Paper ID: 68578
oral
student

IAF/IAA SPACE LIFE SCIENCES SYMPOSIUM (A1)
Life Support, habitats and EVA Systems (7)

Author: Ms. Madelyn Mettler
Montana State University, United States

Dr. Ceth Parker
NASA Jet Propulsion Laboratory, United States
Dr. Kasthuri Venkatweswaran
Jet Propulsion Laboratory - California Institute of Technology, United States
Dr. Brent Peyton
Montana State University, United States

USE OF ANTIMICROBIAL COATINGS TO PREVENT MULTISPECIES, MULTIDOMAIN BIOFILM GROWTH OF ISS ISOLATES IN WASTEWATER SYSTEM

Abstract

Microorganisms often live in macroscopic, slimy communities known as biofilms. These communities are ubiquitous on Earth and extend to the International Space Station. Biofilm formation in the ISS water system has resulted in system failure, requiring the replacement of parts and reevaluation of the wastewater renewal process. One approach to reducing biofilm growth is the application of antimicrobial coatings to the surfaces of the wastewater treatment system, specifically the wastewater tank. This, combined with approaches like nutrient depletion and the use of human-friendly biocides could greatly reduce biofilm accumulation in the ISS and other future craft. This project seeks to determine the biocidal effect of several antimicrobial coatings against five microbes commonly isolated from the ISS water system. The consortium consists of four bacteria: Ralstonia insidiosa, Burkholderia contaminans, Methylobacterium organophilum, and Cupriavidus metallidurans, as well as a fungus, Lecythophora mutabilis. Biofilms are grown in a normal gravity system (CDC biofilm reactor) with a medium that mimics the chemical composition and nutrient availability of the ISS wastewater. Antimicrobial coatings are evaluated on two materials found in the ISS water system: Inconel, a nickel-chromium alloy, and Teflon. This project is unique as it employs a five species biofilm that crosses the bacteria and eukarya domains, rather than single-species biofilms traditionally used in research. Additionally, though the experiments take place at normal gravity, the organisms, medium and materials used closely match those found in situ on the ISS. Biofilm prevention/reduction is evaluated based on viable cells in the biofilm via colony forming units on selective agar plates in the coated system compared to an uncoated control. Confocal and scanning electron microscopy provides information regarding the spatial arrangement of each species within the biofilm. Previous data for single-species Pseudomonas aeruginosa 14 (space flown strain) biofilms on antimicrobial coatings show decreases in biofilm accumulation on all four coatings tested. Mechanisms of action included silver/copper ions, carbon chain lances, and high hydrophobicity. Coatings were either tested in 24-48 h high nutrient or 7-day low nutrient tests. When tested in tryptic soy broth, all coatings reduced biofilm accumulation by several logs. The efficacy of at least one of the coatings appears to be dependent on the medium in which it is tested. For this reason, future experiments will take place in a medium mimicking the ISS wastewater ISS. Data presented will include the previously collected single species data as well as the five-species biofilm on various coatings.