Material Compatibility Study of Coated Metals to Maintain Biocidal Silver in a Spacecraft Potable Water System

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Ionic silver-based biocide remains an option of choice for microbial control in spacecraft potable water systems. However, depletion of silver ions by wetted materials readily reduces ionic silver to nonbiocidal levels. This phenomenon occurs via various transport mechanisms at the liquid-solid interfaces between the silver-containing water and adjacent surfaces. Consequently, challenges remain in the design and/or selection of materials that can be used for the wetted system components that will help ensure silver is maintained at biocidal levels. Since silver has been baselined, and/or remains, as a potable water biocide option for several future spacecraft potable water systems, a multitiered approach is being investigated, looking at heritage materials, new processes, and/or alterative materials. This study conducted the application of eleven chemically-resistant coatings onto coupons that were cut out from three types of spacecraft-grade metals (Titanium Grade 2, Inconel 718, and 316L Stainless Steel) to investigate the performance of this material strategy as a barrier against silver depletion. In this investigation, the coated metals were immersed in a static 400 parts per billion silver biocide solution at a surface-area-to-volume ratio of 2.0 cm-1 and left to soak for predefined time periods. The concentration of the solution in contact with the coated samples was analyzed at various points via inductively coupled plasma mass spectrometry, and the measurements were interpreted as silver retention percentages over time. This paper summarizes the coating selection process, the configuration of the test, and the performance of each coating-metal combination at diminishing silver depletion. The preliminary results demonstrate that some of the selected coatings succeeded at maintaining biocidal silver concentrations far beyond the corresponding base metal in a similar test. The knowledge acquired through this investigation supports the deploying of coatings on plumbing lines for the integration of biocidal silver in the water system architecture of a spacecraft. Nevertheless, further testing must be continued to assess the performance of these coatings on other wetted geometries and any implications of unifying this material strategy with traditional and developmental engineering design processes for spacecraft potable water systems.