MODULE 2

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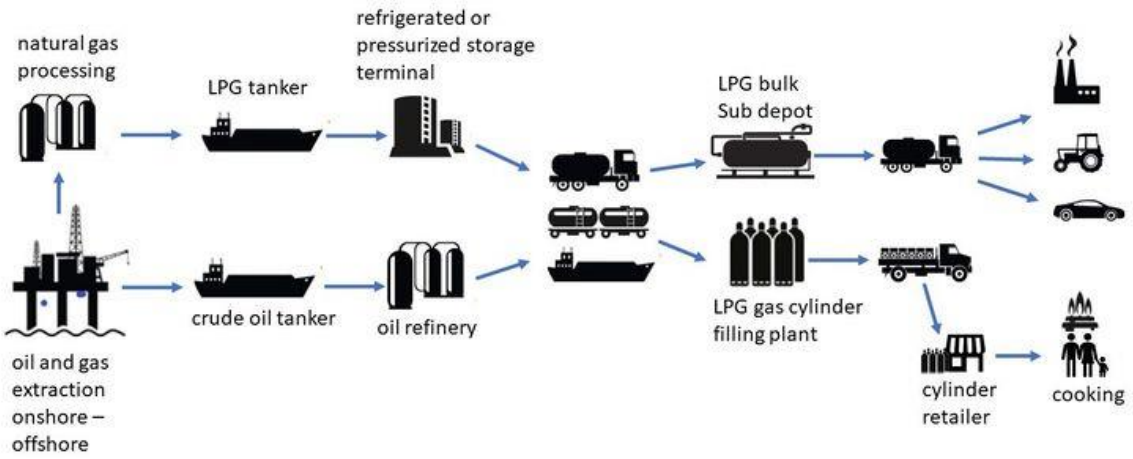
- The various methods of LP transportation and how LP gas is produced.
- The various modes of LPG transportation and storage.

LPG Transportation



petroleum gases (LPG) (propane and butane) are carried in batches as purity goods in pipelines that transport other petroleum products or in dedicated high vapour pressure (HVP) pipes. LPG that is extracted from natural gas or generated at petroleum refineries can be delivered via pipelines, rail cars, trucks, ships, and barges as liquids in mixes of HGLs or as distinct HGL quality goods. When LPG is stored at a moderate level of pressure in gas bottles, cylinders, tanks, and larger LPG storage containers, it exists as either a gas (vapour) or a liquid. Because gaseous LPG has a volume 270 times that of liquid LPG, it is virtually generally delivered in its liquid form. Ships, rail, tanker trucks, intermodal tanks, cylinder trucks, pipelines, and local gas reticulation systems are all options for transporting LPG (propane).

Mode of Transportation

Shipment of Bulk Materials

Very Large Gas Carriers (VLGC) LPG is transported across whole seas in enormous tankers, which are commonly referred to as gas carriers. They are the most prevalent for transoceanic excursions. The class ships can transport up to 43,000 tonnes of LPG (84,000m3) and are typically around 230 metres long. The Very Large Gas Carriers are completely chilled.

The LPG is stored at a temperature of -48°C, which is below the -42°C boiling point of LPG (propane). This indicates that there is no build-up of vapour pressure, with the pressure maintaining about 1 atmosphere. The ship's structure simply has to deal with the weight of the LPG, not any additional pressure. Across 200 VLGCs are now in use around the world.

LPG rail car tanker is transported by rail in bulk and ISO tanks. Large amounts of LPG are transported in bulk using tanker rail carriages. Tankers with a capacity of 65,000 to 127,000 litres, or around 65 tonnes of LPG, may be found. They're around 19 metres long and 5 metres tall. Bulk rail transportation is limited by the necessity for a loading/unloading station at each end. As a result, bulk rail is usually reserved for certain operations, such as delivering LPG from well sites to terminals. Rail, on the other hand, can haul ISO tank containers. When the distances are great enough to justify the economics, rail would be employed instead of trucking.

Intermodal ISO Tank Containers

LPG Container for ISO tanks LPG storage vessels installed inside a specified framework is known as ISO tank containers. The standardised framework, like a standard (closed steel box) shipping container, is designed to ISO (International Organisation for Standardisation) requirements. LPG ISO tanks are typically 6.05m (20ft) long, 2.4m wide, and 2.55m high, while various sizes, such as 12.2m (40ft), are available. The 6m ISO LPG tank has a capacity of 24,000-25,000 litres or around

12 tonnes of LPG. A tank container is designed to ISO specifications to be "intermodal," which means it may be used for several modes of transportation and can be stacked. These containers may be transported by ship, train, or truck, with the LPG cargo without having to be unloaded or reloaded in between.

Reticulated Gas Systems

They are a type of reticulated gas system. There are LPG reticulation systems in various towns or construction complexes. A central storage tank or tank supplies the pipes to the residences. A metre, similar to natural gas metres, is installed in each residence.

