Watertight TANKS

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Tank water tightness has been debated over the years. Nearly 10 years ago, the National Onsite Wastewater Recycling Association (NOWRA) and the National Precast Concrete Association (NPCA) produced a videotape about how to construct watertight tanks. Most state regulations have a statement that septic tanks shall be watertight. Unfortunately, many states either do not define what it means for a tank to be watertight, or the state does not enforce the regulation. In some cases, the tanks are tested at the manufacturers' yards, but not after having been hauled cross-country and set into the excavation in the field. In some cases, a few tanks are occasionally selected for testing on the manufacturers' yards. Wandering through exhibits at the various conferences and equipment exhibitions, it is easy to observe that many tank manufacturers advertise their tanks as watertight.

What is the importance of watertight tanks, anyway? In comparison to the standards for gravity sewers, constructing watertight tanks seems to be overkill. A textbook value for infiltration and inflow for gravity sewers is 30,000 gallons per day per mile of sewer main and service connection. When the soil is saturated after rain, this amount of groundwater runs into the sewers, resulting in sewer overflows such as the one depicted in photo 1. Interestingly enough, this photo shows the large emergency generator to run the pumps in case of power loss. If power is lost during a thunderstorm, the generator can run the undersized pumps and the sewage will still geyser out of the manhole and run into the adjacent stream. For the sake of comparison, infiltration of 30,000 gallons per day per mile would be like having an extra house every 50 feet along the sewer main.

The other side of the infiltration and inflow picture is that the leaks that allow groundwater into the sewers do not have check valves on them. They can leak out as well as in. In sensitive areas, where traditional septic tank-soil absorption systems have been an environmental concern, gravity sewers have been proposed as a solution. If the gravity sewers are allowed to leak 30,000 gallons per day per mile, the environmental threat from septic tank effluent would not appear to be alleviated by constructing gravity sewers that could leak raw sewage.

When septic tanks leak, the effluent may leak out into the environment if the seasonal groundwater is low or non present, or the groundwater could leak into the tank if the seasonal or true groundwater is high. When the seasonal groundwater is high, and the tank leaks around the seams (top or mid- seam) or around the inlet and outlet pipes, the soil absorption system can become hydraulically overloaded. Photo 2A shows concrete tanks with malformed seams that will lead to leaking inward if the high water table reaches the seam. During these times, the soil absorption system may already be under hydraulic stress due to the high seasonal water table and the high climatic load. In the eastern U.S., high seasonal groundwater occurs during the winter months when little evapotranspiration is occurring and the soil is near saturation. When a tank leaks near the top of the tank, or if the seasonal water table is near the top of the tank, allowing the tank to overfill, the result can be a flooded tank and backup of sewage in the house. Photo 2B shows a tank with a malformed top seam with a

Photo 1

Photo 2A

Photo 2B

hole large enough for a hand to go through. This provides a place for the tank to leak if the seasonal water table reaches the top of the tank. This tank was manufactured by a precast tank company whose tanks are certified by the department of health as watertight tanks. Figure 1 illustrates a tank lid separating after the tank settles. When a tank is placed into the excavation and filled with water, unless the soil is stable, settlement may occur. For a 1200-gallon capacity tank, the weight of the liquid alone (not including the tank weight) is slightly over 10,000 pounds. If the tank hole is over excavated and refilled for leveling, the fill material has the potential to be a source for settlement if it is not compacted.

During high seasonal groundwater periods, if a leaking tank is pumped or flows into a pumped tank, the additional groundwater entering the tank can overwork the pump. At a minimum, it is not uncommon to incur high-water alarms due to leaking tanks. The septic tank effluent and groundwater is pumped away from the tank and into the soil absorption system. The result may be an overloaded soil absorption system with surfacing septic tank effluent.

Some discussion of the septic tank's function may help clarify some of the issues with leaking tanks. The septic tank is expected to provide several functions. Among these are solids removal through settlement and flotation, and treatment through anaerobic digestion. If an effluent screen is installed on the outlet, an additional function is removal of solids that are neutrally buoyant.

When water leaks into the tank, the tank can become flooded, and the floating solids layer may wash out of the tank and into the soil absorption field. When the inlet tee or baffle is flooded, it is not uncommon for solids and paper to accumulate in the inlet tee and clog the incoming house sewer. If the outlet tee is flooded over the top of the tee, the floating solids may exit the tank and clog the soil absorption system.

When water leaks out of the tank during low seasonal water table and low water usage (wastewater generation), the sludge layer on the tank bottom and the scum layer on the liquid surface can approach each other, and the stratification in the tank is eliminated. When water re-enters the tank and refills the tank to the level of the outlet tee, the "homogenized" solids layers can be washed out of the tank into the soil absorption system.

During the past decade or more, significant efforts have been made (and rightly so) to study the soil absorption system function and the soil's ability to treat and disperse septic tank effluent. In some cases, due to soil constraints, or due to the sensitivity of the receiving environment, the septic tank effluent or the raw sewage is treated to high water quality prior to dispersal or reuse in the soil. Most states have regulations regarding the vertical separation between the soil absorption system or the application point of the soil dispersal system (drip irrigation, etc.). The point of the separation seems to be to allow the wastewater to pass through some vertical distance of soil prior to intercepting the groundwater—whether it is perched seasonal groundwater or a permanent water table. Normally, the tank depth is greater than the soil absorption system depth. Certainly the tank depth is greater than the depth of drip irrigation tubing.

