

Derivation of Three-Dimensional Heat Transfer Mathematical Equations to Predict Conductivity of Insulation Systems for Liquid Nitrogen Pipe Flow

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ABSTRACT

Cryogenics is dealing with very low temperatures of less than 120 K. Thermal insulation is a key to minimize heat leak in cryogenics during transportation in transfer line. The present study is conducted to derive three-dimensional heat transfer mathematical equations to predict conductivity of insulation systems for liquid nitrogen pipe flow. Elliptic differential equations on special domains were derived based on Fourier method for three-dimensional heat equations. As a result from the study, three-dimensional heat conduction equation for a cylindrical problem was successfully derived. The derived equation provides a mathematical solution to determine the heat transfer rate for a system of cryogenic pipe insulated with multiple layers.

Keywords: *Cryogenic, Thermal Insulation System, Liquid Nitrogen, Pipe Flow, Three-Dimensional Heat Conductivity*