By Pipeline

Between gas fields and storage terminals, LPG pipes are often used. Pipelines are uncommon due to the exorbitant cost of construction.

Local Bobtail Tankers Transport

Bobtail tankers are used for local bulk delivery to end consumers. Because bobtail tankers are not articulated like road tankers, they do not require a trailer. The LPG vessel, also known as a rigid tanker, is linked to the same frame as the main mover. Tanker sizes range from small 4-tonne tankers to huge 12-tonne tankers. A pump and hose reel system is used to distribute the gas. Instead of waiting for the client to empty a cylinder as is the case with an exchange, local tankers allow for automatically scheduled deliveries. It is no longer necessary to inspect cylinders or make delivery calls.

Cylinder Truck

Truck with LPG cylinders. Gas bottles are provided on an exchange basis to lower volume consumers. The driver delivers full cylinders and takes empty ones so that they may be refilled.

For families and companies, this comprises small BBQ gas bottles, forklift gas bottles, and 45kg gas bottles. LPG can be delivered to almost any place with the help of a truck.

Beasts of Burden Deliver LPG

LPG is delivered by mule train. However, certain spots are inaccessible even a vehicle. They return to time-honoured techniques in several regions of the world. They use pack animals to deliver LPG. Mules can carry up to 100kg, thus 2 or 3 small LPG bottles are quite okay.

People Powered LPG Transport

Pedal cart with LPG. Some countries do not even rely on animals for assistance. When distributing LPG over short distances, push carts and bicycle carts are ideal. What better method to distribute in crowded inner cities with regular traffic congestion than by pedal power? Then there's the most simple solution: carrying them one at a time by hand. However, some people appear to be concerned about safety procedures.

STORAGE OF LPG

LPG-Propane gas is nearly always kept in liquid form and is stored in pressure containers. Small camping canisters, BBQ gas bottles, bigger gas cylinders, and even larger LPG gas storage in Propane tanks - bullets are all examples of propane storage containers (LPG cylinder storage). Massive LPG-propane gas storage spheres or large subterranean tanks can be used as gas storage depots. Underground storage of liquid LPG-propane gas can be done in custom-built or prepared storage caverns.

Propane Tank Safety Regulations

The storage of propane gas cylinders (LPG cylinders) should be done outside in a well-ventilated environment. When not in use, LPG-Propane gas cylinders must be stored upright with valves closed. Falling propane gas bottles must be avoided, and they must be protected from collision and damage. Propane tank safety laws may impose limitations on the amount of LPG-propane gas that may be stored, and placarding may be necessary.

To avoid any inadvertent collisions, propane gas cylinder storage (LPG cylinder storage) should always be maintained away from heavy traffic areas. Indoor LPG-propane gas storage should be avoided at all costs. Because propane gas cylinders should not be permitted to sit in standing water, the storage space for LPG-propane cylinders should be level and sturdy, such as a concrete slab, and at a position with good drainage. Any ignition sources, including electrical componentry, should be avoided in the area surrounding the LPG-propane gas cylinder storage area, as well as any flammable items. Propane cylinders should never be put near a heat source that is not natural. Even though the cylinder seems to be empty, the valve should always be maintained closed.

Propane Gas Storage as a Liquid (LPG)

LPG is available in two forms: liquid and gas (vapour). LPG-Propane is usually stored as a liquid and is also known as natural gas liquids (NGL). It becomes a liquid when the pressure on it is increased, whether or not the temperature is reduced. Compressing it into a liquid is a far better and more effective way to store it. It has 270 times the volume of liquid Propane as a gas. As a result, liquefying it is similar to transforming a beach ball into a table tennis ball.

What is the pressure at which propane is stored?

The term "pressure" refers to the average force per unit of area exerted by the gas on the containment vessel's interior walls. The temperature of a Propane cylinder or bigger vessel affects the pressure within. The pressure of Propane within the cylinder increases as the temperature rises. The pressure is unaffected by the fill level until you run out. At 0 degrees Celsius, the pressure of LPG (propane) ranges from 152 kPa (24 PSIG or 1.5 bar) to 2482 kPa (360 PSIG or 24.8 bar) at 70 degrees Celsius. Please consult the pressure chart below for further information.

LPG (Propane) Cylinder Storage Pressure Chart

Temp ºC	Temp ºF	Pressure kPa	Pressure PSIG	Pressure Bar
70	158	2482	360	24.8
60	140	2013	292	20.1

54	130	1794	257	17.9
43	110	1358	197	13.6
38	100	1186	172	11.9
32	90	1027	149	10.3
27	80	883	128	8.8
16	60	637	92	6.4
-1	30	356	51	3.6
-18	0	152	24	1.5
-29	-20	74	11	0.7
-43	-45	0	0	0

Note: Some numbers have been rounded.

