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IMPLEMENTATION OF A FOAM RHEOLOGY EXPERIMENT IN MICROGRAVITY

Abstract

Foam Dynamics are characterized by entangled properties: drainage, coalescence and coarsening. These properties are well known empirically and used in daily technical and industrial applications and products. Still experimental investigation of foam is limited by real world constraints, especially under gravity conditions and a direct link between foam properties and theoretical models is not possible in general. A better understanding of these properties can be obtained isolating the effects of one of these.

Property isolation can be achieved for coalescence and coarsening in laboratory conditions, but this is not possible for gravity-driven drainage. The International Space Station offers a unique opportunity to investigate fluid dynamics processes thanks to the absence–or isolation–of gravity-driven drainage. A Soft Matter Dynamics Platform is under development by ESA for the investigation of foam coarsening, an aging process that requires observation on a long time period. Present and future potential applications of foams require also a better understanding of foam rheology.

This paper reviews an approach to extend the Soft Matter Dynamics Platform to perform foam rheology experiments. A feasibility analysis for an extension of the Soft Dynamics Platform capabilities was performed and different mission concepts were evaluated. The extension consists on the development of a sample cell whereas a well-defined displacement can be applied to the foam sample. Different concepts were evaluated on the basis of the modification magnitude of the changes needed on the original platform. In particular, the generation of a contactless positioning sensor integrated in the foam generation system was analysed. A cost-assessment for a refurbishment and a corrective maintenance mission were assessed. In the end a trade-off was made based on the multiple analysis generated, leading to the choice of a best engineering-solution.