PLASTIC SEPTIC TANK TECHNOLOGY ADVANCEMENT & INSTALLATION BEST PRACTICES
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Abstract
While the basic function of a septic tank as a storage vessel has not changed, every other thing surrounding the topic of tanks has including the types of usage, the materials used, and the rules and regulations surrounding tank applications. This paper will cover those changes and how installers can use new tank technology to their business advantage.

Concrete, fiberglass, and plastic tanks will be included. Types of septic tanks commonly used will be reviewed along with the benefits and applications of each. Additionally advances in pumps and filters for tank applications will be reviewed. The importance of having a watertight septic tank to prevent surface or groundwater from entering and causing hydraulic overload of the drainfield system and/or flushing solids out and causing the drainfield to be plugged will also be covered.

Site and regulatory challenges installers face that dictate tank selection including the need to design compact systems for small lots and for systems in environmentally sensitive areas and how these applications also serve as catalysts for tank innovation will be reviewed along with the options for tank selection in each scenario presented. Case study examples of effective project installations will be included.

Introduction
Changing environmental challenges, market conditions, and regulations are all playing a role in the evolution of new tank designs. While the basic function of a septic tank as a primary treatment vessel has not changed, every other thing surrounding the topic of tanks has including the types of usage, the materials used, and the rules and regulations surrounding tank applications.

Site and regulatory challenges installers face that dictate tank selection including the need to design compact systems for small lots and for systems in environmentally sensitive areas. The use of advanced wastewater treatment systems for limited and sensitive sites is a new application to consider in tank construction and use. The need for large tanks that can be easily transported to remote sites is another catalyst spurring the move to lightweight but durable plastic tanks.

Tank Materials
Tank materials are essential to the function and usage/purpose of the tank and leakage is always a major concern. While concrete is still the most common material for wastewater tanks, recently plastic and fiberglass tanks have become more common in the marketplace. Plastic and fiberglass materials are resilient to wastewater constituents, a benefit for product longevity, and they are notably lighter making them ideal for difficult access sites.

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Resistance of Tank Material Polypropylene to Chemical Degradation:

- Due to the inert nature of polypropylene, the septic tank is unaffected by contact with water, nor does it emit water-soluble substances that might impair groundwater quality.
- Polypropylene is unaffected by extensive contact with soap solutions, bleaches, and typical household products that may be discharged to the septic system.
- Polypropylene is susceptible to the presence of concentrated organic solvents; however, such solvents are not present in the targeted application and if present, would be diluted by the large volume of effluent in the tank.
- The chemical resistance of polypropylene to common gases found in septic tanks as adapted from a larger list in the INEOS PP Chemical Resistance Guide is as follows:

<table>
<thead>
<tr>
<th>Septic Tank Gas</th>
<th>PP Inert Rating*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydrogen sulfide</td>
<td>S</td>
</tr>
<tr>
<td>Ammonia</td>
<td>S</td>
</tr>
<tr>
<td>Methane</td>
<td>S</td>
</tr>
<tr>
<td>Carbon monoxide</td>
<td>S</td>
</tr>
</tbody>
</table>

*S = satisfactory, O = some attack, U = Unsatisfactory

Due to new injection molding manufacturing technology, plastic tanks are able to attain increased strength compared to previous manufacturing methods. Plastic tanks that are manufactured by the rotational molding process are typically a one-piece tank and thus minimize leak potential. Overall plastic tanks are lightweight and easy to transport and install.

Additionally, plastic tank designs have been introduced with a new technology of continuous gaskets, as shown in Figure 1, which are commonplace in the pressurized pipe industry, and the inclusion of a fixed, permanent connector system to lock the seam in place. For these reasons, the evolved plastic tank is quickly becoming accepted by contractors, designers, and homeowners and because of the variety of size options available to satisfy varying needs.
Figure 1: Plastic tank manufactured with continuous gaskets

Manufacturing Process Advancements
In most areas of the United States and Canada, codes still only state that a watertight tank shall be provided without verification, this is beginning to change, as some recent code alterations require testing to ensure tank watertightness.

The Top Three Reasons for Watertight Tanks
- Leaking-in: Water (outside from surface or ground water) entering the tank will cause hydraulic overload of the drainfield system and/or may flush solids out causing the drainfield to be plugged
- Leaking-out: untreated water can pose a health threat to surface or groundwater
- Cracks or open seams allow for roots to penetrate and expand openings

The injection molding manufacturing process has resulted in increased strength and durability. The manufacturing process allows the inclusion of corrugations and ribbing to strengthen the tank as shown in Figure 2. Interior structural bulkheads can be included to increase the strength of the tank. Injection molding can currently achieve tank sizes of up to 1500 gallons. The process allows for a consistent wall thickness and a much higher strength plastic material. This yields a high strength yet low weight tank and the tanks are conveniently manufactured in “halves” allowing the tanks to nest for increased shipping density.
The Green Effect
The acceptance of recycled materials as equals in manufacturing of plastic tanks and the evolution of manufacturing processes result in the production of a consistent, high quality product. Recycled streams of materials are put through rigorous testing at varying points in the material processing procedure to ensure that minimum product specifications are obtained.

