MICROGRAVITY SCIENCES AND PROCESSES SYMPOSIUM (A2)
Microgravity Experiments from Sub-Orbital to Orbital Platforms (3)

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MIXING OF LIQUIDS BY VIBRATIONS - PREPARATION OF THE VIPIL EXPERIMENT ON THE ISS

Abstract

initiated by preparation of VIPIL proposal in the response of ESA AO-2009 call and will continue in the frame of the preparation the experiment VIPIL on the ISS.

The current research is an attempt to provide experimental and numerical evidence for the instability in miscible fluids in the case of horizontal vibrations parallel to the interface. We present the results of the pioneer experiment SOVICON on the observation of the interface behavior between miscible liquids and vibrational convection in reduced gravity, conducted in the 49th Parabolic Flight Campaigns organized by the European Space Agency.

Two miscible liquid mixtures, water and isopropanol of different concentrations, are placed in a closed cell, submitted to horizontal and sinusoidal oscillations at different frequencies and amplitudes. For the certain set of control parameters the localized mean convective flows are emerged in the vicinity of the triple points: the contact point between solid vertical wall and two liquids. These localized convective patterns spread along the solid walls and provide a local mixing along the walls. This type of instability was studied numerically in the averaged approach for high frequency vibrations [1], [2].

During the microgravity experiments we observed another type of instability in the form of standing waves. Above a threshold, a relief appears at the interface between the two fluids. This instability occurs when the vibration amplitude and frequency are above a critical value which is set by the level of viscous dissipation in the liquid. In general, this viscous dissipation will have a few sources: motion in the bulk of the liquid, motion near the boundaries of the liquid container, motion of any present contact lines. For all of these observations physical explanations are in progress.

References

1. GaponenkoY., Shevtsova V., Mixing under vibrations in reduced gravity, Microgravity Sci. Technol., 2008, 20 (1), 307-311.

2. Gaponenko A., Shevtsova V., Effects of vibrations on dynamics of miscible liquids, Acta Astronautica, 2010, 66, 174-182.