NASA TECH BRIEF

Fluid Behavioral Patterns Found in Subscale Geysering Study

A subscale experimental study was initiated to provide a fundamental understanding of geysering mechanisms necessary for the formulation of theoretical analyses. Geysering can be described as the sudden expulsion of fluid from a heated line. It can be produced or initiated in cryogen filled lines by heat transfer from a relatively warm wall or from the external environment. Detrimental effects of geysering include cooling and condensing the cryogen tank ullage gas resulting in tank implosion, and severe impact loads resulting from the rapid line refilling.

An increased understanding of the fundamental aspects of the geysering mechanism should be readily adopted industrially to large storage tank construction, tank farms where volume fluid handling is involved, fuel and supply tanks on trains and ships, oil and liquids long-line transmission, bulk handling facilities on barges, and fluid handling and treating such as in the brewing and chemical industries.

Better analytical techniques are needed to predict geysering for any line size and configuration and to design more efficient and reliable devices to control the significant variables that cause geysering.

Tests were conducted with transparent Corning 9430 tubes heated with electrically conductive coating to allow close visual observation of some of the geysering mechanisms throughout the test series. Water was used as the test fluid. Tests were run with two tube diameters and three L/D ratios (Length of heated tube/Diameter of heated tube). Heating rates were varied for each L/D ratio.

In addition to the controlling parameters identified by previous investigators (heating rate and L/D ratio), the reservoir temperature was found to significantly influence geysering. An algebraic relationship between average heating rate, reservoir temperature, and geysering period was established. The geysering period is inversely proportional to heating rate per pound of fluid in the tube and decreases linearly with increasing reservoir temperature. The geysering period was qualitatively observed to vary directly with geysering severity. Also, the L/D ratio was found to qualitatively affect geysering, probably due to viscous effects and the existence of a critical length of instability. Areas for future studies were identified.

Notes:

1. Complete details of this study are contained in: *Subscale Geysering Research*, by J. E. Burkhalter and V. L. Glasgow, The Boeing Company, February 1967.
2. Copies of this report are available from:
   Technology Utilization Officer
   Marshall Space Flight Center
   Huntsville, Alabama 35812
   Reference: B67-10462

Patent status:

No patent action is contemplated by NASA.

Source: J. E. Burkhalter and V. L. Glasgow
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