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DEVELOPMENT AND PROPERTIES OF LUNAR REGOLITH SIMULANT GEOPOLYMER CONCRETE

Abstract

With the goals of maintaining a human presence on the Moon as part of the Artemis program, a resilient building material is needed that does not rely on supplies from Earth but utilizes the in-situ lunar resources instead. Geopolymer concrete is one of the feasible options for a construction material. An aluminosilicate glassy source (the lunar regolith) can be mixed with an alkaline solution (typically sodium silicate and sodium hydroxide) to make a geopolymer lunar concrete. Currently, the literature on geopolymer concrete with a focus on using the lunar resources is minimal. This has led to an in-depth investigation into the properties of a lunar regolith simulant geopolymer concrete. An important parameter in all concrete materials is the characterization of the raw components to inform the mixture design. While an obvious limitation of the work is not being able to use actual lunar regolith, there are four lunar regolith simulants being characterized in this work for use in the geopolymer concrete to prove the feasibility of the technology. Techniques for characterizing the lunar regolith simulants include x-ray fluorescence, x-ray diffraction, helium pycnometry, laser particle size distribution, and reactivity testing. Once the characterization is complete, a mix design can commence to prepare samples for compressive strength testing and microstructural analysis. Work not previously presented will be shown with regards to the development of the in-situ lunar concrete material. Results of the work are in strong alignment with the *2020 NASA Technology Taxonomy* materials area (12.1) and the in-situ resource utilization area (7.1). This endeavor will formulate and understand how a geopolymer concrete material can be utilized in the Artemis program to enable a sustained human presence on the Moon.