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LUNAR REGOLITH SHRINKAGE CAUSED BY THE OF EXTRACTION OF WATER ICE

Abstract

The understanding of the geo-mechanical properties of rocks on Earth is fundamental for tunnelling and civil construction applications. Similarly, understanding the geo-mechanical properties of lunar regolith is fundamental for the success of exploration and human habitation on the Moon. Volatiles such as water ice are thought to exist on the Moon in a number of different ways, either as separate particles, intertwined with the regolith or in a combination (Cannon 2022). Techniques to extract water ice through heating of the regolith to a temperature that results in the sublimation of the water have been theorised (Sowers 2019, Cole 2022). Frost heave in soil or ground on Earth results from water within the soil freezing, causing the soil to swell as the water molecules freeze. The swelling of the soil causes the soil to exert forces onto all surrounding particulates, resulting in more significant stress when confined and expansion when unconfined. When the water ice is thawed, the opposite occurs, resulting in the shrinking of the soil—both freezing and thawing of soil results in stress changes within the soil (Liu 2017). For lunar applications, water exists as ice within the regolith. The impact of human activities on the lunar surface has the potential to change operational conditions. Changes to the thermal characteristics of the lunar regolith, whether from compacting the upper regolith to increase the thermal conductivity or heating of the regolith for extraction of volatiles. Using the same techniques to understand the heaving process in terrestrial soils, the effect of removing water ice from lunar regolith can be determined. This paper will discuss the impact of lunar regolith shrinkage along with experimental data when water ice is removed.