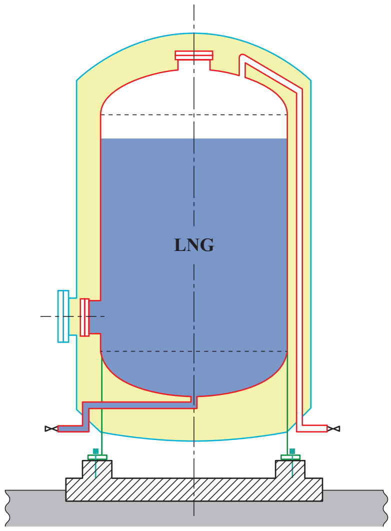
A Perfect Fit: Medium-Sized LNG Storage Tank

Perlite insulated storage tank that fits in small premises

Developed for users of liquefied natural gas (LNG) storage tanks who cannot use standard-size LNG tanks due to location constraints, "perlite insulated storage tanks" accommodate height and space limitations.
IHI Plant Construction Co., Ltd. provides perlite insulated storage tanks tailored to customer needs.

Three LNG storage tanks (600 m^3 each) for Nakahama Plant, Kushiro-gas Co., Ltd.



Perlite insulated storage tank profile

The dawn of medium-sized LNG storage tanks

At the beginning of the 21st century, a fuel shift from liquefied petroleum gas (LPG) to city gas triggered growing demand from local gas companies for small-scale LNG terminals. Under these social conditions, one type of storage tank manufactured by IHI Plant Construction Co., Ltd. (IPC) was added to the list of storage tanks in the "Guidelines for Small Scale LNG Plants" (Japanese guidelines) of the Japan Gas Association as "perlite insulated tank for liquefied hydrocarbon gases," becoming widely recognized in Japan. Taking advantage of this opportunity, IPC storage tanks have made great advancements.

When IPC started developing medium-sized storage tanks for cryogenic gases, including LNG, one of the ways to meet the required 1 000 k*l* capacity was downscaling a large type of storage tank with a capacity of over 10 000 k*l*, that is, the low-pressure storage tank with flat bottom for liquefied hydrocarbon gases (hereinafter, "flat-bottom LHG tank"). However, the system used in the large storage tank was so complicated that it was hard and economically irrational to use the same system for medium-sized storage tanks.

On the other hand, small storage tanks had been actively manufactured since the latter half of the 1980s with the growing demand for liquefied nitrogen for semiconductor cleaning, and the type of tank called the "vacuum insulated tank for liquefied hydrocarbon gases" (hereinafter, the "vacuum insulated tank") was used for these storage tanks. This type of storage tank — kept thermally insulated by evacuation, as the name suggests — had an adiabatic layer filled with an artificial granular foam (perlite powder) serving as heat-insulating material to minimize the volume of boil off gas (BOG), that is, gas produced by the evaporation of LNG caused by natural heat penetration. Basically, these storage tanks were manufactured in following processes: manufacturing and assembly at a factory followed by transportation to and installation at a site. Due to constraints attributable to the scale of the factory and transportation, most of the storage tanks were 100 k*l* or less in capacity. Therefore, requirements for larger capacities were met by installing multiple tanks.

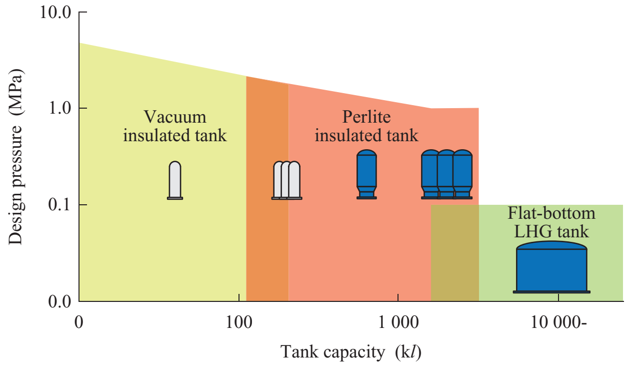
Under these circumstances, IPC adopted a simple design policy and selected a new method of scaling up the vacuum insulated tank for small storage tanks to accommodate medium-sized storage tanks rather than downscaling the flat-bottom LHG tank for large storage tanks. In order to make the new method ready for production, however, we had to clear the manufacturing hurdle of assembling vacuum insulated tanks on site.

