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Analysis and simulation of stratification in cryogenic storage tanks

Content :

The heat leak through the walls of a cryogenic storage tank is one of the major reasons of thermal stratification and self-pressurization which may lead to pump cavitation and thrust degeneration. Under reduced gravity condition it is found that stratification proceeds very slowly and hence lower pressure rise rate. A study is carried out to determine the effect of insulation parameters and gravity variation on temperature and pressure inside the cryogenic propellant tank. One CFD model is established to investigate the stratification and self- pressurization inside cryogenic storage tanks. VOF model is used to track the volume fraction of each of the fluids in each computational cell throughout the domain. The effects of surface tension are included using continuum surface force model. The model is validated using results from earlier literature. Analyses are carried out to determine evaporation rate, evolution of pressure and temperature inside the cryogenic tank with different insulation thicknesses using LN_2 as the working fluid. Analysis shows that tank pressure rise is significantly higher at lower insulation thickness.

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