InsideICC Plumbing, Mechanical and Fuel Gas (PMG)

Underground Water Tanks: Understanding the Installation Process is the First Step in Safety Inspections

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Boerne Concept House in Texas (private residence): This 3,600-square-foot house is one of the first houses in the San Antonio area to achieve Platinum certification, the highest level attainable in the LEED Green Building Rating System from the U.S. Green Building Council.

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Underground storage tanks are increasingly becoming essential components of building projects, driven by rising interest in on-site rainwater and graywater collection and reuse. As a result, building officials may need to expand their expertise to include these products and their components. Some safety inspection work is obvious; for instance, checking that the installer or project owner obtained all necessary permits for the tank installation. Some elements of an inspection, however, are not as intuitive. Therefore, it is important for inspectors to educate themselves.

Environmental Concerns

In the past, the area of focus for tanks was corrosion-resistance. Over the last 50 years, federal regulatory agencies and corporations have gained considerable knowledge about how to protect the environment when it comes to underground storage vessels. In the 1960s, companies began to find that steel underground petroleum tanks buried decades earlier were leaking their contents into the groundwater as these predominantly steel tanks corroded. Since that time, federal and state agencies, as well as independent organizations, have developed numerous regulations and codes to ensure that underground vessels can be operated in a manner that is safe for the environment.

The result was that research and development in the tank industry focused on improving the materials and technology used in tanks. It was clear that underground tanks used for storing or processing liquids needed to be durable, offering long-lasting corrosion-resistance. Such materials as fiberglass, which is inherently corrosion-resistant and does not require a protective lining or coating, have since become an increasingly popular tank choice for a variety of underground storage applications.

More recently, interest in sustainability has created an overall movement in the United States for citizens, governments, organizations and corporations to act responsibly in matters of environmental protection and conservation. Average citizens are becoming more aware of environmental concerns, particularly in regard to available fresh water supplies. With a growing population base on the one hand and a dwindling fresh water supply on the other, people are realizing that on-site water collection and reuse is an essential part of both conserving and preserving water supplies. In addition, green building programs like the U.S. Green Building Council's LEED program and the International Green Construction Code (IGCC) have promoted water efficiency and encouraged builders and developers to incorporate stormwater management, water-efficient landscaping, water use reduction and innovative wastewater technologies into their projects.

A major responsibility of inspectors is to verify that the tank being installed has been manufactured to meet all applicable requirements, such as those in standards by Underwriters Laboratories® (UL), the American Water Works Association (AWWA) and NSF International for the intended application. For some non-potable water applications, however, there are no current standards for certain tank types. Generally, the tank itself and any accessories or piping must be made of corrosion-resistant materials approved for the particular application. In the cases of graywater and wastewater tanks, the materials used must also be compatible with the treatment system used with the tank.

Accessories

Another element of consideration is whether the tank is equipped with the proper accessories for that particular application. It is essential that tanks have the pumps, valves and filters needed to maintain and operate with the particular type of tank used. Components and tanks must also be designed to prevent infestation by insects or infiltration by vermin.

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For example, water tanks used for on-site water collection must have an appropriately sized overflow pipe that allows for the discharge of water as required by local codes. The overflow must also be incorporated into the installation design in such a way that it does not compromise the integrity of the tank foundation. Another example is that a potable water tank utilizing connection to a potable water source (such as a makeup water line) must incorporate protection against backflow, per local codes.

A key source of the appropriate steps required to inspect a tank installation is the tank manufacturer's installation instructions. Whether the tank installation is for residential rainwater collection, such as the Sustainable Concept House in Boerne, Texas, or a commercial application, such as the rainwater/stormwater collection tank at the University of Texas-Arlington, proper installation and maintenance of an underground tank is a crucial element in a project's ongoing safety.

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Manufacturer's Instructions

If a tank manufacturer's installation instructions include a tank installation checklist, inspectors have a ready guide for determining whether a tank has been installed according to applicable codes and regulations, as well as the tank manufacturer's requirements and recommendations. For example, Minneapolis-based Xerxes has a two-page checklist in its installation manual, which guides an installer through every critical juncture of the installation process. Xerxes, a fiberglass tank manufacturer, has long known the benefit of a comprehensive set of installation instructions and an installation checklist.

