CHARACTERIZATION OF HAWAIIAN BASALT AGGREGATE & THE EFFECTS OF CHEMICAL COMPOSITION ON SINTERABILITY: IMPLICATIONS FOR FUTURE LUNAR/MARS ISRU APPLICATIONS.

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Introduction: Infrastructure is a necessity for human settlement on the Moon/Mars to ensure survival. Infrastructure such as habitats, foundations and launch pads will be vital. The ability to create construction materials *in-situ* will be even more important for future settlers who cannot bring all their construction materials from Earth.

For the last several years, the Pacific International Space Center for Exploration Systems (PISCES) has been studying regolith sintering to determine if it is a viable technique for producing usable manufacturing/construction materials. Hawaiian basalt has been the focus of this study due to its similarity to Lunar/Martian regolith.

In 2015/2016, PISCES collaborated with NASA's SwampWorks and successfully developed interlocking tiles made with sintered basalt from a local quarry. Since then, PISCES has developed two thermal profiles (1,149°C and 1,177°C) using the same material as the interlocking tiles. The difference in temperature produced two materials that were structurally superior to residential concrete; each possessed structural characteristics unique from one another. The higher temperature material resulted in a much denser and more durable product (*see Image 1*).

PISCES is continuing its basalt sintering research and has collected and chemically tested samples from more than 7 locations on Hawaii Island. Energy Dispersive X-Ray Fluorescence (EDXRF) analysis has shown that, despite being from the same island, the samples have significant chemical variation *(Graph 1)* depending on their age, location and origin. Each sample was sintered using the two previously mentioned thermal profiles to determine its value as a sintering feedstock. The results clearly indicate that chemical composition plays a significant role in the quality of the final sintered product. Mauna Loa basalt tends to produce structurally durable products while all other basalts tend to result in structurally weak products.

Moving forward, clearly identifying which characteristics are needed for effective sintering will help identify landing sites on the Moon/Mars where regolith with favorable qualities may be used for construction/manufacturing. PISCES is planning to conduct X-ray Diffraction (XRD) analysis on Hawaii basalt, and thin section analysis and structural testing of its sintered basalt products. These tests are needed to further characterize the relationship between regolith chemical composition and the structural quality of its resulting product when sintered.

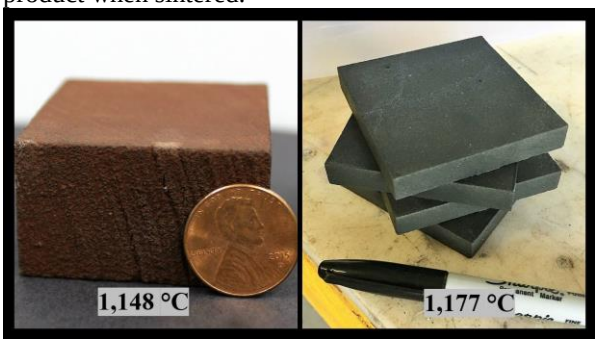
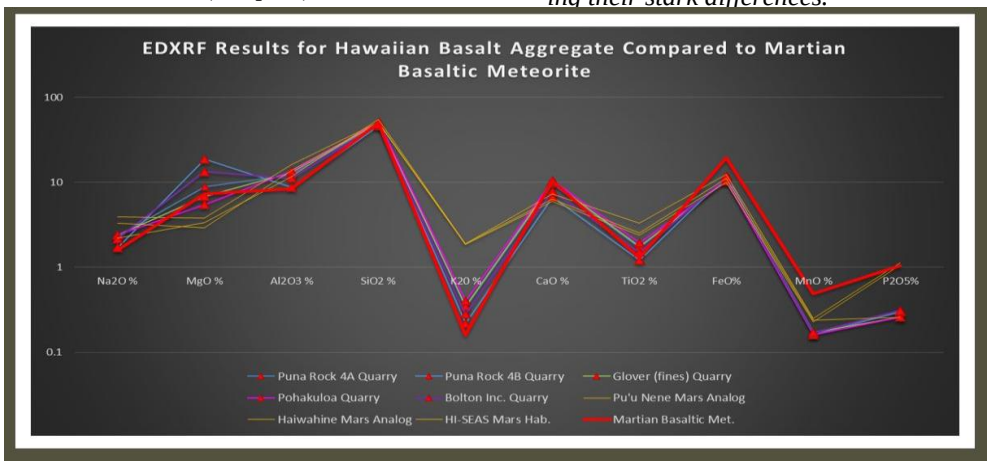


Image 1: 1,148 °C brick & 1,177 °C brick illustrating their stark differences.



Graph 1: EDXRF results for Hawaiian basalt agregate compared to Martian basaltic meteorite.