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MOONLIFE: FERMENTATION OF MOON REGOLITH AS AN IN-SITU RESOURCE UTILIZATION TECHNOLOGY

Abstract

The development and successful application of in-situ resource utilization (ISRU) technologies is expected to play a determining role in current and future Moon and Mars surface exploration plans. Sustainable human presence on the Moon, without frequent ground support, is not possible without the capability of extracting basic resources from the environment. In this sense, oxygen, water or propellants are key strategic players in human and robotic exploration. Numerous research lines nurtured by public agencies and industrial partners are currently set to tackle this challenging scenario, whose advances are expected to improve not only the efficiency of ISRU technologies but also the resource management strategies on Earth. Furthermore, interest in key technologies for planetary mining in space has exponentially grown over the last years, and legislation is being updated to regulate access of potential stakeholders to these resources. In this context, the MoonLiFe (Moon Living Fermenters) instrument aims to explore the use of lunar regolith as nutritional supplement for genetically-engineered microorganisms that produce valuable resources. As part of the European Space Agency (ESA) Biosciences Topical Team mission proposal, this demonstrator would explore, on board the European Large Logistic Lander (EL3), a system of interlaced microbiologically catalyzed reactions to produce targeted quantities of O_2, CO_2, and CH_4. To this end, the optimal concentration of lunar regolith would be studied on the surface, as well as the effects of the radiation and reduced gravity on the performance of this technology.

In this work, we shall present the main laboratory results from the development of this technology to:

1. Optimize the required lunar regolith concentration in the fermentation process and assist the adaptation of microorganisms to lunar-analogue environment using lunar simulant as nutritional supplement.
2. Validate the measurement and extraction process of gaseous resources for an engineering model development under the constraints of the EL3 ESA Topical Team biosciences mission proposal
3. Demonstrate Technological Readiness Level 4 for a potential payload onboard the International Space Station.