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IAF SPACE EXPLORATION SYMPOSIUM (A3)
Moon Exploration – Part 2 (2B)

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ALCHEMIST-ED: EUROPEAN EARTH-BASED DEMONSTRATOR OF PRODUCTION OF WATER FROM LUNAR REGOLITH

Abstract

In-Situ Resource Utilisation (ISRU) enables sustainability in space exploration through the harnessing of resources that are available in space in order to create products and services for robotic exploration, human exploration, and for commercial purposes. These natural resources can include regolith, minerals, metals, volatiles, water/ice, sunlight, vacuum, thermal conditions and even discarded materials/systems.

Oxygen is a resource of the utmost importance, and the most immediate candidate for ISRU. It serves as fuel oxidizer (and is therefore one of the resources brought to space from Earth in the largest quantities), and as part of the air and water used by crews to breathe and use in life support systems. Oxygen is abundant in the Lunar Regolith, and is also present in the form of volatiles in certain areas of the Moon.

As part of this project commissioned by the European Space Agency, an end-to-end laboratory system for water production from a lunar regolith simulant has been designed, developed and tested.

Hydrogen reduction of Ilmenite, the process of choice for the present effort, relies on the endothermal reaction of ilmenite feedstock with hydrogen in order to produce water, with the primary component for the reaction being FeO. After obtaining water vapor (mixed with hydrogen), thus removing the oxygen from the regolith simulant, this water vapor is condensed. In future developments, the water can be cleaned up, and can be split into reactant Hydrogen and Oxygen (with multiple ISRU applications).

The system has been tested with the most appropriate regolith simulants available, successfully obtaining water and achieving TRL4. The beneficiation and reduction elements are described, the test results displayed, challenges and future work indicated. Other related ISRU efforts in Europe are described.