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MYCOTECTURE: HARNESSING FUNGAL MYCELIUM FOR SUSTAINABLE EXTRATERRESTRIAL HABITATS

Abstract

Creating long-term human settlements on the Moon and Mars is a formidable challenge, and one of the biggest hurdles is the sourcing and transportation of building materials. Conventional building materials are too costly to launch into space because of their volume and weight. A novel solution is mycotecture—the utilization of fungal mycelium to cultivate architectural structures in place. This method utilizes the natural growth characteristics of fungi to produce lightweight, strong, and biodegradable materials for use in extraterrestrial conditions.

This paper reviews the potential of mycelium construction for off-planet habitats, with a focus on new findings and experimental results. Mycelium is the vegetative part of fungi and consists of a matrix of filamentous hyphae that are capable of colonizing and aggregating a variety of substrates, e.g., agricultural by-products or regolith simulant. When dried, mycelium composites exhibit beneficial characteristics, e.g., high strength-to-weight ratio, thermal insulation, and fire and mold resistance.

We consider the feasibility of launching inflatable structures with fungal spores and nutrient provisions, which, upon arrival on the lunar or Martian surface, would utilize local resources like regolith to develop and grow structural components. This method offers a self-replicating and self-healing construction process, reducing the need for large-scale material transport and enabling adaptive growth to environmental conditions.

Furthermore, we explore the radioprotective qualities of melanized fungi, such as Cladosporium sphaerospermum, which have been shown to decrease ionizing radiation. Incorporating such fungi into habitat design could provide passive radiation shielding, protecting astronauts without adding significantly to mass.

The paper also touches upon the challenges of using mycotecture in space, including controlling growth parameters, structural integrity in low gravity, and preventing contamination. We present ongoing research work, such as NASA's attempts to test mycelium-based materials in space conditions, and give future directions for developing this technology.

With the application of biological efficiency and fungal adaptability, mycotecture presents a prospective field for the construction of sustainable extraterrestrial buildings in alignment with the ISRU plans and reducing the space logistical bottleneck