Liquefied Natural Gas

Iranian Oil,Gas and Petrochemical

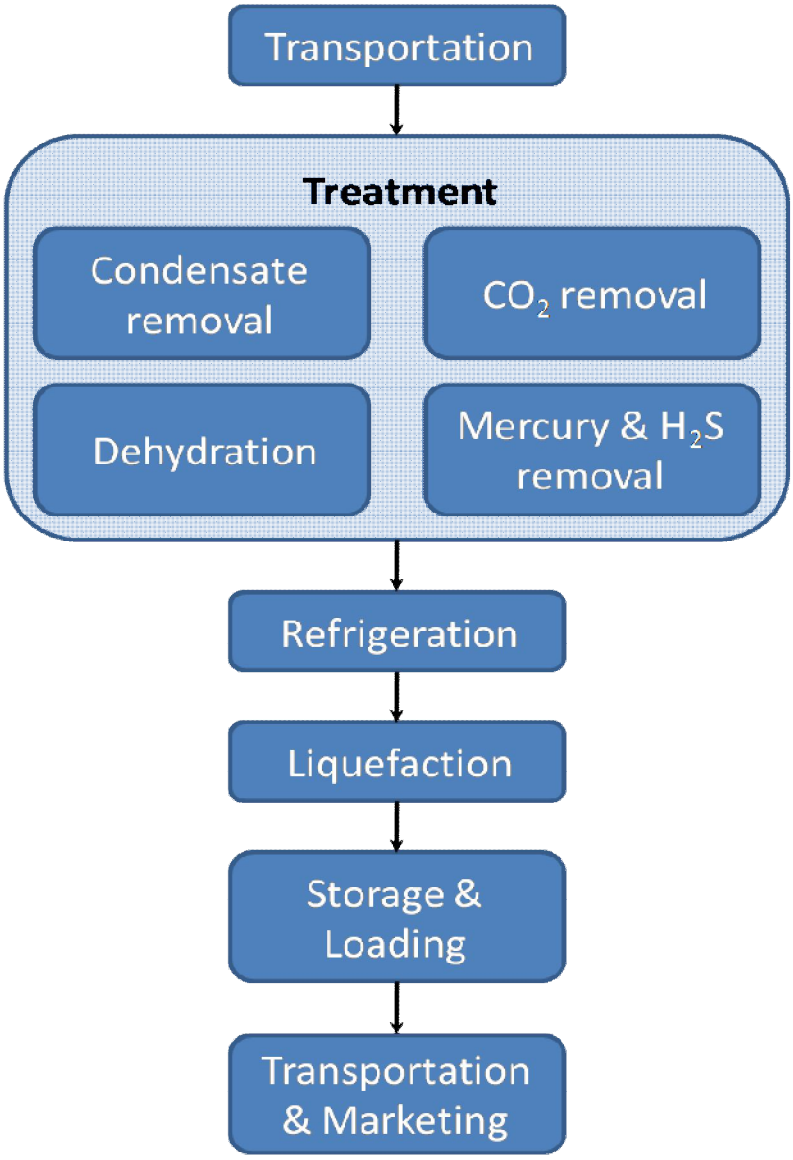
Products Exporters' Union

Article — Research ☑

Liquefied Natural Gas (LNG) is natural gas (predominantly methane, CH_4) that has been converted to liquid form for ease of storage or transport. It takes up about $1/600^{th}$ the volume of natural gas in the gaseous state. It is odorless, colorless, non-toxic and non-corrosive. Hazards include flammability after vaporization into a gaseous state, freezing and asphyxia. The liquefaction process involves removal of certain components such as dust, acid gases, helium, water and heavy hydrocarbons which could cause difficulty downstream.The natural gas is then condensate into liquid at close to atmospheric pressure by cooling it to approximately -162°C(-260°F) maximum transport pressure is set at around 25 kPa (4 psi).

LNG achieves a higher reduction in volume than compressed natural gas (CNG) so that the (base on volumetric analysis) energy density of LNG is 2.4 times greater than that of CNG or 60 percent of that of diesel fuel. This makes LNG cost efficient to transport over long distances where pipelines do not exist. Specially designed cryogenic sea vessels (LNG carriers) or cryogenic road tankers are used for transporting such material.