Before beginning the process of excavating for an underground tank to be used for water applications, there are many factors to be considered, depending on the specific application, location and type of tank. Examples include:

1. **Pre-installation testing of the tank.** Some water and wastewater tanks' manufacturing instructions specify pre-installation testing of the tank at the site.
2. **Location.** An inspector tracking an underground tank installation must also ensure that the tank installation site has been properly chosen. A tank installer must take into account nearby existing structures and utilities, and meet minimum clearances mandated by federal, state or local codes.
3. **Access control.** The installer must also erect barricades to prevent unauthorized traffic (both vehicular and pedestrian) around the excavation hole prior to the start of excavation.
4. **Excavation safety.** Installers must utilize all necessary equipment and procedures in order to excavate and secure the hole according to Occupational Safety & Health Administration's (OSHA) standards for the type and size of excavation planned. All workers must be properly trained on the equipment and procedures to be used.

Safety training should extend to code officials and inspectors, to ensure that they are able to carry out their responsibilities safely on the jobsites involving excavations.

Rainwater/stormwater collection tank at the University of Texas-Arlington.

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Excavation and Foundation Backfill

When it comes to underground storage tanks, as with any building element, having a sufficient and proper foundation is crucial. In the case of buried structures, no matter what material the tank is constructed of – fiberglass, steel or concrete – being surrounded by the correct type and amount of backfill material is essential for the tank's structural integrity, proper operation and ongoing maintenance. There is perhaps no single element in a tank installation more important than the proper backfill material and the backfill surround. A tank manufacturer's installation instructions should clearly detail the backfill requirements for different tank types (water, wastewater, chemical or petroleum, for example) and for different conditions (traffic or no traffic, dry-hole or wet-hole, stable or unstable native soil).

An installer's first step in the backfill process is to clear the excavation hole so that the bottom is free of any large rocks or objects that would interfere with laying a smooth, level bed of backfill. In wet-hole installations, the excavation must be pumped of water so that a minimum water level is maintained while a tank is being installed. If possible, the water level should be kept below the top of the backfill bedding until the tank can be fully backfilled and ballasted.

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Next, a tank installer must establish whether a concrete slab and/or a geotextile filter are necessary to secure the excavation. After either or both are installed, if needed, the installer can then place the bedding with backfill – either rounded or crushed stone – that meets the specifications of ASTM C 33, ASTM D 448 and AASHTO M 43.

Hardness and stability of the material, when exposed to water or loads, is important criteria of backfill. Limestone, sandstone, sea shells and shale, for example, are not approved choices. Aside from choosing the right material, it is also important that the material is free from sand, debris, large rocks and organic materials and frozen materials.

Three factors determine the depth of an excavation (other than applicable codes and regulations): groundwater, site traffic and the condition of the excavation bottom. If the level of water in the ground may rise above the bottom of the tank at any time during the life of the tank, the excavation must allow for it. For instance, a backfill bed of 18 inches is advised in sites where water may accumulate in the hole or where the native soil is soft. In wet-hole conditions, an underground tank must be ballasted or otherwise secured to prevent the tank from floating when empty.

If there will be traffic above the installation (that is, loadings for highway vehicles up to H-20 or HS-20), or if the excavation base is soft or uneven, a reinforced concrete slab or other stabilizing material may be required below the backfill bedding. Such factors also impact the tank's depth of cover (and type of cover) over the tank.

Another critical juncture in the installation process is the determination of what, if any, kind of anchoring system a specific installation requires: deadmen, anchor straps or concrete anchor slabs, for instance. In installations with more than one tank, tank manufacturers specify spacing required between tanks and from the tank to the ends and sides of the excavation hole. Again, an inspector must verify these requirements to ensure the tank has been properly installed.

Prior to bringing the backfill to the top of the tank, some tanks require additional testing. In addition, some piping connections to the tank must be tested. Inspectors must not only verify that such testing is performed according to instructions, they must also verify that the tank is vented and that all piping connections to and from the tank are corrosion-resistant and flexible.

Once safety inspectors become more familiar with underground tank installations, much of their work will be second nature. In the meantime, following a carefully prepared and presented set of tank installation instructions will go far toward preparing them for this work. **bsj**

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As always, your articles, ideas and submissions are welcome. Send them to foliver@iccsafe.org along with a daytime phone number at which to contact you with questions.