A Functional Comparison of Lunar Regoliths and Their Simulants

D. Rickman[1], J. Edmunson[2], and C. McLemore[3]

[1]National Aeronautics and Space Administration, Marshall Space Flight Center, 320 Sparkman Drive VP61, Huntsville, AL 35805; Ph (256) 961-7889; email: Doug.Rickman@NASA.gov

[2]BAE Systems, NASA Marshall Space Flight Center, Huntsville, AL 35812; Ph (256) 544-0721; email: Jennifer.E.Edmunson@NASA.gov

[3]National Aeronautics and Space Administration, Marshall Space Flight Center, VP33, Huntsville, AL 35812; Ph (256) 544-2314; email: Carole.A.McLemore @NASA.gov

ABSTRACT

Lunar regolith simulants are essential to the development of technology for human exploration of the Moon. Any equipment that will interact with the surface environment must be tested with simulant to mitigate risk. To reduce the greatest amount of risk, the simulant must replicate the lunar surface as well as possible. To quantify the similarities and differences between simulants, the Figures of Merit were developed. The Figures of Merit software compares the simulants and regolith by particle size, particle shape, density, and bulk chemistry and mineralogy; these four properties dictate the majority of the remaining characteristics of a geologic material.

There are limitations to both the current Figures of Merit approach and simulants in general. The effect of particle textures is lacking in the Figures of Merit software, and research into this topic has only recently begun with applications to simulants. In addition, not all of the properties for lunar regolith are defined sufficiently for simulant reproduction or comparison; for example, the size distribution of particles greater than 1 centimeter and the makeup of particles less than 10 micrometers is not well known. For simulants, contamination by terrestrial weathering products or undesired trace phases in feedstock material is a major issue. Vapor deposited rims have not yet been created for simulants. Fortunately, previous limitations such as the lack of agglutinates in simulants have been addressed and commercial companies are now making agglutinate material for simulants.

Despite some limitations, the Figures of Merit sufficiently quantify the comparison between simulants and regolith for useful application in lunar surface technology. Over time, the compilation and analysis of simulant user data will add an advantageous predictive capability to the Figures of Merit, accurately relating Figures of Merit characteristics to simulant user parameters.