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MOISTURE AVAILABILITY AND MICROBIAL ACTIVATION IN SPACECRAFT

Abstract

We spend much of our time in built environments where we are continually exposed to microorganisms. Within indoor environments on earth, or in environments such as occupied spacecraft, these bacterial and fungal exposures can impact human health. Exposures to microbial growth may be particularly harmful, which is predominantly influenced by moisture availability to dust that contain microbes. This dust is hydroscopic and quickly absorbs water from the air; therefore, when ambient relative humidity levels reach a certain threshold, microbial growth will occur. Different microbial species may be harmful in different ways, but the occurrence of active growth may be the most important factor regardless of taxonomy. In confined environments such as spacecraft elevated moisture conditions are expected due to human activities such as breathing, hygiene routines, food preparation and exercise. These activities have diurnal variations which will influence the water availability for microbial growth over time. NASA has a robust monitoring program for spacecraft that is designed to eliminate or mitigate any potential health effects originating from microorganisms. However, the current standards do not account for microbial growth in spacecraft. Our goal is to propose improved microbial standards for spacecraft based on expected microbial growth due to elevated relative humidity, which is easy to measure. Standards will protect human health and spacecraft integrity. Our hypothesis is that we can determine if growth will be activated based on the number of hours per day spent above a relative humidity threshold. The environment will be considered acceptable if growth is prevented. The first step in creating these standards is to experimentally determine the time required for activation of microbial growth under various moisture conditions. We will consider currently available data collected from incubations performed on house dust from earth to estimate what the activation of microbial growth in dust from spacecraft might resemble. We can apply this activation time to examine a subset of samples from the Humidity and Microbial growth in ISS Dust (HUMID) project to verify if our estimates are valid. The theoretical model produced from this work will determine the amount of time that can be spent at an elevated relative humidity in spacecraft before microbial growth will occur. The ability to explore longer distances into space is dependent on maintaining conditions within the confined environment. These proposed standards will help to ensure the health of astronauts and the success of future missions.