World Academy of Science, Engineering and Technology
International Journal of Aerospace and Mechanical Engineering
Vol:19, No:12, 2025

Numerical Analysis of Sloshing Dynamics in Liquid Hydrogen Sloshing Tank with Rib Structure

Authors : Ujjwal Shrestha, Young-Do Choi

Abstract : The demand for clean and renewable energy sources is increasing rapidly. Liquid hydrogen is considered the most viable option to replace fossil fuels. When liquid hydrogen is transported from one place to another, the movement of a partially filled liquid hydrogen tank causes sloshing. Sloshing induces dynamic pressure on the storage tank wall, which leads to excessive stress and deformation of the tank walls. The numerical analysis is conducted using Reynolds averaged Navier-Stokes (RANS) and volume of the fluid model to investigate the 3D sloshing dynamics of liquid hydrogen. The sloshing dynamics are influenced by the frequency and amplitude of loading conditions, hydrogen filling level, the geometry of the tank, and wave motion. The 30%, 50%, and 90% hydrogen filling levels are selected to evaluate the sloshing dynamics. The pure surge and the combined surge and sway motions are exerted to visualize the free surface movement. Fluid-structure analysis was conducted to understand the impact of sloshing dynamics on the tank walls. Finally, the rib structure is applied in the tank to reduce sloshing dynamics.

Keywords : sloshing, liquid hydrogen tank, filling level, rib structure, FSI analysis
Conference Title : ICFMT 2025 : International Conference on Fluid Mechanics and Thermodynamics
Conference Location : Sydney, Australia
Conference Dates : December 02-03, 2025