Propane Gas Storage (LPG) Available in a Variety of Sizes

Butane Lighters, Disposable Butane Cartridges, Small BBQ Bottles, Forklift Gas Bottles, Cylinder - Large Propane Bottles, Cylinders Large Propane Tanks, Propane Bullets, Storage in Intermodal ISO Tank Containers, Mounded Tanks, Underground Propane Storage Caverns

Lighters that use butane

The smallest LPG storage vessel is probably a butane lighter. The fuel in a standard disposable butane lighter is only approximately 4 grammes. The manufacturer and model of the lighter will determine this. Butane, isobutane, or a combination of the two can be used as fuel.

Butane Cartridges

Disposable butane cartridges weighing 220g (8oz.) are used in tiny camping stoves and other gadgets. A Countersink Release Vent is now standard on many of these cartridges (CRV). The CRV is a built-in safety feature for the cartridge. It enables the escape of some gas in the event of an overpressure scenario, such as when subjected to excessive heat. This reduces the possibility of an explosion. Butane cartridges that have been used should be properly disposed of. Empty containers should be sent to community recycling centres.

Forklift Propane Gas Bottles – Cylinders

Forklift gas is kept in two distinct sizes of cylinders. They're constructed of steel and aluminium, as well. Forklift gas cylinders are available in 15kg aluminium and 18kg steel.

Bottles for the Barbecue

There are two major sizes of propane gas bottles for BBQ and camping: 9kg and 4kg. There are also smaller sizes available. Two types of valves are commonly used: A Camper valve is also installed on 4kg camper cylinders. Camper valves are for appliances that are meant to be used with a Camper valve.

Large Propane Bottles- Cylinders

Propane 45kg gas bottles, often known as 45kg gas cylinders, are the most commonly used size for households and small enterprises. Propane tanker trucks can interchange or replenish 45kg gas bottles on-site. Two 45kg gas bottles make up a typical installation. This allows you to transfer bottles while you wait for the empty bottle to be exchanged or refilled. For heavy use, cylinders in the 90kg, 190kg, and 210kg sizes are available. Because these bigger cylinders are too huge to be switched practically, they are always filled by Propane tanker trucks. Other countries employ a variety of sizes that are comparable to ours.

Intermodal ISO Tank Containers for Propane Gas Storage

Propane gas storage vessels installed inside a specified framework are known as ISO tank containers. The standardised framework, like a standard (closed steel box) shipping container, is designed to ISO (International Organisation for Standardisation) requirements. LPG ISO tanks are typically 6.05m (20ft) long, 2.4m wide, and 2.55m high, while various sizes, such as 12.2m (40ft), are available. The 6m ISO LPG tank has a capacity of 24,000-25,000 litres or around 12 tonnes of Propane. A tank container is designed to ISO specifications to be "intermodal," which means it may be used for several modes of transportation and can be stacked.

Propane Bullets – Large Propane Gas Storage Tanks

Sizes of propane gas bulk storage tanks for a variety of applications. These are also known as "LPG Bullets," "Propane Bullets," or simply "Bullets." These propane tanks are suitable for commercial, industrial, and agricultural use. While vertical implantation is an option, the vast majority of bullets are installed horizontally. They come in sizes ranging from 12 tonnes to 40 tonnes and beyond.

Caverns for Propane Gas Storage Underground

Why would we want to store propane gas underground? Underground storage is a cost-effective method of storing huge amounts of propane. Unlike above-ground tanks, there is no requirement for cooling, and the project has an unlimited lifespan. The above-ground plant and equipment are straightforward and need little upkeep. Hydrostatic water pressure in the surrounding stone usually keeps the gas contained within the cavern. A specific docking system for loading and unloading Propane ocean tankers may be incorporated into these facilities. These can be as big as VLGC class ships with a tonnage of up to 45,000 tonnes. Smaller tankers are also loaded into the docking system for re-distribution to other sites.

Bullets – Mounded Tanks

Large Propane gas storage tanks or bullets should be placed beneath the mounded ground for added fire protection. The mounding serves as a barrier against adjacent fires, vandalism, and sabotage. The bullets are horizontally buried. Some of the biggest have a diameter of up to 7 metres and a length of up to 70 metres. Mounded bullets allow massive amounts of Propane to be stored in a single area.

Horton Spheres - Propane Gas Storage Spheres

Propane may be stored in a storage sphere in a very efficient and cost-effective manner. To store the same amount of Propane, spheres require less steel than cylinders. For pressure containers, spheres are also a useful form since they equally distribute the tension. In comparison to bullets, Horton spheres use less area to store the same amount of Propane. Furthermore, because they contain more in a single pressure vessel, they assist to reduce the cost of pipes and foundations. The Hortonsphere® is named after Horace Ebenezer Horton, who in 1923 built the first spherical pressure vessel.