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Capillary transport of cryogenic liquids in porous media

Ming Zhang[1], **Michael Dreyer**[1]

1. ZARM, Unversity of Bremen, Bremen, Germany, 28359

E-mail: zhang@zarm.uni-bremen.de

We will report on the experimental investigation and modelling of the suction and vertical transport of cryogenic liquids (nitrogen) driven by capillary forces in porous materials (glass frits). Due to the porous character of the solid materials and the volatility of liquid nitrogen the transport phenomena of this investigation is very complex. It includes not only mass and heat transport processes but also the evaporation of the liquid phase. The irregular microstructure of the porous materials and the interaction with the gas environment challenges the description and prediction of the system performance. The knowledge of this investigation is not only of theoretical interest, it could also be useful for the further development of Propellant Management Devices for cryogenic propellants, where porous materials are often used as a transport media to ensure the gas free fuel delivery over the tank outlets during every mission phase. We use a covered glass Dewar to create a well defined gas environment. The liquid transport process is investigated with a precision balance by recording the change of mass of the solid body. The results will be compared with experiments carried out with non-volatile liquids under isothermal conditions and also used to validate the prediction of the theoretical models, which are based the Washburn sorption model. This model use Darcy´s law to model the flow resistance and is extended to consider the evaporation of liquid in solid structures and on the surface of solid bodies.

Keywords: capillary transport;cryogenic liquid;porous media;PMD;

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