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ESTIMATION OF GEOTECHNICAL PROPERTIES OF ICY LUNAR REGOLITH IN CRYOGENIC ENVIRONMENTS

Abstract

In order to successfully perform activities on the moon, including in situ resource utilization (ISRU) and functional vehicle mobility, it is essential to understand the geotechnical properties of lunar soil. Compared to the environment on the surface of the Earth, the lunar surface has drastic differences that may significantly affect the geotechnical behavior of the lunar regolith. For example, NASA instruments indicate that the lunar surface experiences extreme changes in temperatures form -173 degrees Celsius (C) to 127 C, and the minimum temperatures on the southern pole and northern pole are -238 C and -247 C, respectively. According to the LCROSS data there is some uncertainty in the water content on the lunar surface: 5.6 2.9 percent by mass at the impact site. It is therefore important to measure the geotechnical behavior of the icy lunar regolith in cryogenic conditions. In this study a basaltic lunar simulant with water content of 6 percent by mass was used to predict the effects of changing cryogenic temperatures on the strengths of the icy lunar regolith, including uniaxial compressive strength and Brazilian tensile strength. The testing indicated that icy lunar regolith has behavior similar to that of soft rocks in cryogenic temperatures. In addition, it was observed that decreasing temperatures from -130 C to -190 C and strength are correlated for both compressive and tensile strengths. This paper will introduce the preparation of the icy lunar simulant samples, the testing procedures, the data analysis, and the implications of the results on the objective of estimating geotechnical properties icy lunar regolith.