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CONTROLLING BUBBLE FORMATION AND DEMIXING IN EXPERIMENT CELLS.

Abstract

A traditional challenge for liquid experiments, particularly in case of experiments conducted in a human space flight environment like the ISS with strict safety requirements, is to keep the experiment cells that contain the liquids bubble free. In ground based lab experiments, the time between filling and experiment conduct is quite short. For microgravity experiments, the time frame from filling of the cells to actual experiment is typically in the order of 4 to 6 months, significantly increasing the chance of bubble formation.

The proposed paper provides an overview of the technical and operational approach as used for the SODI DCMIX experiment in order to control the formation of gas bubbles in the liquid cells.

The SODI instrument has been launched to the ISS in 2009 and has successfully performed various fluid experiments like IVIDIL , COLLOID and DSC/DCMIX. The SODI instrument is still on board the ISS and operated once per year when new DCMIX cells are uploaded.

For DCMIX2, the second set of experiment cells for the SODI DCMIX family, the liquids used are a mixtures of Toluene, Methanol and Cyclohexane. However, it was found that elastomers used for sealing the experiment cells had a slight permeability to the liquid mixtures, leading to premature formation of vapour bubbles in the experiment cell. The appearance of such a bubble in the experiment cell obviously has to be avoided, so it is important to control the bubble formation.

In the paper, the specific approach hereto is described. The elastomer selection was performed by using theoretical data on the elastomer in combination with measurements of the liquid absorbance in the seal material. Breadboard tests were then used for accelerated compatibility tests. While the Flight Model DCMIX2 cell array was built using the selected elastomer seals, the Engineering Model DCMIX2 cell array was filled with the experiment liquids and used for a long duration compatibility test. In addition, the typical acceptance and verification process for space flight hardware was optimized to keep the time from filling the DCMIX2 cells on ground to the start of the experiment on orbit as short as possible. A strict test sequence was defined to meet the verification and safety requirements, yet to shorten the typical preparation time frame from 4-6 months to almost 1 month.

The DCMIX2 primary scientific objectives have successfully been met and additional scientific results were obtained from the SODI instrument in 2013.