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FUNGAL BASED BIOCOMPOSITE FOR HABITAT STRUCTURES ON THE MOON AND MARS

Abstract

One of the key capabilities for long term human exploration missions beyond low Earth orbit is a suitable technology for in-situ resource utilization (ISRU). Indigenous or locally cultivated resources lower the mass and volume of a payload brought that needs to be brought from Earth, and as a result decreases the costs. Therefore, an efficient trade-off space has to be created between robotic ISRU systems brought from Earth, and type of materials used in the process to increase the long term mission sustainability.
The objective of the current study is to investigate the production process and feasibility of fungal based biocomposite material for habitat structures on the Moon and Mars, using automated additive construction technology. Previous studies have shown that certain type of fungi are able to survive in extreme environmental conditions due to the ability to produce melanin. We were able to identify a natural mushroom forming strain (227) of Schizophyllum commune (SC) that has the capability to produce melanin. Experiments with -radiation in Co-60 facility at ESTEC showed that SC is able to survive in 2 Gy, 20 Gy and 200 Gy dose levels, with the 30The proposed production process of the biocomposite on the Moon or Mars would require cultivating the mycelium of SC in-situ from with a minimum amount of starter culture brought from Earth. This would be combined with locally grown Azolla filiculoides, an aquatic fern with the ability to rapidly increase its biomass growing on water while fixing nitrogen and carbon directly from air. For an additive construction experiment with a 6-axis robotic arm a mixture of SC mycelium, Azolla filiculoides, water and psyllium was used to generate an extractable paste through a nozzle system, and manufacture a number of 3D structures with different print parameters.
In this paper we discuss the main results of the experiments, feasibility of the production process on the Moon and Mars, the suitability of the biocomposite material for structural applications based on its mechanical and thermal properties, and make recommendations for the future studies.