New Materials for Underground Propane Tanks

Alternatives to traditional steel tank aim to improve durability and decrease cost

More homebuilders than ever are installing underground propane tanks. A recent survey showed 34 percent of homes built over the last 12 months in locations with partial or no access to natural gas use an underground propane tank. The survey found that once builders understood the benefits of underground propane tanks, their intention to use propane in homes they plan to build in the next 12 months jumped from 18 to 29 percent.

Even areas with access to natural gas show increased interest in underground propane tanks. The desire for a reliable energy source for stand-by generators has proven a powerful draw, as has the popularity of outdoor living areas. An unobtrusive underground tank can fuel generators, swimming pool heaters, grills, mosquito eliminators, fireplaces, patio heaters, and countless other amenities. These increase not only the homeowner's enjoyment of their house, but also the value of the home itself.

Traditional underground propane tanks are made of steel, which requires protection from corrosion caused by an electrochemical reaction between the steel and surrounding soil. The cost of this treatment and other corrosion-maintenance costs encouraged the Propane Education & Research Council (PERC) to support two research projects that examine alternative materials for underground tanks.

First, the *Study of Alternative Tank Material for Underground Propane Storage Tanks* (**Docket 11728**) determined that a composite underground propane tank could be a cost-effective alternative to a steel tank. Based on the study's success, the *Alternative Materials for Underground Propane Storage Tank-Phase 2* (**Docket 12096**) project is a follow-up study that will prepare a detailed design and manufacturing cost estimate of a 500-gallon composite propane tank.

Project Description

Led by Batelle Memorial Institute, **Docket 11728** included the following tasks:

- Identify the top five materials or combinations of materials to manufacture an underground tank that would be competitive with steel underground tanks
- Estimate the time frame and conditions under which a tank can begin to be manufactured
- Formulate a demonstration or field test program to test the most promising materials

Composite Tank Benefits

Composite tanks offer a variety of benefits over traditional steel tanks:

- Reduced maintenance costs: no need for cathodic protection and monitoring of the tank
- Light weight: easier to transport, install, and remove compared to steel tanks
- Affordable: rising steel prices are closing the gap between the cost of steel and alternative materials

A small dome inches above the ground is the only visible sign of an underground tank.

Installation of an underground propane tank.

Project Status

Phase I (Docket 11728): Complete

Battelle developed preliminary designs for composite tanks for underground service. The designs were based on previous experiences with underground petroleum storage tanks, considering:

- Tank design pressure
- Cyclic pressures due to temperature and filling
- Soil loading

Battelle used a feasibility design approach for underground composite propane tanks for residential use based on:

- American Society of Mechanical Engineers (ASME) guidelines for primary pressure vessel design
- American Water Works Association (AWWA) Manual of Water Supply Practices to account for the buried installation of the tank

Estimation of Costs

- Rough-estimate first cost of the composite tank is slightly higher than that for steel, though estimated steel tank costs do not include cathodic protection monitoring costs
- Preliminary cost analysis shows that alternative material underground tanks are potentially competitive with steel construction from a life cycle standpoint

Feasibility Design

Two critical design elements were considered:

- Determination of the tank thickness to meet internal pressure requirements
- Determination of whether the tank design satisfies the buckling criteria

Phase II (Docket 12096): Approved

In this phase of the project, Battelle and Lincoln Composites will pursue the following objectives:

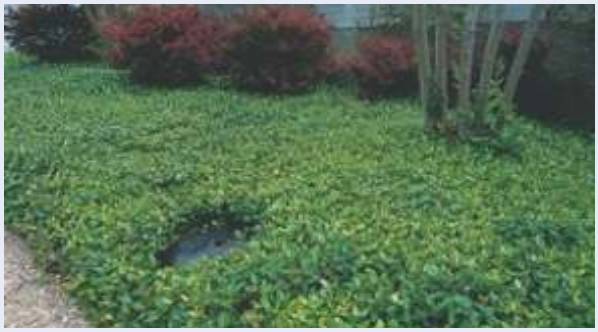
- Prepare a detailed design and manufacturing cost estimate of a 500-gallon underground composite propane tank
- Build a mockup composite tank for display at the 2006 World LP Gas Forum and Global Technology Conference
- Perform literature studies of material compatibility and appurtenance corrosion analyses

Underground Propane Tanks and the Home

Single-family homes can be fueled by a variety of tanks, with sizes tailored to a particular demand:

- 100-gallon tanks provide energy for specific applications such as outdoor rooms
- 500-gallon tanks easily accommodate an average four-bedroom home
- 1,000+ gallon tanks can fuel large homes with applications such as swimming pools and hot tubs

Entire developments are now using centralized underground storage systems that feature a gas main, metered access, and piping sized to serve all applicable residential applications from pool heating to outdoor grills to clothes dryers.



Conclusions

The successful completion of this project will provide a valuable tool in the continued expansion of propane markets. The already apparent benefits of an underground tank system, coupled with a more affordable purchase cost and elimination of corrosion-prevention costs, will encourage increased application of propane across the domestic markets.

The last few years have illustrated to homeowners in the United States the utility of on-site power generation and general independence from the local grid. Because propane can serve this need in addition to other domestic functions such as using propane to heat pools, fire grills, warm hearths, and light the night, the convenience and ease of a composite underground tank will be a natural and immediate choice.

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For More Information:

Propane Education & Research Council
Gregory Kerr
Director of Research & Development
1140 Connecticut Avenue
Suite 1075
Washington, DC 20036
202-452-8975

www.propanecouncil.org
www.usepropane.com

Project Partners:

Battelle Memorial Institute
Rodney L. Osborne
Assoc. Mgr. of Applied Energy Systems
505 King Avenue
Columbus, OH 43201
Phone 614-424-4833
Fax 614-458-4833

Lincoln Composites
Lincoln, NE