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SOLAR SINTERING ON LUNAR REGOLITH SIMULANT (JSC-1) FOR 3D PRINTING.

Abstract

Man has not walked on Moon since 1972 but the dream to return lives. Efforts are being made to return to the Moon within the next few decades and to stay much longer than any previous manned mission. For that reason, extensive research is needed to build habitable architectures using natural IN-SITU resources (ISRU) available on the lunar surface with Additive Manufacturing (AM) technologies. A goal that can promote a thriving settlement would be to develop a technology that prints structures with material comprises of 90% lunar Regolith, thereby radically decreasing the amount of material that must be transferred from the Earth to support a lunar village.

The purpose of this experiment is to find conceptual design and feasibility of using 3D printing technology for building infrastructure and habitats on the Moon. The outcome of this research is expected to be an in-depth evaluation of the composition base material and the working principles of the additive manufacturing process for building space habitats and structures on the lunar surface using indigenous materials. The preliminary stage of this experiment was to determine a technique to print structures using natural resources. The challenge is to find a technique that would not require high power (i.e. laser sintering) to melt regolith mixture. Fresnel lenses can provide a passive technique for concentrating solar energy. Our group built a breadboard system using a Fresnel lens at a specific focal length that produced temperatures of more than 1100 °C within a short time period during the process. We demonstrated that it was sufficient to melt Moon dust simulant (JSC-1) into fused metallic glass or slag which consumes an adequate amount of strength to create additive bonds for printing structures. Though, the real integration of this advance additive manufacturing method is essentially a matter of further research. The next step is to repeat the experiment under simulated lunar environments where the effects of vacuum and reduced gravity can be assessed. The primary objective is to enhance additive manufacturing capabilities to create a unique device which can print complex components for building a lunar base.

Since regolith is broadly accessible on the lunar surface, this innovation is promising for the physical applications to construct a lunar village. Many space organizations like NASA, ESA and commercial space companies are involved in developing new concepts of 3-D printing techniques to promote space development over the next twenty years.