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AN APPROACH TO STUDY ADDITIVE MANUFACTURING OF REGOLITH SIMULANT UNDER VACUUM AND REDUCED GRAVITY ENVIRONMENT.

Abstract

There has been a visionary approach since a decade to establish a base on Earth's little dusty neighbor, the Moon. We need to explore the Moon since it is the perfect outpost to accumulate resources outside the Earth's gravitational field. An operational lunar village would be economical, resourceful and efficient to transport materials for settlement on Mars and conduct further missions into deep space. Future robotic and manned missions to the Moon must be reliable and safe for operating all the necessary equipment in order to utilize the Moon's IN-SITU resources (ISRU). Our aim is to study regolith behavior under combined effect of vacuum and reduced gravity environment.

During past Apollo missions, lunar regolith grains created unfavorable scenarios, indexing dust issues related to human safety and robotic activities as for rovers. Our approach will reevaluate the scenarios and continue research to invent a beneficial and effective technology to pave the lunar surface for preventing astronauts and all service equipment from dust effects. This paper portrays examinations of different techniques for stabilizing the lunar regolith for dust moderation. We performed experiments through our several attempts of solar sintering on regolith simulant with a breadboard system attached to a Fresnel lens which has created a sufficient amount of temperature nearly 1200°C and melted regolith within a short time. Corresponding to solar sintering, we have observed the effects of laser sintering on regolith simulant(JSC-1) for 3D printing. Throughout many iterations, both techniques were able to produce fused metallic glass with an adequate amount of strength to create additive layer bonds for printing structures. Our innovation is adequately exceptional for 3D printing of structures with regolith under vacuum environment.

At this initial stage of building an experiment, our primary objective is to get a glimpse of the laser beam impact and reaction on regolith simulant, positioned inside vacuum environment. The process of dust behavior analysis will take place inside a chamber connected to a turbomolecular pump which will create vacuum inside the chamber. The mitigation techniques to stabilize dust would characterize the effects quantitatively. The final phase of this experiment is to develop a methodology with an economic aspect and technical support in order to build and test a Regolith-3D-printer in a parabolic flight campaign. Our approach aims to accelerate this experimental research by enhancing the technology and find a substitute for the conventional method of additive manufacturing process for future Lunar constructions.