Paper ID: 63528
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IAF/IAA SPACE LIFE SCIENCES SYMPOSIUM (A1)
Biology in Space (8)

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INVESTIGATING THE USE OF MATERIAL COATINGS FOR THE PREVENTION OF BIOFILMS ON ISS WATER SYSTEM MATERIALS

Abstract

Biofouling and biofilm growth in closed habitats in space is a concern for the success of future missions including the future Lunar Gateway. Complications in the water system of the International Space Station (ISS) due to biofilm occlusion of a valve highlights the need for antibiofilm and antibiofouling measures in microgravity. The solution to preventing biofilm growth in such environments will likely require the combined use of chemical biocides, antimicrobial coatings, and nutrient control methods. This study investigated the use of a material coating to minimize biofilm accumulation on stainless steel, Teflon, Inconel (a nickel-chromium alloy), and titanium which are all used in the ISS water system. A previously space flown strain of the Gram-negative bacterium Pseudomonas aeruginosa PA 14 and an a yeast Rhodotorula mucilaginosa isolated from the ISS were grown in CDC biofilm reactors to evaluate the ability of the novel antimicrobial coating to reduce biofilm accumulation on the materials used in the ISS waste water system. The efficacy of the coating was evaluated based on log reduction of viable cell counts and confirmed with scanning electron microscopy (SEM). The coating was highly effective at preventing accumulation of P. aeruginosa biofilms for 24- and 48-hour time periods but had no effect on R. mucilaginosa. One hypothesis for the difference in efficacy involves the cellular structure of the bacteria versus yeast regarding the mechanism of action of the coating. Additionally, SEM images showed attachment structures that may confer survival advantages to the yeast on the coated and uncoated surfaces. Current and future work seeks to determine the efficacy of the coating for extended periods of time (weeks to months). Additionally, several other coatings in combination with the use of chemical biocides will be evaluated for their ability to reduce P. aeruginosa and R. mucilaginosa biofilm growth in the CDC biofilm reactor. This research investigates several methods to mitigate biofilms of bacterial and fungal species, the latter often being overlooked in such studies. Most of the research has been completed but these completed results have not been presented at previous meetings.