure's saddle, but should rest on a bearing plate between the tank and the saddle.

Special Coatings

Concrete surfaces are especially vulnerable to acid spills. If the tank stores corrosive materials, the support structure and the secondary containment area should be coated with a chemically resistant coating. Winter deicing procedures should also be reviewed to ensure that corrosive salts are not needlessly damaging structural supports and containment areas.

Secondary Containment

All aboveground storage tanks should be located in impervious secondary containment structures which are designed to guard against environmental damage from tank failures and prevent gradual environmental degradation due to spills from overfilling, maintenance activities and piping failures. The tank should be placed low enough, or the containment wall should be high enough, so that leaks in the tank do not spray over the containment area. Containment areas should also be inspected for cracks, spilling and excess rainwater accumulation, as any of these could damage the support structures foundation.

Hazard Markings

Any facility with ASTs should remember that firefighters or site workers responding to an emergency at the site need readily accessible and accurate information on a tank's contents. Accordingly, all tanks should have easily visible and legible markings that indicate what materials are stored within the tank, what hazards the stored material possesses and what special fire fighting precautions are necessary. This information is easily conveyed through the use of appropriate NFPA placards and stenciling.

Fire Safety

Tanks containing flammable liquids are subject to rapid, violent explosions even after the tanks have been burning for a considerable time. These explosions can engulf large areas and create widespread damage. When a fire occurs in a tank, only well-trained firefighters should be in the area.

All flammable tanks should have water cannons or other cooling devices available to cool them when there is a fire in the area. These systems should be inspected and tested monthly, and facility personnel should be trained and drilled on their proper use.

Pressure Changes

Tanks are designed to hold liquids or gases at a given temperature and pressure. Changes in the internal or external tank pressure can result in catastrophic tank failure. It is important to remember that sunlight shining on a tank can increase internal tank pressure, which must be released to prevent tank failure.

Many tanks use vents to regulate internal pressure. If these vents become blocked for any reason, excessively high tank pressures may result, causing tank failure. Many vents are blanked off during maintenance activities that involve confined space entry. It is important to ensure that all blanks are removed after tank maintenance activities are concluded. It is also important to check that vents are of the proper size when filling the tank with a different material. High vapor pressure materials can easily exceed the design requirements of a tank designed to hold a low vapor pressure liquid.

Tank vents may become blocked due to sludge buildup, accumulation of condensed product, ice, rust, bird or other animal nests or improper maintenance. Rainwater in secondary containment areas has also been known to block vent pipes, causing tank failure. All tank vents should be periodically inspected to ensure that all vents, flame arresters, etc., are properly maintained.

Tanks will also fail if the internal pressure in a tank falls below the outside atmospheric pressure. This situation most often occurs when a pressure vent is blocked and a tank is emptied, thus creating a vacuum in the tank. If a strong enough vacuum is created, the tank will “oil can” or implode.

Vehicle Protection

Tanks located in areas of high vehicle traffic should be separated from traffic flow by vehicle guards (i.e. crash posts) or earthen berms. Vehicles backing into secondary containment areas can cause small cracks in containment areas that are not immediately noticeable but may leak or cause the containment wall to fail in the event of an earthquake or tank failure. Also, vehicles backing into tanks can very possibly knock the tank off the support structure.

Flood Protection

Tanks should not be located in a 100-year floodplain unless absolutely necessary. When tanks are located in a floodplain, tank tie-downs are necessary to prevent tanks from floating off support structures during floods. Dikes should be placed around tanks located in or near 100-year floodplains. The top of the dike should be higher than the 100-year flood level elevation and the tanks securely attached to the support structure to prevent the tank from floating should the dike be overtopped by floodwaters.

Maintenance Programs

All tanks and associated piping should be subject to a routine inspection and maintenance program. Depending on the material stored, annual or five-year tank wall thickness tests should be performed. The paint or other exterior coatings on tanks should not be allowed to degrade, as areas of rust or corrosion greatly weaken a tank's structure. Attention should also be placed on the maintenance of other tank structures such as ladders, catwalks, access holes, etc., which are used to conduct maintenance and operations activities. Note that many tanks have grounding straps or sacrificial anodes to prevent corrosion. These items should be checked during periodic maintenance checks. The function of level gauges, pressure release devices, temperature gauges and fire sensors should also be part of a routine inspection program.

Conclusion

Tanks represent important capital assets and are often critical operational items. Proper maintenance and care of tanks can allow smoother facility operation and prevent fires or environmental impairment. Many tank failures, resulting in large environmental cleanups, resulted from poor or nonexistent maintenance practices. For more information on ASTs, support structures and associated piping maintenance and inspection programs, please contact:

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Additional loss control and general CSRMA information can be found at the CSRMA

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