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BACTERIAL GROWTH AS A CAUSE OF THE ORLAN SPACESUIT WATER COOLING SYSTEM MALFUNCTION.

Abstract

The astronaut's spacesuit on board the International Space Station is an absolutely indispensable equipment for maintaining the station and performing experiments during extravehicular activities (EVA). In 2022, in the Orlan spacesuit, during the EVA, malfunctions were discovered in the spacesuit cooling system, which led to the interruption of this EVA session. In order to determine the cause of the malfunction, a microbiological study of various components of the spacesuit cooling system was carried out. Water samples from the spacesuit water cooling system, water from the onboard part of the heat-exchange cooling device circuit and the internal surfaces of a pump that pumps water during EVA, were analyzed using microbiological inoculation methods on various nutrient media. To obtain the greatest species diversity of microorganisms, both aerobic and anaerobic nutrient media. As a result of inoculation of water samples, the presence of bacteria was detected in an amount 4×10^6 CFU/ml. The dominant species was *Burkholderia cepacia*. The presence of such microorganisms as *Bacillus subtilis*, *Rothia amarae*, *Bacillus cereus*, *Bacillus endophyticus*, *Pseudomonas oryzihabitans*, etc. was also determined. These cultures were identified using Bruker MALDI-TOF mass spectrometer. Microscopy of a black-green conglomerates from a water sample revealed a dense aggregation of microbial cells. These conglomerates apparently stopped the normal circulation of water in the cooling system. Analysis of microbial growth samples from the inner surface of the pump showed the presence of different types of bacteria: *Cupriavidus metallidurans*, *Bradyrhizobium denitrificans*, *Methylobacterium spp*, *Methylocella silvestris*, *Novosphingobium humi*, etc. These strains were identified by 16S ribosomal DNA gene sequencing. These bacteria use different types of nutrition and different adaptation mechanisms, which allowed them to create a complex multi-species biofilm in which the advantages of some bacteria contribute to the survival of others. *Cupriavidus metallidurans* is a hydrogen bacteria that obtains energy for growth by oxidizing molecular hydrogen, is able to exist in an environment with high concentrations of heavy metals, and even precipitate them. Apparently, such a cooperative way of existence allowed these bacteria to master for life essentially a new ecological niche for Earth's bacteria – the water inside the spacesuit cooling circuit is exposed to a greater number of space flight factors due to extravehicular activity (increased radiation, nutrients limit, temperature changes, microgravity, oxygen concentration) compared to the conditions inside the ISS modules and even more so compared to Earth's conditions.