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ANALYTICAL APPROACH OF THE BEHAVIOR OF LUNAR REGOLITH SIMULANT IN A VACUUM ENVIRONMENT

Abstract

This paper presents some experiment results and analysis of lunar soil simulant, FJS-1 and LHS-1, to clarify the behavior of them in vacuum environment. NASA's Artemis program aims to land a pressurized rover to the moon and operate mission with it. The surface of the moon is covered by a layer of fine dust which is known as regolith. The regolith dust that lifts during rover running can adhere to the equipment mounted on the vehicle, potentially causing significant impacts on its functionality. To mitigate the effects of regolith dust on the onboard equipment, it is crucial to understand the behavior of regolith particles that are lifted by the tires. To predict dust lift up by tire rotating, we are studying the use of the Discrete Element Method (DEM). Uniaxial compression test and dynamic angle of repose test were utilized to propose a parameter calibration methodology for applying to DEM. Design of experiments (DOE) was adopted to verify the influence of DEM parameter that each test has. These tests were performed not only in atmospheric conditions but also in a vacuum environment. Uniaxial compression test was performed in vacuum chamber and dynamic angle of repose test was performed with rotating drum which is able to keep vacuum inside. Uniaxial compression test revealed difference of unconfined yield strength (UYS) between vacuum and atmosphere, and also between FJS-1 and LHS-1. Dynamic angle of repose test revealed avalanche angle of each simulant as well as dynamic angle of repose, and also difference between vacuum and atmosphere. To the best of the knowledge of the authors, this is the first effort to make these test in vacuum condition with regolith simulant. The obtained results can be utilized for future studies on the interaction between the rover tires and soil.