Modeling of Liquefaction of Cryogenic Propellant in a Tank

A. Hedayat[1], L. G. Bolshinskiy [2], and A. K. Majumdar[1]

[1] Propulsion Department, Marshall Space Flight Center, Huntsville, AL
[2] Jacobs ESSSA Group, Huntsville, Alabama

Over the past decades NASA has been focusing to develop technology that would to allow for production of cryogenic propellants on the surface of Mars. The in-situ propellant production reduces the amount of propellants needed to be taken to Mars and ultimately to reduce mission cost. Utilizing Martian resources, the produced gaseous propellants (i.e., oxygen and methane) are liquefied and stored prior to use on the Mars ascent vehicle. In this paper, a model for the liquefaction process of gaseous propellants in a cryogenically refrigerated tank is presented. The tank is considered to be cylindrical with elliptical top and bottom domes. A multi-node transient model is developed based on the mass and energy conservation equations and wall-gas and liquid-gas interface mass and heat transfer correlations. Description of the model and predicted results will be presented in the final paper.