IAF SPACE EXPLORATION SYMPOSIUM (A3)
Interactive Presentations - IAF SPACE EXPLORATION SYMPOSIUM (IPB)

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A SYSTEMS-LEVEL APPROACH TO EXTRACTING OXYGEN FROM LUNAR REGOLITH VIA MOLTEN REGOLITH ELECTROLYSIS.

Abstract

Molten Regolith Electrolysis (MRE) refers to the process by which lunar regolith is melted, and then electrolyzed, to produce oxygen and metals (Schreiner 2015, Sibille et al. 2019, Sadoway et al. 2019). With oxygen accounting for 80

The study results show that an MRE ISRU plant that weighs 1 tonne could be capable of producing 10 tonnes of oxygen per year from highlands regolith. The concept of operations are: 1) An excavation rover hauls regolith to the base of the plant and dumps it into a hopper. The IPE excavator is baselined. 2) A COTS-derived "spiral vibratory elevator" lifts the regolith from the hopper to the inlet of the reaction cell. 3) The regolith is poured into the cell. Batch processing is baselined for which we designed a novel opening/closing mechanism that is dust tolerant, and allows internal reactor pressure to be maintained. 4) The reactor melts the regolith as it separates the oxygen from the metals through electrolysis. 5) The oxygen is and then purified and cryogenically condensed and stored. The molten waste is extracted through a tap toward the bottom of the MRE reactor cell and centrifugally flung onto the Moon's surface to cool as spherules for collection and disposal. 6) The rover continues hauling regolith to the plant and removing slag, wirelessly recharging as needed.

The system requires 25 kW, several of the other smaller components of the system will require additional power that will require 2 kW. Power is provided by three 10 kW solar photovoltaic sources, operating 292-314 days of the year, augmented with regenerative fuel cells or batteries. We expect 70

Challenges and future work should include understanding melts and regolith dynamic behavior in lunar gravity; understanding the power requirements of cryogenic storage of O2; and the duration, timing, and power needs for surviving the lunar night.