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C4Or1C-02: Impact of Internal Baffle Designs on Liquid Hydrogen Sloshing in Cryogenic Aircraft Fuel Tanks

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Hydrogen because of its zero carbon emissions and highly energy-dense nature has a strong potential to be used as an aviation fuel. One of the ways of using hydrogen in aircrafts is to store liquid hydrogen in cryogenic tanks on board and then vaporize and mix with air before being burned in the combustion chamber. But a major challenge with cryogenic hydrogen storage is the dynamic movement of the fuel which can lead to fuel boil off and bubble formation. In the current paper, the sloshing motion of liquid hydrogen in a CHEETA type thin-walled composite fuel tank, under acceleration data obtained from an Airbus A-320 in cruising conditions, is investigated. The dynamic fluid structure interaction problem is solved numerically using the Coupled Eulerian-Lagrangian (CEL) technique in ABAQUS. The developed modelling strategy is then employed to study the impact of various internal baffle designs on the sloshing behavior of the fuel under different fill levels. This study not only establishes that sloshing is a major cause for concern when it comes to liquid hydrogen aircraft fuel storage, but also advances our understanding in devising potential mitigative strategies.

Keywords: Fuel sloshing, Fluid structure interaction, Coupled Eulerian-Lagrangian, Liquid hydrogen fuel, Net-zero carbon aviation.

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Author: RYALI, Lokaditya (General Electric Global Research)

Co-authors: Dr MARIAPPAN, Dhanushkodidurai (General Electric Global Research); STAUTNER, Wolfgang (General Electric Global Research)

Presenter: STAUTNER, Wolfgang (General Electric Global Research)

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