Leak Detection

Bulletin

Aboveground Storage Tank Integrity Verification Limitations

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Understanding the limitations of integrity verification methodology is necessary to implement an effective aboveground storage tank (AST) management strategy. Leak detection testing can create financial incentives when used during proactive risk management, regulatory compliance and after service repair applications.

The management of aboveground storage tanks is becoming of increased concern to tank owners. Regulatory compliance and the escalating costs associated to liability, tank downtime, fines and penalties, environmental cleanup and negative publicity have created this growing concern and are driving the need for an effective management strategy. The identification of leaks on a timely and reliable manner is a key component of the strategy. Consequently, a thorough understanding of the limitations of the various integrity verification methodologies will be of utmost importance to decision-makers and in overall development and implementation of the tank management strategy.

Numerous factors must be taken into consideration during an evaluation of integrity verification methodology. The evaluation should include tank preparation requirements, tank downtime, results generation time requirements; results accuracy and overall costs. This will determine the method that is best suited to a specific application will meet specific management objectives and will recognize leaks in an accurate and reliable manner. The cost of using a method of integrity verification must also be proportionate with the information that is generated by the technique. Does the information provide with conclusive integrity verification results as is the case with a leak detection test or does the generated information describe conditions as with the case a visual condition. The attributes and additional benefits of the technology need to be taken into consideration.

Roof Mounted Mass Measurement Leak Detection Test

A mass measurement test system, designed for underground storage tank testing, is being used to test vertical aboveground tanks. This system has been third party performance certified to test underground tanks only.

During the test procedure, a load cell is required to make finite measurements of the tank fluid's mass and recognize a change in the mass during the data collection time. A probe is suspended into the tank fluid from a load cell that has been anchored in the tank roof. The load cell determines the rate of change in the mass by measuring a change in the weight of the probe. A loss of mass will cause a decrease in the amount of buoyancy exerted against the probe and an increase in the weight of the probe.

In theory, this should be very accurate method of testing for leaks. However from a practical perspective, this method has difficulty detecting leaks because of the "noise" that found in the test data. Tank shell dynamics, wind, vibration, temperature change and other field conditions create "noise" – poor quality data and inaccurate load cell measurements. Leaks cannot be recognized during these situations, which is prevalent during most field conditions. This test procedure is not performance certified to test vertical ASTs and will generate an inaccurate "pass" leak detection test result. This situation is of particular concern especially when in fact the tank may be leaking.

Marker Chemical Leak Detection Test

Oil and gas producers are using this method to test under and above ground storage tanks because it does not require any tank downtime. These tanks are used for production, process and storage applications. Tanks and connected underground piping must be tested for leaks. The regulation does not specify approved leak detection methods or a minimum performance standard for leak detection methodology. Tank owners are required to use good engineering practices in the evaluation and determination of an appropriate integrity verification methodology.

Marker chemical leak testing involves placing a marker chemical in the storage tank, extracting samples from subsurface probe wells and using a laboratory to evaluate the samples for the presence of the marker agent. The laboratory results describe the presence or lack of presence of the marker agent in the evaluated sample. A two to four week period is required from the time the marker agent is placed into the tank and the laboratory report. This method does not necessary reflect the tank's integrity but rather, whether in fact the marker chemical migrated to the probe well and was detected in the sample processed by the laboratory.

Numerous variables can influence marker chemical results accuracy and reliability. A simple method to evaluate reliability is to compare the percentage or number of marker chemical test failures with industry averages. Marker chemical reliability will become questionable when it's failure rate is less than the failure rate generated by other types of performance certified testing methods. The significance of the concern will increase proportionately with the differential in the failure rate comparison.

Marker chemical testing was initially developed to test tanks containing gasoline and diesel fuels The initial US EPA third party performance evaluations were completed using fluorocarbons. The marker chemical had to be reformatted due to fluorocarbon restrictions. Does the reformatted marker chemical have equivalent performance capabilities as the original version? Has the new marker chemical been third party performance evaluated to determine its leak detection performance certification?