Evolving Tank Applications
In septic system applications, the need for compact systems for small lots and for systems in environmentally sensitive areas is serving as a catalyst for tank innovation including increased safeguards to ensure watertightness. On difficult sites, the ability to install a tank in a shallow, low profile configuration to leverage the available space while avoiding rock or problematic soil conditions is another need pushing designers to innovate.

Environmental regulations have required single-family residential wastewater treatment systems, as shown in Figure 3. For locations in environmentally sensitive areas, regulations may also require an advanced treatment system. The vessel that houses the treatment system is the tank. Installing a treatment system within the tank should allow for design flexibility, ease of component installation, and provisions for maintenance. Tanks have incorporated these design features to address the regulations and provide solutions.
Although the focus of this paper, tanks for onsite wastewater treatment are one application. Pump tanks, rainwater harvesting tanks for non-potable and potable use, stormwater runoff storage tanks, and agricultural and chemical storage tanks are also evolving to accommodate new regulations and applications.

**Septic Tank Installation Best Practices**

Proper excavation and bedding procedures are essential for a quality installation of septic tanks. Regardless of the tank material (concrete, plastic or fiberglass), appropriate measures should be taken to ensure the excavation is safe and the proper bedding is placed and leveled, prior to setting the tank as shown in Figure 4. Once the tank is installed then backfill with suitable material per the specific manufacturers installation instructions.

**Figure 3:** The Tank is a key component in residential wastewater treatment systems

**Figure 4:** Preparing the base for a tank installation.
Excavations should be performed to minimize over-digging the base reducing the chance of uneven settling or the need for excessive bedding material. The length and width of the excavation should provide enough space to allow for proper compaction of the suitable backfill. Furthermore, the excavation should be such that the bridge between inlet, outlet and/or delivery lines and the virgin soil is minimal. It is recommended that when a smaller diameter pipe is used for a pump or delivery line and it spans over excavated ground, that pipe should be sleeved inside a larger diameter pipe to help avoid any breaks due to settling ground.

Example: a 2” pipe used for pump discharge should be sleeved inside a 4” pipe from the 4” tank outlet to virgin soil, then a 4x2 Fernco placed at that end to not allow any backfill to enter the sleeve. The Fernco also serves as a “shock” of sorts, to give some cushion should there be any settling.

Once the tanks are properly backfilled, as shown in Figure 5, and compacted in lifts with suitable soil per manufacturer’s installation instructions, topsoil should be placed up to the final grade to provide for and promote suitable grass growth and positive drainage away from the risers and lids.

Figure 5: Backfilling the Tanks.
Tank Application Case Study
Illinois Mine Reclamation Project Utilizes Advanced MBR Wastewater Treatment System Utilizes Plastic Tanks

Overview
Goose Lake Ranch is an 800 plus acre reclaimed strip mine property in Fulton County, Illinois consisting of over 50 lakes that are famous for incredible fishing. The Herman Brothers family is rehabbing an existing campground, adding resort cabins, and 90 campsites and they plan to film a TV series on the property.

Challenges
Since the property consists almost completely of reclaimed coalmine spoils and lakes in close proximity to each other, it posed some extremely challenging wastewater situations. The inconsistent soils, numerous lakes and drastic elevation changes challenged system designers along with stringent new code requirements.

System Design
NSF350 water recycling membrane systems (MBR) were installed within Plastic Tanks. The numerous MBRs are either 500 or 1000 GPD units and are built to suit the location with single units for individual cabins and 1000 gpd MBRs serve clusters of resort cabins, beach houses, a store, and a banquet hall. Installing the Plastic Tanks allowed the units to be constructed in a shop to specifications and then delivered and installed, as shown in Figure 6, around the property as needed without requiring a heavy boom truck thus saving substantial expenses.

Figure 6: Plastic Tanks Installed in Series.
An engineered-aggregate was installed for the treated effluent dispersal fields, eliminating heavy trucking and the spreading and compaction challenges of stone. The Plastic Tanks were also installed for trash and pump tanks and the dispersal fields are time dosed.

A blower outside the tanks in a plastic enclosure blows air to scour the membrane to keep it clean which keeps the biomass alive and growing. A 1.5 amp marine pump is attached to each MBR and very slowly pulls the recycled water out and then transitions to gravity flow to the dispersal fields.

**Conclusion**

Tanks serve many uses, while the function of a septic tanks is primary treatment has not changed, there have been other significant changes including the types of usage, the materials, manufacturing process, and the rules and regulations surrounding tank applications. These advances have also provided tanks will meet stringent watertight standards. Tanks have changed to be higher quality and strength, meet higher standards, more allow for more uses.

**References**