

PROGRESS ON ALUMINUM PRODUCTION FROM LUNAR REGOLITH SIMULANTS THROUGH MOLten SALT ELECTROLYSIS. J. N. Ortega¹, J. Smith¹, F. Rezaei, D. Bayless¹, W. Schonberg¹, D. Stutts¹, and D. Han¹, ¹Missouri University of Science and Technology, 1870 Miner Circle, Rolla, MO 65409. (Contact: handao@mst.edu)

Introduction: The LISAP-MSE project, funded through NASA BIG Idea Challenge 2023, investigates a process developed to produce aluminum metal on the lunar surface via molten salt electrolysis. This process is outlined in the flowchart as seen in Figure 1 below.

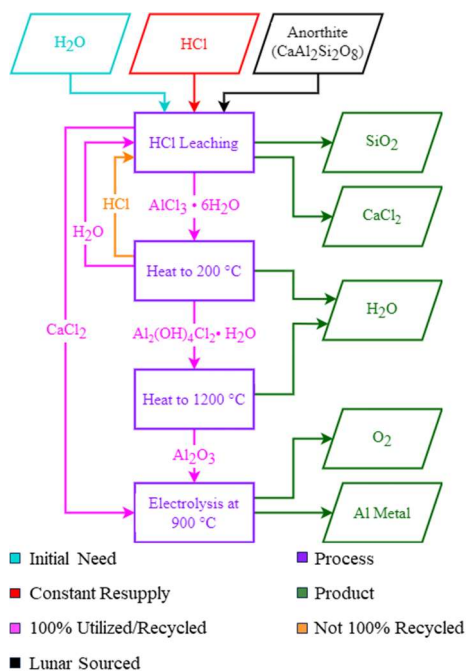


Figure 1: LISAP-MSE Flowchart

Methodology:

The LISAP-MSE project demonstrated the use of leaching, thermal decomposition, and electro-deoxidation to reduce lunar soil simulants into aluminum metal.

It was shown that with a steady supply of hydrogen chloride, this in-situ resource utilization (ISRU) method can supply almost all of the necessary materials consumed in electro-deoxidation to produce aluminum metal, oxygen, water, and silica from anorthite.

Results:

Leaching of the anorthite using hydrochloric acid was utilized followed by two thermal decomposition steps. Once the thermal decomposition steps were completed, X-ray diffraction (XRD) confirmed that approximately 37 percent of the crystalline solids present in the final product was alumina

with nearly all of the remaining material being calcium aluminates.

Then, the alumina was electrolyzed using a setup shown in Fig. 2.

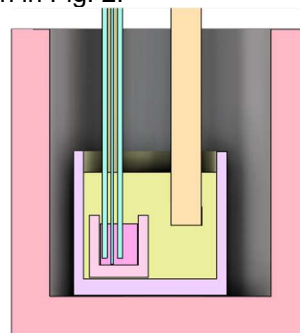


Figure 2: Drawing of Electrolytic Cell

Upon completion, metallic spheroids ranging from sub micron to 6mm were produced and recovered (Fig. 3).



Figure 3: Metallic Spheroid Products of Electro-Deoxidation

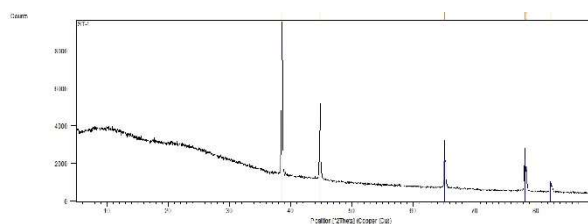


Figure 4: XRD Spectra

The metallic products were then analyzed using XRD. The XRD spectrum indicated that aluminum was the only detectable crystalline solid in the sample. As the detection limit for most solids is roughly 5 mass percent, it can be concluded that aluminum metal was not only produced in this process, but that the sample was approximately 95% pure.