IAF HUMAN SPACEFLIGHT SYMPOSIUM (B3)
Interactive Presentations - IAF HUMAN SPACEFLIGHT SYMPOSIUM (IP)

Author: Mr. Aagam Jain
India

Mr. Ravi Kumar Varma
Space Applications Centre (ISRO), India
Dr. Prahsant GK
Vellore Institute of Technology, India
Ms. Rabhya Gupta
VIT Bhopal University, India
Ms. Asma betteka
Russian Federation

INNOVATIVE SUSTAINABLE CONSTRUCTION FOR MARS COLONIZATION THROUGH IN-SITU RESOURCE UTILIZATION (ISRU)

Abstract

Aagam Jain1,

1 Department of Aerospace, VIT Bhopal University & Space Applications Centre (SAC), Indian Space Research Organisation (ISRO), Ahmedabad, India.

The research explores the effectiveness of the Basalt-Vinyl Composites for the future colonization of the mars. The cost of transporting construction materials from Earth to Mars is prohibitively high, making In-Situ Resource Utilization (ISRU) essential for sustainable space colonization. ISRU involves utilizing indigenous resources at mission destinations rather than relying solely on supplies from Earth, thereby augmenting human exploration capabilities.

The geological distribution and composition of volcanic deposits in Hawaii offer an optimal environment. With Mars characterized by a 1% atmosphere, extreme temperatures, and reduced gravity, traditional construction materials face significant challenges. Basalt, abundant on Mars and found in volcanic rocks on Earth, emerges as a promising solution due to its durability, resilience, and accessibility.

This research explores the viability of utilizing basalt-vinyl composites for 3D printing construction materials, envisioning a future where additive manufacturing revolutionizes space habitat construction. Basalt's resistance to radiation and temperature fluctuations makes it an ideal candidate for Martian environments. By combining basalt fibers with vinyl ester resin, a filament is produced that exhibits high tensile strength, flexural strength, stiffness, and impact resistance.

Samples collected from the lava tubes of Mauna Loa, Hawaii, during analog astronaut missions provide insight into basalt's properties and suitability for extraterrestrial construction. Radiation testing in the zenith face of the The Materials International Space Station Experiment (MISSE) will further validates basalt's resilience.

Optimizing building aerodynamics is crucial for advancing Mars colonization and safeguarding structures during Martian storms. Moreover, incorporating aerodynamic principles into construction enables us to lessen the effects of strong winds and dust particles typical of Martian weather. Aerodynamic designs diminish wind resistance, lowering the likelihood of structural harm or failure. Furthermore, these designs regulate indoor temperatures, enhance energy efficiency, and enhance overall living conditions for inhabitants. Emphasizing aerodynamics in building planning enhances the safety, sustainability, and

durability of Martian habitats, fostering enduring human habitation and colonization endeavors on the Martian surface.

Partnering with space agencies and construction firms, this research aims to pave the way for additive manufacturing in space and on Earth, offering a sustainable alternative to traditional construction materials. From small tools to large habitats, basalt-vinyl composites offer versatility and durability, facilitating human expansion into the cosmos and the realization of a multi-planetary future.