This leak detection method's performance is also affected by water. The marker chemical is not compatible with water, is not absorbed by water and does not vaporize in water. The chemicals were designed to be compatible and absorbed by gasoline and diesel fuels. Consequently, this technique may not be suited for tanks that contain water or when ground water is present in the probe wells or when the ground water is above an underground tank. The water non-compatibility could have a significant impact on leak detection results reliability. This creates several concerns. Does water impact the migration of the marker chemical, can a sample be pulled through water and is it detectable in a probe containing water?

Probe spacing and positioning will also have an impact on test results and reliability. Each probe monitors about a ten to twelve foot radius. Consequently, a probe is required about every ten feet. For example: an aboveground tank with a sixty foot diameter will require about six probes and a 2200 liter underground flare knock out tank with a hundred feet of connected underground piping will require about twelve probes. An insufficient probe well quantity could impair the detection of the marker chemical. Are a sufficient number of probes installed to detect marker chemical?

The detection of the marker chemical in the probes well will be influenced soil conditions and types. In sandy conditions a leak in an above or underground tank will most likely migrate in a downward direction with little or no lateral migration. Tightly compacted soils such as clay as a backfill can also prevent marker chemical migration and detection in a probe well. Soils with high levels of petroleum contamination will act similar to clays and can restrict migration. The best migration performance can be achieved when the backfill specifications are followed during the initial tank installation. Will soil conditions influence marker chemical migration, probe well detection and results reliability? Is the convenience of using a marker chemical test worth the uncertainty of the test results under the above noted circumstances?

Vacuum Box Testing

This method is used to test tanks for leaks after repairs. It is a simple and effective procedure when used with care. Vacuum box testing is an inspection method intended for weld joints and is not usually applied to the entire tank bottom. For this reason and due to occasional human error in its application, the vacuum box testing can miss leaks.

Other popular, tank bottom inspection tools are magnetic flux floor scanning and ultrasonic thickness detection. These methods attempt to locate possible leaks by finding areas of reduced thickness in the tank bottom. Ultrasonic testing is a spot testing procedure and gives an excellent evaluation of the spots tested. A very small percentage of the total tank bottom is actually measured.

Magnetic flux scanners can cover most of the tank floor. The scanners miss the areas close to the wall and places where physical obstructions prevent the machine from performing. Neither of these methods completely inspects the tank bottom and can miss leaks.

Hydrotesting.

The hydrotest is a structural test that is only required if significant repairs are made in the area near the tank walls. In spite of this, many operators fill their tanks with water after a bottom repair as a leak test. The hydrotest can be supplemented with dye to assist in using this test. However, even with dye in the water, it is not considered a leak test. Most tank bottom leaks will not migrate past the tank wall. The leak will go into the ground and will not be evident outside the tank. Even when the tank is considered to be sitting on clay or other soil with limited permeability, the weight of the tank wall will usually prevent migration of leaks outside the tank perimeter.

Internal Visual Inspections

This is a commonly used method of evaluate the internal condition of an aboveground tank. The scope of the inspection is always subject to interpretation: for instance a inspector limitations may miss one pit in the floor than be the cause of a leak. To inspect for topside corrosion or leaks, it is essential that the floor be cleaned. While expensive (several thousand dollars for a crude tank), it's one way of uncovering defects. It is usually found that tank integrity costs are dominated by cleaning / sludge removal prior to the inspection, and the confined space entry precautions, rather than by the actual inspection costs.

Visual inspection results are non-quantitative. Leak detection results reliability and accuracy can be questionable and will be influenced by the numerous variables including 1) inspector qualifications and experience 2) internal cleanliness and lighting conditions 3) thoroughness and scope of inspection 4) underside floor condition.

AST Mass Measurement Leak Detection Test

Unlike the improperly used, roof-mounted mass test, the Mass Technology Corporation (MTC) test system was designed to verify aboveground tank integrity through leak detection testing. This technique has been third party performance evaluated and meets recognized standards. ASTs of various sizes can leak detection tested with a high confidence level in result accuracy.

A micro-sensitive pressure transducer, resting on the tank floor, measures any changes in the mass of the fluid within the tank and determines if there is a leak. This test requires the fluid level to be 60% of tank volume during the test procedure. The tank must be taken out of service during the procedure and the downtime will vary from 6 to 48 hours and is based on tank diameter. Tank outlets and inlets should be blinded because leaking valves are common and will result in re testing the tank. This technique is ultra sensitive. Fluids with a high evaporative loss rate can have an influence on test results.

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