STUDY ON THE GAS RETENTION CAPABILITY OF METALLIC SCREENS

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Abstract

In the present development of upper stages for launcher systems, the use of cryogen propellants leads to new challenges for the management of the propellants, in particular for the feature of multiple re-ignitions of the engine during a mission. The tank system has to guarantee gaseous and bubble free supply of the propellants at the requested thermodynamic conditions to the feed system at each time. In this regard, metallic screens have important functions. In addition to the filtering task, they are able to retain gaseous or vapor bubbles up to a maximum possible gas-to-liquid pressure difference that the screen can withstand, the so called bubble point.

This bubble point is dependent on the screen mesh geometry, its porosity, the fluid properties (gas, liquid), the temperature conditions, and is a characteristic value for each screen. Decreasing the porosity leads to an improvement of particle filtration and gas retention but also causes an increase of pressure loss over the screen. For the tank system design, the knowledge of pressure loss and gas retention capability of the used screen is essential to optimize the system for given mission requirements.

This study focuses on the maximum gas retention capability of metallic screens against gas breakthrough. Experimental studies on space application relevant screens and on defined single holes of micrometer size in metallic plates are made with storable and cryogen liquids to understand the dependencies of the bubble point pressure on screen geometry and the used test liquid. The experimental data for each screen in dependence on the used test liquid will be presented. For each screen a correlation is determined, which can be used to scale the bubble point value within the examined range of fluid properties. The experimental data fits very well to existing data of the literature and expand the data base. In addition results on the defined single-hole geometries will be presented which contribute to the understanding of bubble formation in screen geometries.