ANSYS-Fluent CFD model of a Liquid Nitrogen evaporation rate

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ABSTRACT

The Liquefied Natural Gas (LNG) is a clean source of energy; when burnt it has low associated NOx and SOx emissions. It is convenient for heating and power generation and is also a valuable chemical feedstock. LNG has a very good safety record and not many major accidents associated when compared to other fossil fuels. However it is a flammable gas and thus the appropriate risk assessments (and thus prediction/modeling) have to be considered.

The prediction of the potential hazards associated to accidental liquefied natural gas (LNG) spills has motivated a number of different studies including experimental and numerical approaches. Most of these studies focus on dispersion predictions, however there is limited information regarding vaporization. It led the necessity of further improvements on the understanding of this phenomena and the quantification of the most important parameters that can affect evaporation behaviour. Evaporation of cryogenic liquids like LNG is governed by the heat transfer phenomena including conduction, convection and thermal radiation mechanisms. Considering this, the present work examines these contributions by analyzing the effect of conductive process, radiation and wind on their evaporation rate. For this, well controlled, small scale experiments were performed using liquid nitrogen as a safe analog of LNG. Computational Fluid Dynamics (CFD) simulations were performed using commercial CFD code (ANSYS - Fluent). The result was validated with experimental data collected from a small scale, laboratory test experiment.

Key words
CFD, LNG, liquid nitrogen, source term, heat transfer, evaporation, modeling