

Human Exploration Initiatives at EAC: Spaceship EAC and the Development of Large-Volume Lunar Regolith Simulant for LUNA

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Abstract

In order to address analogue capability gaps previously identified by ESA studies [1], EAC has embarked on a number of exploration enabling initiatives at the centre in Cologne, Germany. Herein, preliminary results of two of these projects are presented; the Spaceship EAC initiative and EAC-1, a large-volume lunar regolith simulant for the LUNA facility.

1. Introduction

The operational capabilities of the European Astronaut Centre (EAC) in terms of training and support for human spaceflight operations on the ISS are well known. With increasing attention now being given to post-ISS human spaceflight and exploration scenarios, teams at EAC and the broader ESA are collaborating on projects that would leverage the capabilities and experience available from EAC to further these exploration objectives.

1.1 LUNA and EAC-1

EAC is currently constructing a 900 m² surface operations testbed facility. This facility, called LUNA, will provide the capability to run high-level integrated simulations on site by combining a habitat, FlexHab, the lunar terrain testbed, changeable lighting conditions, an operational crane, storage and temporary office spaces, with access to power, data and communication networks. The location of the facility in Cologne will allow for ease of access to ESA personnel, but the facility is also envisaged to be readily accessible to external researchers and stakeholders without any cost-barriers.

The structure consists of a 34 m diameter inflatable dome housing the testbed area, with an experiment preparation area and a ~600 m² lunar regolith testbed. This has identified the need for an accessible and cost-effective lunar regolith simulant. Herein, the physical and chemical data for the chosen lunar regolith simulant material “EAC-1” are described and discussed with comparisons to other commercially available regolith simulant materials.

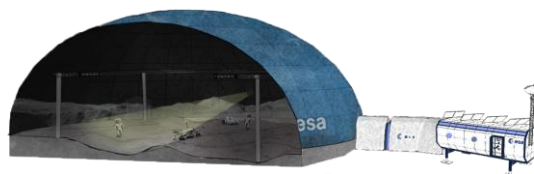


Figure 1: The LUNA facility with the habitation module, FlexHab attached. Image: O. Punch, Spaceship EAC.

The depth of the lunar regolith simulant testbed is foreseen to be about 60 cm, which requires almost 700 tonnes of material. As there are currently no available commercial providers of lunar regolith simulant material in such volumes, efforts have been made to develop a suitable material in-house. The Eifel volcanic region, situated approximately 40 km away from EAC, was selected as a potential source due to its proximity. A basaltic material has been identified and is currently under investigation. The results of these studies are presented herein.



Figure 2: The EAC-1 lunar regolith simulant.

1.2 Spaceship EAC

In addition to LUNA, another effort to foster human lunar exploration at EAC is the Spaceship EAC initiative, started in 2012. This transversal initiative aims to utilize the spaceflight experience of EAC and other involved agencies to investigate and validate low Technology Readiness Level (TRL) ideas and operational concepts for human lunar exploration scenarios. The initiative further helps prepare the centre for exploration activities envisioned in the future.

Some of the topics that are covered are:

- Virtual Reality for training
- Sintering studies of regolith
- Radiation Shielding
- Additive Manufacturing
- Energy Production and Storage
- Robotics and Human Factors

Herein, the current plans and projects of Spaceship EAC are outlined and discussed.

References

[1] *Analogues for Preparing Robotic and Human Exploration on the Moon*, ESA GSP Study, Contract 4000111890.