

Liquefied Gases

December 2017



In July 1948 a tank car filled with dimethyl ether (DME) arrived at a factory in Ludwigshafen, Germany. It stood in sunlight for about 10 hours when it is believed that a weld seam failed. About 200 people were killed, nearly all by the explosion of the flammable DME vapor cloud created by the leak. Nearly 4000 people were injured, the majority by exposure to toxic substances escaping from installations damaged by the blast (Picture 1).



In July 1978, a tank truck carrying propylene ruptured, and the released gas ignited. This occurred in a vacation area near Tarragona, Spain. The explosion killed 217 people, including the driver. 200 other people were severely burned (Picture 2).

A common cause of these accidents was a tank overfilled with liquefied gas. In the first incident, the tank identification plate incorrectly showed a higher capacity than the tank car could actually hold. In the second incident the cause may have been human error when filling the tank.

Did you know?

- Gases such as nitrogen, oxygen, and argon are shipped or stored as liquids at extremely low temperature, or as compressed gas at ambient temperature and thousands of psig (hundreds of bars) pressure.
- Other gases such as ammonia, chlorine, sulfur dioxide, vinyl chloride, propane, LPG, and dimethyl ether (DME) condense to a liquid at room temperature under moderate pressure, and are usually shipped or stored as liquefied gas.
- A vessel filled with condensed liquid contains more material than the same size vessel filled with compressed gas – liquid has a higher density. For example, a cylinder of argon gas at 2900 psig (200 bar) holds about the same amount of material as a cylinder of the same size containing liquefied propane at only 116 psig (8 bar).
- Liquefied gases, like most other liquids, expand when heated. As the liquid expands, the vapor space in a closed container shrinks. If the container becomes completely liquid filled and continues to be heated, it can rupture from the pressure of liquid expansion. Thermal expansion of a liquid can generate very large pressures with a relatively small temperature increase. The result of the container rupture is a boiling liquid expanding vapor explosion – BLEVE (November 2009 and August 2013 *Beacons*).

What can you do?

- Energy in a pressurized container depends on its size, temperature, pressure, and the state of the contents – condensed liquid or compressed gas. Avoid adding to this energy by exposing containers to heat from their surroundings.
- Read the safety information about gas containers you handle, and follow recommended procedures.
- If you fill containers with a liquefied gas, ensure that you do not overfill them.
- Read the October and December 2006 *Beacons* which discuss gas cylinder safety.
- You may have liquefied gases at home – for example, as fuel for a grill, a home heater, or a stove. Liquefied flammable gas may also be present in lighters or aerosol cans. Handle these with the same care as you would at work, and make sure that your family understands the hazards.

Do not underestimate the hazards of liquefied gases!

Questions:

1. **(10 min)** Considering that tanker trucks often must be driven and parked in the sun, discuss in 3-4 sentences the errors which seemed the most avoidable.
2. **(5 min)** List two hazards of working with DME.
3. **(5 min)** *What did you learn?*
What kinds of serious consequences are likely to occur when a tanker truck vessel explodes and what kinds of federal or state regulation could have prevented this from occurring?