Contribution ID: **241**

Type: **Poster presentation (105min)**

Numerical investigation of the thermal distribution and pressurization behavior in a helium pressurized cryogenic tank with a multi-component model

Thursday, 10 July 2014 10:30 (2h 15m)

Heat and mass transfer process at gas-liquid interface exerts significant influence on pressurization performance of cryogenic storage tank. In this paper, an improved CFD model adapted to multi-component and two-phase is constructed to describe the heat and mass transfer effect within the propellant tank considering the existence of pressurizing helium. In the model, the temperature difference between real fluid temperature and its saturation temperature Tsat corresponding to vapor partial pressure is taken as the phase change driving force. The wall together with fluid region is simultaneously considered as the computational domain, and low-Re k–ε approach is selected to account for the fluid-wall heat transfer. Hydrogen and oxygen tanks with helium pressurization are respectively computed, by which the pressure curves and temperature distribution are obtained and analyzed. The computation results show that the interfacial temperature is reaching consistency with Tsat under the action of driving force over the whole process. Heat transfer between gas-wall, gas-liquid and liquid-wall is well presented, higher ullage temperature and pressure and a lower wall temperature are obtained than those without multi-component consideration. It is also found that the representation of the field distribution for hydrogen and oxygen are obviously different. The oxygen gas, with larger density than pressurizing helium, mainly locates under the helium region during the pressurization process. While for the hydrogen tank, hydrogen gas experiences an upward diffusion process derived by hydrogen-helium density difference. The difference of gas concentration distribution in propellant tank may produce different effect on the temperature distribution. On the whole, the new model can provide more reasonable field distribution and description while the existence of pressurizing helium.

Primary author: Dr WANG, Lei (Xi'an Jiaotong University)

Co-authors: Mr ZHU, Kang (Xi'an Jiaotong University); Prof. LI, Yanzhong (Xi'an Jiaotong University); LIU, Zhan (Xi'an Jiaotong University)

Presenter: Dr WANG, Lei (Xi'an Jiaotong University)

Session Classification: Thu-Mo-Posters Session 3.1

Track Classification: C-04: Space cryogenic applications