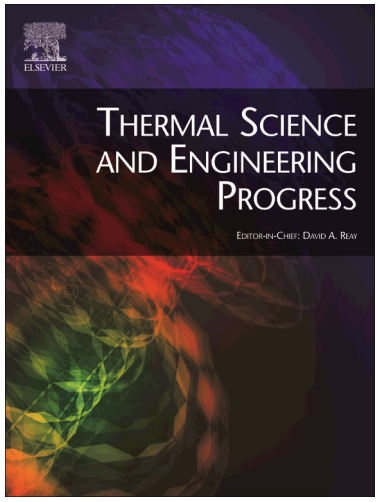

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Cryogenic pipe flow simulation for liquid nitrogen with vacuum insulated pipe (VIP) and Polyurethane (PU) foam insulation under steady-state conditions

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ABSTRACT

Cryogenics is concerned with working with fluids at very low temperatures; less than 120 K. Cryogenic pipe flow is very different compared to normal fluid pipe flow in terms of evaluation and analysis due to the fluid state change that is caused by a heat leak in cryogenics during transportation through the transfer line. As the cryogenic system is necessarily immersed in insulation, it becomes more difficult to access. Numerical solutions and computational fluid dynamics (CFD) simulations that are non-disruptive and relatively low in cost are an advanced alternative for studying cryogenic systems. The present study reports the liquid nitrogen pipe flow simulation for process pipe with vacuum insulated pipe (VIP) and with Polyurethane (PU) foam insulation to understand the temperature distribution in the pipe flow under steady-state conditions. The 3-dimensional liquid nitrogen pipe flow simulation has been conducted using ANSYS FLUENT software. The temperature distributions resulting from the liquid nitrogen pipe flow simulation with VIP are within the range of 77.0 K to 82.1 K for inlet volume flow rates from 250 LPH to 2000 LPH. The optimum result in terms of the temperature distributions was produced from the liquid nitrogen pipe flow simulation with VIP.