Paper ID: 51061
student

IAF MATERIALS AND STRUCTURES SYMPOSIUM (C2)
Interactive Presentations - IAF MATERIALS AND STRUCTURES SYMPOSIUM (IP)

Author: Mr. Joshua Rasera
Imperial College London, United Kingdom

Prof. Jan Cilliers
Imperial College London, United Kingdom
Dr. Kathryn Hadler
Imperial College London, United Kingdom
Dr. Julien-Alexandre Lamamy
ispace, Inc, Luxembourg

THE BENEFICIATION OF LUNAR REGOLITH USING ELECTROSTATIC SEPARATION FOR SPACE RESOURCE UTILISATION

Abstract

Space Resource Utilisation (SRU) has the potential to be the breakthrough technology that enables the further exploration and habitation of space by humankind. The use of in-space materials to provide water, fuel and building materials reduces significantly the launch mass, therefore reducing dramatically the cost of space travel. The production of oxygen on the Moon using lunar regolith is the first step for SRU, since it can be used both to sustain human life and as fuel for further exploration.

Over 20 different reduction processes have been proposed in the literature for metal and oxygen production from lunar regolith, with hydrogen and carbothermal reduction receiving the most attention. In order to produce oxygen reliably and efficiently, a consistent feedstock is required. Each process has different feedstock requirements, including particle size and mineral type. Hydrogen reduction, for example, requires a high content of ilmenite in the feed. This intermediate stage of the SRU flowsheet, beneficiation, has received relatively little attention.

The separation of regolith by size and particle type presents numerous challenges due to the high fraction of fine particles, the range of different particle types present (glasses, mineral fragments, agglutinates) and the environmental constraints. On Earth, most mineral separations are carried out using water as carrier fluid, with many exploiting density differences between mineral types. A different approach is required for lunar SRU.

Electrostatic separation is one technology that does not require carrier fluid. Differences in electrostatic properties of materials can be exploited both for size separation and for increasing the concentration of certain minerals, such as ilmenite. In this study, the electrostatic properties of mineral components of regolith have been investigated and quantified. A free-fall experimental system was used to charge the particles, and the resultant charge was measured using a Keithley 6517B electrometer and Faraday pails. Narrow size fractions were tested to quantify the effects of particle size on charging efficiency. The effects of additional particle and environmental variables were studied. Based on the findings, a novel separation system was designed and tested. The optimisation of the separation system will provide a reliable feedstock to ensure the success of the downstream processes.