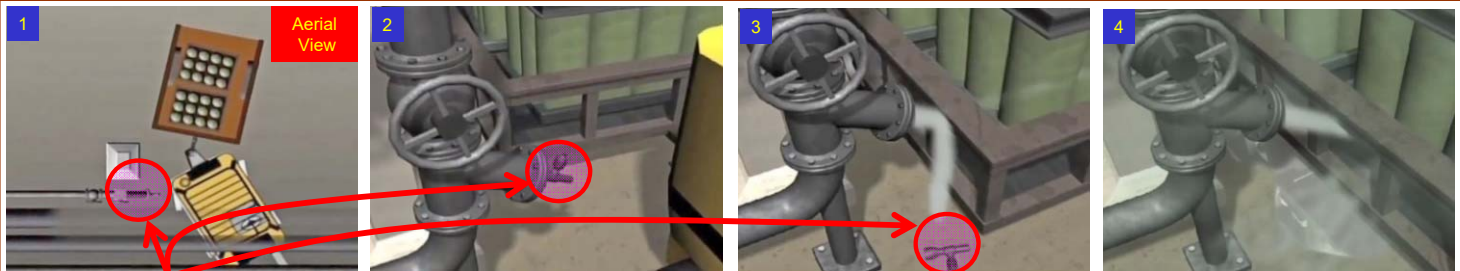


Vulnerable Piping

August 2017



In October 2005 there was an explosion and fire in an olefins plant in Texas. A fork truck was towing a trailer of compressed air cylinders through a process unit (1). The trailer struck a protruding drain valve on a strainer in a liquid propylene pipe (2). The drain line, operating at 216 psig (15 bar-g), was severed (3) causing a 1.9 inch (4.8 cm) opening. Propylene, which boils at -54°F (-48°C), was released (4) and rapidly created a flammable vapor cloud (5). The fork truck driver and other workers in the area saw the release and immediately fled. The control room was informed and operators immediately began to shut down the unit and activate emergency response procedures. However they were not able to isolate the leaking pipe and stop the release. The vapor cloud ignited about 2 minutes after the release started (6). Several workers were knocked down by the explosion, and two were burned, one seriously. 14 other workers received minor injuries.



The explosion ignited a pool fire which exposed structural supports for piping, vessels, heat exchangers, and other process equipment to flames. About 30 minutes after the fire began, support columns, which had not been fireproofed, failed. Their collapse resulted in additional damage and loss of containment of flammable materials. The plant was evacuated, neighbors were told to shelter in place, and a school was evacuated. The fire burned for 5 days. The manufacturing unit was shut down for 5 months.

Reference: US Chemical Safety Board (CSB) Case History, <http://www.csb.gov/formosa-plastics-propylene-explosion/>, July 2006. Pictures are taken from the CSB video describing the incident.

What can you do?

- Seek out piping, valves, and other equipment which might be vulnerable to damage – for example, by accidental collision or by somebody standing on the equipment. Report potential problems to management for action – such as piping modifications or providing protective barriers. Follow your plant's management of change (MOC) procedure when making changes.
- A quarter turn valve does not have to be broken off to leak. It can be opened accidentally by a person or a vehicle. Consider plugging or capping open ended vents, drains, sample lines, or other pipes to prevent leaks.
- If your job requires driving fork trucks, cars, trucks, golf carts, or any other type of vehicle, stay on approved routes when traveling through the plant. Always drive carefully and follow your plant driving rules!
- If you are involved in maintenance, construction, or another special activity which requires vehicles to travel in areas of the plant where they are not normally present, make sure that the job safety analysis considers vehicle hazards such as collision, damage to piping, equipment, and structures, and the vehicle as a potential ignition source.
- Watch the US Chemical Safety Board video (see reference above) to learn more about the incident.
- Read other *Beacons* related to this incident – May 2010 (fireproofing of structural steel) and January 2003 (inadequate clearance for high equipment).

Protect your plant from collision!

Questions:

1. **(10 min)** Describe at least three ways in which the facility might have been designed or equipped differently to prevent or mitigate the incident. You may find helpful the full CSB [case study](#).

2. **(10 min)** *What did you learn?*

Most engineers do not consider that something as innocuous as a forklift can initiate a raging five-day, five-story tall chemical plant fire with over a dozen people burned or injured. This disaster also resulted in the burning of seriously high quantities and concentrations of chemical gas, the release of these gases to the atmosphere, and a five-month plant shutdown. What lessons have you learned from this incident about safety hazard analysis and plant design which you will apply to your work as a chemical engineer?