When a leaking tank is installed, the separation distance between the sewage and the groundwater is essentially ignored. If the tank leaks around the inlet fittings, raw sewage is potentially leaking into the soil and groundwater. If the tank leaks at the bottom, there is potentially no separation between the leaking sewage and the groundwater. In some cases, the tank may be installed in dry weather when

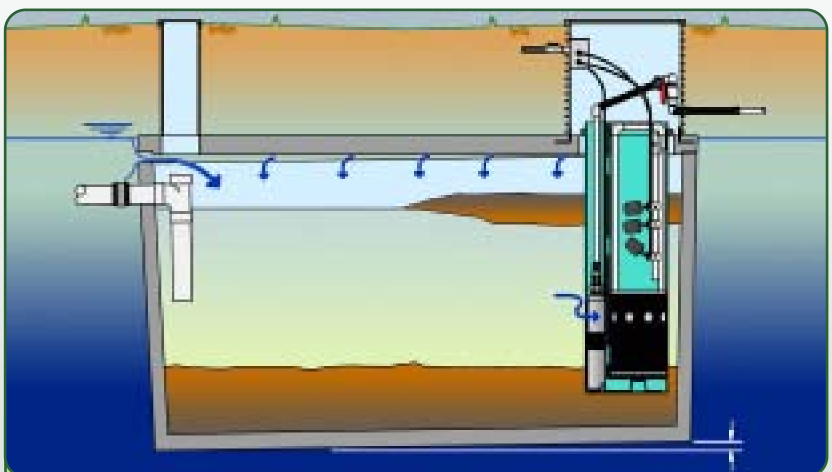

Figure 1 Tank lid separation

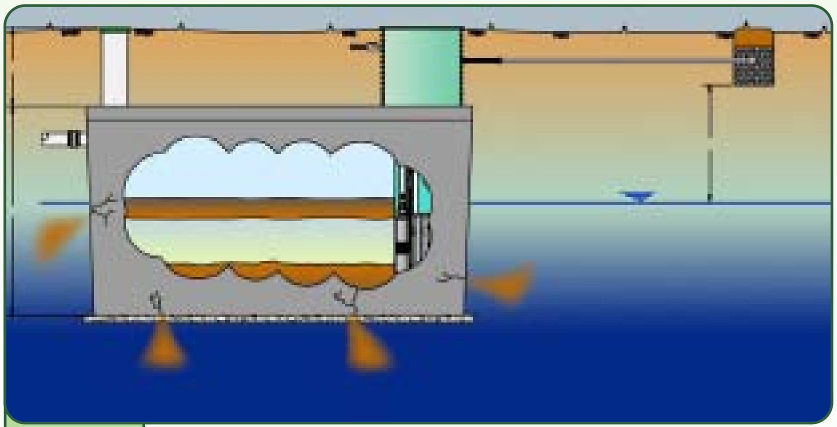

Figure 2 A leaking tank

the seasonal groundwater is not present. The tank can leak into the zone where the groundwater will be in the wet part of the year, and sewage is essentially introduced directly into the groundwater. Figure 2 illustrates this point. When this happens, it would seem that all of the work of the soil scientists, engineers, designers, and regulators to maintain a vertical separation in the soil absorption system or dispersal area is negated by setting the leaking tank directly into the groundwater so that it can leak sewage into the zone that was so diligently protected in the soil absorption area. The point being, what is all of the fuss over the soil absorption area if the tanks aren't really watertight? Sort of swallowing the camel while straining the gnat aren't we? Not that we shouldn't continue the efforts to properly site the dispersal area, but we should make the same level of effort to provide watertight tanks and pipes. Without watertight tanks, all of the effort to maintain the vertical separation would seem to be wasted time and money.

When the issue of testing a tank in the field is discussed, several arguments can be presented. Most of the arguments are centered on time and money. Some of them include the following:

- The tanks are tested on the manufacturer's yard; isn't that good enough?
- In order to hydrostatically test the tanks in the field, water must be hauled in to fill the tank(s).
- In order to test the tanks in the field, it will involve an extra trip to the site for either the installer or the regulator.
- It's too expensive and it takes to much time.