A shift in design — from vacuum insulation to perlite insulation

Evacuation of the adiabatic layer is one important process in the assembly of vacuum insulated tanks. However, the evacuation involved several challenges. One of the challenges was that evacuation took around 1 month. Another tougher challenge was that moisture and dust entered the adiabatic layer and hindered the evacuation from being performed. Vacuum could not be achieved until moisture was completely removed, and dust would clog the vacuum pump. For this reason, IPC changed its design, selecting an approach eliminating the need for evacuation and keeping the adiabatic layer's internal pressure at normal pressure. Obviously, by omitting evacuation, the adiabatic performance of the adiabatic layer declined and heat penetration increased, making the increase in BOG from the liquefied gas in the storage tank unavoidable. In storage tanks for factory use, this BOG had to be disposed of. In other words, the omission of evacuation increased waste. On the other hand, for storage tanks in which liquefied gas was vaporized and constantly consumed (e.g., city gas storage tanks), waste could be eliminated by guiding the flow of the BOG into the supply line after vaporization. In other words, these storage tanks did not always require high adiabatic performance.

An adiabatic layer with normal internal pressure posed another challenge — it must be able to follow fluctuations in atmospheric pressure and temperature. Instead of evacuating the adiabatic layer, air in the adiabatic layer was replaced with nitrogen to keep a normal internal pressure. An adiabatic layer that used nitrogen gas to maintain a low internal pressure was also used in flat-bottom LHG tanks for large storage tanks. However, due to its design pressure in the adiabatic layer being nearly equal to atmospheric pressure, flat-bottom LHG tanks needed to be equipped with a breathing tank for the loading and unloading of nitrogen so that the pressure in the tank could fluctuate with atmospheric changes. On the other hand, the perlite insulated tank for liquefied hydrocarbon gases — having a structure that can accommodate a relatively high pressure setting for the adiabatic layer and therefore be less susceptible to atmospheric changes — allowed us to create a system that did not need a breathing tank. By adopting this type of tank, we successfully realized medium-sized storage tanks for cryogenic applications while drastically reducing cost and construction period.

In 1999, as a result of our efforts mentioned above, the "perlite insulated tank for liquefied hydrocarbon gases" (hereinafter, the "perlite insulated tank") was adopted as a type of medium-sized storage tank for LNG for the first time. This breakthrough triggered a fuel shift in local communities in Japan, causing the number of orders to skyrocket. In recent years, due to the dissemination of gas-turbine power generation, the need for fuel LNG storage tanks has been growing. For this reason, the number of delivered IPC perlite insulated tanks is among the highest in the industry.



Scope of application of above-ground LNG storage tanks

Commitment to dissemination to overseas countries

IPC perlite insulated tanks feature perfect-fit shapes and quick turnaround times. We can manufacture the same capacity tank in any shape from "tall and thin" to "short and wide" to the nearest millimeter. Thus, we can customize our products to suit the customers' situation. For example, we can deliver short storage tanks to customers who do not want to ruin the landscape and thin storage tanks to customers needing to install storage tanks in a small amount of space. To date, we have been manufacturing perlite insulated tanks mainly for Japanese customers, and their simple design and construction method have gained us trust and a good reputation, which are intangible, but valuable properties of IPC.

From now on, we will disseminate IPC perlite insulated tanks to overseas countries as well so that their value will be recognized by overseas customers. Taking advantage of the high degree of freedom of design and manufacturing of IPC perlite insulated tanks, we will help customers realize a plan that clears difficult conditions such as limited turnaround and installation on small grounds or even remote islands.

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