Paper ID: 51376
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IAF SPACE EXPLORATION SYMPOSIUM (A3)
Interactive Presentations - IAF SPACE EXPLORATION SYMPOSIUM (IP)

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HAWAIIAN BASALT CHARACTERIZATION AND THE EFFECTS OF CHEMICAL COMPOSITION VARIANCES ON THE SINTERING PROCESS; POTENTIAL IMPLICATIONS FOR LUNAR/MARS ISRU APPLICATIONS.

Abstract

In Situ Resource Utilization (ISRU) refers to the ability to utilize local resources found in an area of interest. The idea is to reduce the amount of materials carried from Earth to the Moon/Mars. There has been a lot of interest in lunar and Mars regolith as a source for construction materials and volatiles extraction.

Regolith sintering has been proposed as a potential means to produce a manufacturing and/or construction material feedstock. The Pacific International Space Center for Exploration Systems (PISCES) in collaboration with NASA's SwampWorks successfully developed interlocking tiles made with sintered basalt from a quarry on the island of Hawai'i. PISCES has developed two sintered materials under two different thermal profiles (1,149 C 1,177 C) using the same basalt feedstock. The structural properties of the material produced were superior to those of residential and specialty concrete, respectively.

PISCES has continued researching basalt sintering, characterizing basalt samples from multiple locations on the island. The samples have revealed a significant variation in chemical composition based on their source and the age of the lava flow they originated from. These samples were submitted to the two sintering profiles mentioned above to see how their varying chemical compositions affect the resulting product. The results show that chemical composition plays a significant role in the quality of the final sintered material. While some samples produce exceptionally durable sintered blocks, others result in materials that would not function well for manufacturing and construction. A slight variation in the basalt's chemical composition can produce sintered materials with significantly different structural properties.

Being able to identify what characteristics are desirable for sintering will aid the search for optimal locations and sources of basalt regolith for sintering on the Moon or Mars. Moving forward, thin section analysis, X-Ray Diffraction (XRD) and more structural testing are needed to better characterize the relationship between regolith composition and sintering quality.