

System Level Analysis of a Water PCM HX Integrated into Orion's Thermal Control System Abstract

In a cyclical heat load environment such as low Lunar orbit, a spacecraft's radiators are not sized to reject the full heat load requirement. Traditionally, a supplemental heat rejection device (SHReD) such as an evaporator or sublimator is used to act as a "topper" to meet the additional heat rejection demands. Utilizing a Phase Change Material (PCM) heat exchanger (HX) as a SHReD provides an attractive alternative to evaporators and sublimators as PCM HXs do not use a consumable, thereby leading to reduced launch mass and volume requirements. In continued pursuit of water PCM HX development an Orion system level analysis was performed using Thermal Desktop for a water PCM HX integrated into Orion's thermal control system and in a 100km Lunar orbit. The study analyzed 1) placing the PCM on the Internal Thermal Control System (ITCS) versus the External Thermal Control System (ETCS) 2) use of 30/70 PGW versus 50/50 PGW and 3) increasing the radiator area in order to reduce PCM freeze times. The analysis showed that for the assumed operating and boundary conditions utilizing a water PCM HX on Orion is not a viable option. Additionally, it was found that the radiator area would have to be increased over 20% in order to have a viable water-based PCM HX.