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Author: Mr. Julian Baasch
Technical University of Berlin, Germany

Mr. Theodor Heutling
Technische Universität Dresden (DTU), Germany
Mr. Philipp Lehnert
University of Stuttgart, Germany
Dr. Stefan Linke
TU Berlin, Germany
Mr. Niklas Voigt
OHB System AG-Bremen, Germany
Mr. Martin Propst
TU Dresden, Germany
Mr. Jannis Petersen
Technische Universität Dresden (DTU), Germany
Dr. Christian Bach
Technische Universität Dresden (DTU), Germany
Prof.Dr. Konstantinos Kontis
School of Engineering, University of Glasgow, United Kingdom
Dr. Jeroen Van den Eynde
ESTEC, European Space Agency, The Netherlands
Dr. Advenit Makaya
European Space Agency (ESA), The Netherlands
Prof. Carsten Schilde
Technische Universität Braunschweig, Germany

TRADE-OFF ON ISRU-MANUFACTURING-METHODS FOR LANDING STRUCTURES TO ENSURE A SUSTAINABLE LUNAR SURFACE ACCESS.

Abstract

The ESA funded project Lunar Islands is a collaborative effort involving TU Dresden, TU Braunschweig, University of Glasgow, ONERA, and TU Berlin focusing on the plume-surface interaction of lunar decent with manufactured landing pads. This paper explores the key manufacturing processes for lunar regolith, aiming to transform it into a viable building material for the construction of a landing pad on the lunar surface. The utilization of on-site resources is crucial to minimize transportation costs from Earth, with lunar regolith emerging as the most abundant raw material for lunar infrastructure. Therefore, significant importance is attached to researching and testing various processing options for lunar regolith, positioning it as a fundamental building block for the construction of landing pads.

Post-Apollo missions, the concept of an inhabited lunar outpost gained traction, exploring diverse paths for development stages and approaches, including scientific exploration, resource utilization, or es-

tablishing a permanent lunar base. Initial phases involved preparatory exploration of the Moon through satellite mapping, followed by autonomous landers and rovers. These missions played pivotal roles in gathering essential data and conducting preliminary assessments on the lunar surface. The subsequent phase envisions the construction of a small lunar base for scientific purposes, adaptable for future expansion, including plans for oxygen, water, and food production. This base, initially accommodating a few astronauts, focuses on experiments in self-sustainability, lunar sciences, and material refinement from regolith.

As plans for a lunar outpost progress, the need for supplies and astronauts to be transported by rocket-powered landers remains high. Therefore, this paper delves into possible manufacturing methods for processing lunar regolith and provides evaluation criteria for assessing these processes. Solar Sintering and Melting (SOSM), Heat Resistor Regolith Sintering (HRRS), and Regolith Compaction (RCO) emerge as the most promising manufacturing methods for building a landing pad during the initial lunar outpost phase. SOSM and RCO are advantageous for their simplicity and low energy usage, while HRRS boasts excellent material properties and is likely to require minimal maintenance.

Further investigations within the Lunar Islands project involve the production and testing of samples from SOSM and HRRS with rocket engines to analyze durability, contributing to the advancement of lunar infrastructure and the sustainability of future lunar missions. This ongoing research aligns with ESA's objectives for lunar exploration, marking a significant step toward establishing a human presence on the Moon and fostering global collaboration in space exploration.