LNG is principally used for transporting natural gas into the markets,where it is regasified and distributed through natural gas pipeline. It can be used in natural gas vehicles, although it is more common to design vehicles to use compressed natural gas. Its relatively high cost of production and the need to store it in expensive cryogenic tanks have hindered widespread commercial used. Despite these drawbacks, on energy basis LNG production is expected to hit 10% of the global crude production by 2020.



A typical LNG process. The gas is first extracted and transported to a processing plant where it is purified by removing any condensates such as water, oil, mud, as well as other gases such as CO_2 and H_2S. An LNG process train will also typically be designed to remove trace amounts of mercury from the gas stream to prevent mercury amalgamation with aluminium in the cryogenic heat exchangers. The gas is then cooled down in stages until it is liquefied. LNG is finally stored in storage tanks and can be loaded and shipped.

The (volume-based) energy density of LNG is approximately 2.4 times greater than that of CNG which makes it economical to transport natural gas by ship in the form of LNG. The energy density of LNG is comparable to propane and ethanol but is only 60 percent that of diesel and 70 percent that of gasoline.

Production

The natural gas fed into the LNG plant will be treated to remove water, hydrogen sulfide, carbon dioxide and other components (e.g.,benzene) that will freeze in low temperatures needed for storages. LNG typically contains more than 90 percent methane. It also contains small amounts of ethane, propane, butane, some heavier alkanes and nitrogen. The purification process can be designed to give almost 100 percent methane. One of the risks of LNG is a rapid phase transition explosion (RPT) which occurs when cold LNG comes into contact with water.

LNG storage tank

A liquefied natural gas storage tank or LNG storage tank is a specialized type of storage tank used for the storage of Liquefied Natural Gas. LNG storage tanks can be used in ground, above ground or in LNG carriers. The common specification of LNG Storage tanks is its ability to store LNG at the very low temperature of -162°C (-260°F). LNG storage tanks have double containers, where the inner contains LNG and the outer container is equipped with insulation materials. The most common tank type is the full containment tank. Tanks vary greatly in size, depending on their usage. In LNG storage tanks if LNG vapours could not released, the pressure and temperature within the tank would have continued to rise. LNG is a cryogen, and will keep its liquid state at very low temperatures. The temperature within the tank will remain constant if the pressure is kept constant by allowing the boiling off gas to escape from the tank. This is known as auto-refrigeration.

The advantages of LNG

- It makes it possible to use natural gas in areas where natural gas is not available via the national delivery network or municipal distribution system.
- It is a more economical source of energy when compared with black products (fuel oil and diesel) and LPG.
- It is suitable for consuming purposes such as process, steam recovery, heating and cooking in sectors like tourism, steel, paper and ceramic.
- Because of its high energy content, the total amount its needed energy is reduced.
- It expands 600 times to reach its gaseous state (1 unit of LNG = 600 units of natural gas).
- A large amount of natural gas can be stored and transported with low pressure.
- It can be used in all burning devices by processing minor changes.
- Since it is a clean fuel, it contributes to improved product quality and reduces maintenance costs.

Environmental concerns

Natural gas can be considered as the most environmentally friendly fossil fuel, because it has the lowest CO_2 emissions per unit of energy and because it is suitable for using in high efficiency combined with cycle power stations. For an equivalent amount of heat, burning natural gas produces about 30 per cent less carbon dioxide than burning petroleum and about 45 per cent less than burning coal. Based on a per kilometer transporting basis, emissions from LNG are lower than piped natural gas, which is a particular issue in Europe, where significant amounts of gas are piped several thousand kilometers from Russia. However, emissions from natural gas transported as LNG are higher comparing

natural gas produced locally to the point of combustion as emissions associated with transportation are lower for the latter.

Safety and accidents

Natural gas is a fuel and a combustible substance. To ensure safe and reliable operations,particular measures are taken in the design, construction and operation of LNG facilities.

In its liquid state, LNG is not explosive and can not burn. For LNG to burn, it must first vaporize, then mix with air in a proper proportions (the flammable range is 5 percent to 15 percent), and then be ignited. In the case of a leak LNG vaporizes rapidly, turning into a gas (methane plus trace gases), and mixing with air. If this mixture is within the flammable range, there is the risk of ignition which would create fire and thermal radiation hazards. Gas venting from vehicles powered by LNG may create a flammability hazard if parked indoors for longer than a week. Additionally, due to its low temperature, refueling a LNG-powered vehicle requires training to avoid the risk of frostbite. LNG tankers have sailed over 100 million miles without a shipboard death or even a major accident.