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IMPLEMENTING BIOBURDEN REDUCTION AND CONTROL ON THE DELIQUESCENT HYDROGEL OF THE EXOMARS, HABIT INSTRUMENT

Abstract

The HABIT (HabitAbility, Brines, Irradiation and Temperature) instrument, will be the first Swedish Instrument that will land on the surface of Mars as a part of the ExoMars 2020 mission (ESA/IKI). It is also the first European ISRU (In-situ Resource Utilization) instrument capable of producing liquid water on Mars extracting atmospheric water vapor using salt deliquescence to form a stable liquid brine. HABIT also will study current habitability conditions on Mars investigating the air and surface thermal ranges and UV (Ultra-Violet) irradiance. The BOTTLE (Brine Observation Transition To Liquid Experiment) is the container element of HABIT with four independent cells housing deliquescent salts, which have been found on Mars, exposing them to the Martian atmosphere. In order to prevent capillarity of deliquescent or hydrated salts a mixture of deliquescent salts with Super Absorbent Polymer (SAP) based on poly-acrylamide is utilized. This mixture has deliquescent and hydrogel properties that can be reused by applying a thermal cycle, complying thus with the purpose of the instrument. A Poly-Tetra Fluro Ethylene (PTFE) coated nylon HEPA (High Efficiency Particulate Air) filter stands as a physical barrier allowing interaction between the gaseous molecules of the Martian atmosphere and the salt mixtures, and at the same time prevents the passage of any biological contamination from the cells to the outside or vice-versa. In addition to the physical barrier, a strict bioburden reduction and analysis is made on the contained salt mixtures adhering to the European Cooperation for Space Standardization protocol of Microbial examination of flight hardware (ECSS-Q-ST-70-55C). The deliquescent salts and the SAP products need to be properly treated independently to adhere to the planetary protection protocols. In this paper, we have described the bioburden reduction process utilized to sterilize the salt mixtures in BOTTLE and the assays adopted to validate the sterilization. The sterilization process adopted involves ultra-fine filtration and Dry Heat Microbial Reduction (DHMR) of the deliquescent salts and the SAP respectively. The performance of SAP after DHMR is validated to ensure its working efficiency after sterilization. A standard swab assay and a pour-plate assay are adopted in the validation process and a comparison is made between them to determine the best assay to be applied for future space hardware utilizing such salt mixtures for planetary investigation and ISRU. The demonstrating of the compatibility of these products

with the processes commonly required for space applications has implications for the future exploration of Mars.