Some answers to these arguments are as follows:

- Maybe, but what happens to the tank when it is loaded on a truck, driven down the highway, bounced along gravel or dirt roads? Is it still watertight when it is set in the excavation?
- What happens when the tank connections are made? Are they watertight? Was the tank tested over the top seam and over the connections to ensure that they didn't leak? If a riser was installed, was the connection between the top of the tank and the riser tested to ensure that it didn't leak?
  - Aren't the tanks filled after setting them in the excavation and before leaving the site? If not, what happens when a rain occurs and fills the tank excavation? Won't the tank float and become unlevel? In the eastern U.S. it is unwise to leave an empty tank in the excavation. One rainstorm can undo a significant amount of work by causing the tank to float.
- When the regulator, the designer, and possibly the installer were evaluating the property for soil and site conditions, was this an argument? Is maintaining adequate vertical separation worth another trip, or is it really worth the risk to the soil absorption area to not test the tanks and take the chance that it will or won't leak?
- Is it less expensive to fix a leaking tank after it has been backfilled, used, and caused a soil absorption system worth several thousand dollars to malfunction and burn up a pump costing several hundred dollars? How much money was spent evaluating the site for the proper soil conditions? What if the tank leaks sewage into the receiving environment and the site has to be remediated? Isn't it worth one more trip?

In addition to these arguments, similar to most septic system topics, there are a few "watertight" myths that are floating around out there. Some examples are:

"The soil around the tank will seal up the leaks."

The only experience I have with this myth would indicate otherwise. A tank in one of the experiments we conducted showed some signs of leaking when we installed it, and tested it prior to backfilling. We experienced high water alarms and increased metered effluent after most rains over a period of 4 years. The tank was installed in expansive clay, and after 4 years, the soil had not sealed the leaks. At another site in southwest Arkansas, a pump tank continuously gave high water alarms and excessive (yes, the pump burned up, that's how we knew it was "excessive") pump run times.

"Once you start using the tank, the bacteria will seal it up."

Really? Cool. Where do you get those bacteria? We need to introduce some into the sewer shown in photo 1. The City would sure like to have some. A dead cat in the septic tank once a year makes the system work great, too. Seriously, that hasn't been my experience. In both cases mentioned above, the systems were in place and were receiving sewage for years, and there was no

Photo 3

sign that the leaks were sealed by bacteria.

Granted, these are only two data points to add to the discussion of leaking tanks sealing themselves after some period of use. However, they are the only data points I have, and if there are data to validate the myths, they should be provided as evidence that constructing watertight tanks is unnecessary.

It isn't impossible to build watertight tanks that can withstand time, use, and installation in a real onsite/decentralized wastewater system. Simply using a different material doesn't solve the problem. Any type of tank can leak. Any type of tank can be misapplied or installed into conditions for which it wasn't designed to withstand. The polyethylene tanks in photo 3 were installed for use as pumped interceptor tanks in a STEP (Septic Tank Effluent Pumping) system. The tank manufacturer examined the installation and found that the tanks had been installed in a high water table and in a soil that they (the manufacturer) did not recommend for use of their tanks. The lesson learned here is that the designer should contact the manufacturer and discuss soil type before recommending the tank.

Photo 4

Photo 4 shows a polyethylene tank suffering from deflection. Not all polyethylene tanks are constructed the same. If the tank is going to need the structural strength to withstand an application, it should be designed and constructed with the appropriate structural integrity. In a conversation at the Florida training center, I recently learned that polyethylene tanks might not be manufactured from all-virgin materials. If tanks fail the quality control test, they may be ground into pieces and the pieces are reused in the rotomolding process for new tanks. The amount of "regrind" or reused polyethylene apparently affects the structural integrity of the tank.

Photo 5

Photo 5 shows a fiberglass tank with a split seam. Just because a tank is fiberglass, that doesn't mean that it won't leak, or that it can withstand any hydrostatic or soil pressure. Also, it is not uncommon for tanks to have defects when they are glued or glassed together in halves. Tank fabricators generally need to climb a learning curve when they begin putting tanks together that have been shipped to them in more than one piece. Just because it's a fiberglass tank doesn't mean that it doesn't need to be tested in the field.

Some construction and fabrication techniques are available for manufacturing tanks that are more likely to be watertight. Some of the suggestions garnered from professionals across the U.S. are noted below. Since I don't claim to be a tank manufacturer, I have depended upon others for their suggestions.

Concrete Tanks:

- Make the tank walls 3" or thicker.
- Do not use mid-seam tanks.
- Use flexible fittings on inlet and outlet—no knock-outs to be grouted around pipe.
- Use reinforcing bars instead of welded wire.
- Use lap joints along lid and top of wall.
- Use a low water : cement ratio.
- Use plasticizers.
- See the NOWRA/NPCA video.

Fiberglass Tanks:

- Use flexible inlet and outlet joints.
- Use proper backfill.
- Use ballast as recommended by manufacturer.

Polyethylene tanks:

- Do they creep?
- Bed in sand or gravel or the manufacturer's suggested bedding.
- Do not use in high seasonal water table if the tank isn't made for it—check with the manufacturer.
- Do not use in high shrink-swell clays if the tank isn't made for it
- Conduct vacuum testing.
- Use tanks that are made for pump tanks when a pump is specified.
- What about when the tank needs to be pumped? Don't pump it during high groundwater periods if the tank isn't constructed to withstand high hydrostatic pressures.
- Limit the amount of non-virgin materials or "regrind."

Watertight tanks are as important as properly sited and designed soil absorption areas. If the tanks leak in or out, the time and effort spent on the soil characterization and designing the soil absorption area may be for naught. The difference in price between a leaky tank and a watertight tank may well be insignificant compared to replacing the soil absorption system.