

A large, cylindrical industrial tank under construction. The tank's surface is covered in a complex network of pipes, ladders, and scaffolding. A worker wearing a yellow hard hat and an orange safety vest stands in the lower-left foreground, looking up at the tank. The background is a plain, light-colored wall.

Boiling Liquid Expanding Vapor Explosion (BLEVE)

Garth Reed
Waste Treatment Plant Project



Waste Treatment Plant Project





History

- First coined by Factory Mutual (FM) researchers on April 24th, 1957
- Container failure occurred as a result of overheating a mixture of formalin and phenol
- Physical model of the tank failure:
 - Applicable to any vessel containing a liquid that was at a temperature well above its boiling point at the moment of vessel failure.



History

- 1978 NFPA Fire Journal article, “Just what is a BLEVE”
 - A major container failure, into two or more pieces, at a moment in time when the contained liquid is at a temperature well above its boiling point at normal atmospheric pressure.





What Is It?

- True definition from 1978 is broad, but exact
- There has been some confusion over the years on the term BLEVE
- Physical reaction in which the material rapidly converts from a liquid to a gas.
- Merely a change in state in contrast to a chemical reaction (explosives)
- BLEVEs can occur with many types of liquid gases, both flammable and non-flammable



Top Historical Causes

From 1926 to 1986 top 3 causes of BLEVEs

- Fire or flame impingement
- Physical damage (from collisions or impact)
- Overfilling (most from before the advent of PRVs)





Conditions Necessary

- A true BLEVE is independent of the cause of the container failure
- Conditions for occurrence:
 - Container is under pressure
 - Container has to be weakened in some way (impact, corrosion, fire)
 - The pressure exceeds the strength of the container





[Video](#)





Type of Storage Vessels at WTP

LP Gas (Construction Use)

- One 18,000 gallon tank

Anhydrous Ammonia (Permanent Plant)

- Two 6000 gallon vessels

Liquid Carbon Dioxide (Permanent Plant)

- One vessel, ~ 275,000 pounds liquid CO₂



Facility Layout





Liquid CO₂ Vessel





Methods to Reduce BLEVE Risk

- Vehicle impact barriers
- Prevention of flammable liquids from pooling under vessels
- Minimize combustibles (including vegetation) near vessels
- Surveillance requirements for relief valves
- Design and maintain storage tanks per applicable ASME and NFPA standards
 - NFPA 58, Liquefied Petroleum Gas Code, ASME Boiler and Pressure Vessel Code, etc.
- Appropriate emergency shutoff valves.
- Emergency planning
 - Example - Adequate and unobstructed water supply for manual cooling of tank exterior in the event of fire exposure.



Questions?





Sources

BLEVE: Facts, Risk Factors, and Fallacies,
David F. Peterson, April 1, 2002,
www.fireengineering.com

*Boiling Liquid Expanding Vapor Explosions
(BLEVE) – An Overview*, by V. K. Singh
and A. D. Kharait, Chemical Business,
October 1995