Abstract for Dynamics Days Crete 2006
Topic: Pattern Formation

Vibrational dynamics of two immiscible liquids interface in rotating cylinder

V.G. Kozlov[1*], A.N. Salnikova[2], M. Stambouli[3]

[1] Institute of Continuous Media Mechanics RAS; Ecole Centrale Paris
[2] Perm State Pedagogical University, 614990, Sibirskaia 24, Perm, Russia
[3] Ecole Centrale Paris, 92295 Chtenay-Malabry, France.
[*] Electronic Address: viktor.kozlov@ecp.fr

The dynamics of two immiscible liquids of different density in the rotating horizontal cylinder subject to longitudinal vibrations is investigated experimentally. In contrast to theoretical analysis [1], in which the case of high-frequency vibration and relatively low cavity rotation is considered, the present investigation is carried out at vibrational frequency comparable with rotational one, when the influence of Coriolis force on the liquid oscillation is important. It is revealed [2] that intensive vibration results in excitation of a space periodic axis-symmetrical quasi-stationary relief on the phase interface. This relief appears due to Kelvin-Helmholtz instability of tangential discontinuity. The threshold of the relief excitation, its structure and spatial period are studied in dependence on vibrational parameters, rotational frequency and the liquids volumes ratio. It is found that with decrease of dimensionless rotation velocity the wave number increases.

Another effect consists in formation of mean currents in the form of toroidal vortexes periodic along the axis and located in the bulk of the light liquid. It takes place at relatively low intensity of vibration and is caused by the excitation of standing inertial waves, arising in the system in a resonance way. The 3D vortexes excitation is accompanied with the azimuth flow of the interface in the cavity frame. The intensity of the flows increases with vibration intensity and could achieve high values. The interface of the liquids in this case could remain cylindrical in mean. The structure, wave number and intensity of mean flows caused by inertial waves are strongly determined by dimensionless velocity of rotation. This effect may be used in practice for the control of mass-transport processes on the liquid-liquid interface.

The conclusion about the determining role of Coriolis force (dimensionless rotation velocity) both in case of mean flows and mean interfacial phenomena is done.

The work is supported by Russian Foundation for Basic Research (Grant RFBR 06-01-00189).

---

[1] D.V. Lyubimov et al., (2003) *The dynamics of interfaces in vibrational fields* , PHYSMATHLIT, Moscow.

[2] V.G. Kozlov, A.N. Salnikova, *Convective flows...* **2**, 187 (2005).