The Anatomy of Liquid Nitrogen (LN_2) Cryo Dewar Tank Failures

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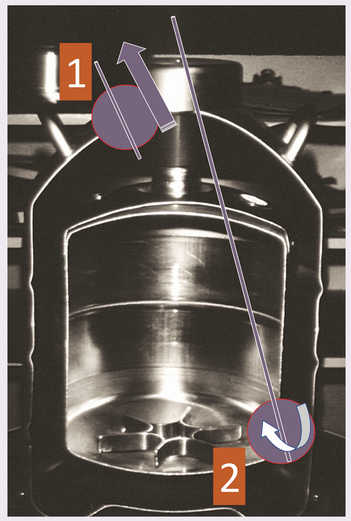
Objective: The goal of our investigation was to simultaneously evaluate, interrupt and understand weight and temperature changes of induced dewar tank failures under continuous video surveillance over a 24 h interval.

Design:

We prospectively correlated 'failure' characteristics of several aged (>18 years old; n=6) 35-36L Taylor-Wharton dewar LN_2 storage tanks and one 'recalled' new Biocane 73L ThermoSci /Chart dewar tank.



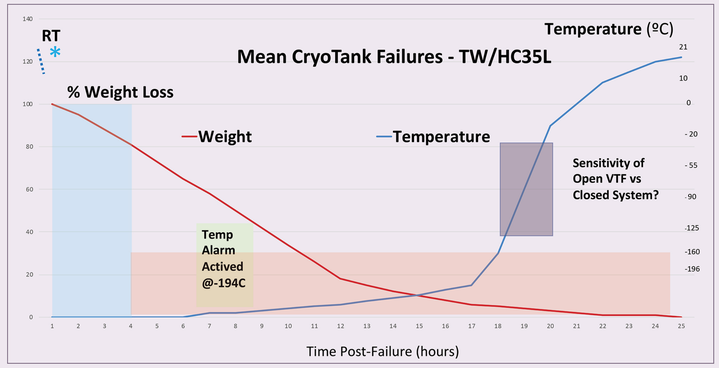
1) We initially drilled (1/16") the vacuum port of the 73L dewar and two smaller tanks (35HC, 36VHC). We increased the external drill opening to 1/8" and 3/16" on two more tanks;
2) Two additional 35HC tanks where drilled (1/4") through their inner base seam into the vacuum space.

You Tube video: https://youtube/QlvyiNbNVqA

RESULTS

Initial Signs of Failure:
External Leak: Overt sound of of de-pressurization
Internal Breach: Abrupt bubbling of LN_2 up into the neck
Both Type: Frosting of Cap and streaming of LN vapors out of the top notable by 3 min.

- External temperature at base of neck changed from RT to 10◦C within 8-10 min.



- Within 4 hours a 20% weight loss was detectable, whereas an ultra-sensitive Temp. alarm (set at -194C) took 6.5 to 8 hours to alert our network.
- In all cases, a 12-16 hour tolerence interval occurred to potentially detect visual ques of pending failure and safely remove specimens before potentially harmful glass transition temp's were reached.
- Temperature begins elevating rapidly as <5% tank weights occurred, with no significant differences seen based on drill size or tank volume (73L vs 35L).
- Internally ruptured tanks experienced similar evaporation curves, but on the more rapid range.

Summary

- Tank quality and type of vacuum breach can influence the rate of failure. In all cases overt physical signs of pending failure were continuously visible for +14hr before critical temperatures were reached.
- Overall, external quality measurements and device systems represent a promising future offering greater precision, labor efficiency, and improved specimen security/safety.