Steel Facts

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STEEL'S PROVEN PERFORMANCE

- Steel's strength and versatility dominate every aspect of the petroleum supply chain.
- Steel can be buried at any depth, even shallow burials.
- Steel can be installed in any groundwater situation—even tidal areas.
- Steel resists pressures that plastic and FRP cannot tolerate.
- Steel tanks perform more than 300% better than FRP in strength tests.
- Steel underground tanks are naturally grounded.
- Steel is not permeable to vapors or liquids.
- Steel is safe and recyclable.

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MECHANICAL PROPERTIES: STEEL OUTPERFORMS FRP

The Strength of Steel

The Steel Tank Institute has conducted tests that demonstrate steel's superior mechanical properties. The outcomes disprove the contention that fiberglass reinforced plastic (FRP) is "just as good" as steel for tank applications.

STI conducted the structural performance tests defined in UL 1316, Standard for Fiberglass Tanks, using steel tanks. The results are conclusive.

STEEL TANKS SHOW 22 TIMES GREATER SAFETY FACTOR UNDER INTERNAL PRESSURE

To test the strength of FRP tanks under internal pressure, UL 1316 specifies that an internal 25 psi hydro load test be conducted in a 10-foot or smaller diameter tank. A safety factor of 5 psi is typically applied in production tests of FRP tanks.

In STI's steel tank test, however, the load was increased to 110 psi—more than 400% higher than the FRP requirement and 22 times the 5 psi production test.

STEEL TANKS THREE TIMES STRONGER THAN FRP UNDER EXTERNAL PRESSURE

UL's test for FRP tanks under external pressure requires that an empty tank be installed in a standard excavation and the pit filled with water to grade. A vacuum is then applied to the primary tank.

For STI's test, however, a steel tank was buried to a seven-foot depth and completely submerged in water. Vacuum was then applied until the vacuum equipment could pull no more.

The steel tank withstood a total external pressure, including water and vacuum, of negative 15 psi, three times more than the required performance standard for FRP tanks, and still the steel tank did not fail.

The steel tank shown above was tested to -15 psi—that's *30 times UL's standard for safety.* Steel tanks are designed for negative pressures up to -0. 5 psi.

WATER LOAD TEST

The UL 1316 test calls for the FRP tank to be placed in a sand bed depth equal to 1/8 of the tank diameter. The tank is then filled with water for one hour.

Steel tanks are routinely installed aboveground, so the water load test is not a challenge. Nevertheless, STI duly completed the test. Extending the test beyond requirements for FRP was not necessary.

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Mechanical properties: STEEL outperforms FRP

Steel and fiberglass have fundamentally different properties. Steel is an elastic material with excellent ductility and impact strength, while fiberglass exhibits poor ductility and impact strength. Simply put, when steel only dents, fiberglass (composite) will break.

- An elastic material like steel expands instantly when a significant load is applied, and just as quickly returns to its original state once the load is removed. Steel remains fully elastic as long as the stress remains at or below the yield stress of the steel.
- In comparison, a rigid, viscoelastic material like FRP is subject to time-dependent strain and weakens over time as load is applied.

Mechanical properties of steel

Mechanical properties pertain to reaction of the material to an applied load. The mechanical properties of metals determine their range of usefulness and establish expected service life. Mechanical properties also help classify and identify materials.

The most common mechanical properties considered for materials are ductility, strength, and hardness. For all three properties, steel tanks outperform tanks made of FRP.

Ductility allows a material to bend rather than break. The higher the ductility, the more the material can change shape without cracking or rupturing. One measure of ductility is the amount a material can stretch without brittle fracture.

Steel is naturally grounded. A steel tank won't explode like this FRP tank did when lightning struck nearby.

Steel stretches about 15 times more than fiberglass reinforced plastic. Its higher ductility means buried steel tanks can resist loads from high water tables and heavy trucks better than more brittle materials, such as FRP.

For the same reason, steel tanks are safer than brittle FRP tanks under severe conditions such as lightning strikes, tornadoes, mud slides, extreme temperature changes, and earthquakes.

Strength is necessary to resist the loads imposed on the tank. The flexural strength of a material is its ability to resist deformation under load, that is, how much stress an object can endure before it breaks.

For underground tanks, loads include traffic and soil loads pushing down, groundwater pushing up on the tank bottom, and pressures created when filling and withdrawing product. Steel endures high stresses without cracking and is the high-performance choice for underground tanks.

Hardness characterizes a material's resistance to indentation. The hardness level of an FRP tank must be regularly measured to ensure that it remains consistent over time. Inadequate hardness may be an indicator of incompatibility with products stored, leading to leaking or evaporation.

However, the steel used to fabricate tanks is inherently hard enough to resist penetration from sharp objects. Further, steel tanks are compatible with all types of fuels, chemicals, and liquids normally stored in underground tanks.

Steel is your strongest choice

Specify steel when choosing the material for your tanks or pipelines. Remember that only steel has long term material strength that's not time-dependent, as well as superior mechanical properties.

STEEL: CONSISTENT MATERIAL PERFORMANCE

- **STRONG—**able to handle stresses from soil loads, wind and seismic activity.
- **IMPERMEABLE—**to vapors and fluids of all types.
- **FLEXIBLE—**adaptable to tank designs of virtually unlimited shape and capacity.
- **COMPATIBLE—** with all ethanol and biodiesel fuel blends.
- **HIGH LIFE-CYCLE VALUE—**long-term material strength that's not time-dependent.
- **SUSTAINABLE—**more steel is recycled in America each year than paper, aluminum, glass, and plastic combined.