Boiling Liquid Expanding Vapor Explosion (BLEVE)

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History

• First coined by Factory Mutual (FM) researchers on April 24\textsuperscript{th}, 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
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
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
