Experimental and analytical studies on a foam insulated rigid type transfer line for use with liquid nitrogen

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**ABSTRACT**

- Designed & developed long rigid-type transfer line for LN2 to transfer from a 5000 litre storage tank to Helium liquefier Model1610 at ~ 50 m by integrating several units of ~ 6.5 m length each.
- Each unit was fabricated with ½” dia copper inner tube with 2” dia PVC outer tube & rigid foam insulated and instrumented with temperature sensors.
- We present the analytical and experimental studies of the cool down and mass flow characteristics of the single foam insulated unit.

**DESIGN OF TRANSFER LINE**

- **Cool Down Studies**
  - Cool Down Studies of the single foam insulated unit.

**Analytical Model Equations**

- Steady heat flow
  - Mass Flow Rates
    - Convection equation for LN2 flow in copper pipe.
    - Radiation heat loss from copper pipe to LN2.
    - Insulation properties of foam and air.
- Experimental Studies
  - Mass Flow Rates
    - Experimental Flow rates for LN2.
- Conclusion
  - Rigid type foam insulated LN2 transfer line has been developed for ~ 50 m length. Single segment of ~ 6.5 m is instrumented and experimentally studied.
  - The steady state heat load is theoretically estimated. The cool down of the transfer line is analytically modeled.
  - Experimental studies show that the cool down behaviour compares well with analytical model and mass flow rates are found to increase with increasing supply pressure.
  - Now multiple units of this transfer line are now integrated to build the complete transfer line for the end application.

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