Moon Rocks into Spacecraft LOX: Modernizing a Study and Comparing Reactions. C. J. Buelke[1] and J. G. Casler[1], [1]Space Studies, University of North Dakota, Grand Forks, ND 58203 (chris.buelke@my.und.edu, casler@space.edu)

Introduction: Many papers[1-3] in the early 2000's have been proposed and ideas conceived on how to get back to the Moon. There are numerous reasons for doing so, but one in particular focuses on obtaining resources in the form of liquid oxygen (LOX) to be used as fuel in spacecraft. Obtaining LOX can be achieved by simply melting and splitting harvested ice, or by extracting oxygen from minerals on the lunar surface. A NASA study conducted by Eagleworks in the late 1980's investigated the extraction of oxygen by reducing ilmenite with hydrogen. While the study showed promise, it is now outdated and could benefit from an update. This paper investigates the modernization of the Eagleworks study[4] and is compared with two other reactions to approach an optimal method for producing LOX. The scope of the study will feature a pilot plant with an annual production capacity of two metric tons of LOX. A comprehensive review of the current state of harvesting, benefitiation and extraction equipment, plus the support hardware required for them, is accomplished by analyzing both recently published literature[5-9] and the state of technological maturity of the hardware in question. Initial analyses indicate the three different reactions investigated each have advantages and disadvantages. For example, hydrogen reduction is the simplest process, requiring the least number of reactants. However, when considering stoichiometric ratios of reactants, it is the least efficient reaction per unit of ilmenite. On the other hand, carbochlorination is the most efficient but requires a more complex setup overall. Additionally, one reaction could edge out over another in terms of value depending on what byproducts are desired, or whether self-sufficiency is a hard goal. Other benefits resulting from the investigation include improved operational parameters for producing LOX, including a reduced[10] boil-off of the stored LOX product and an overall reduction in facility hardware mass.

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