Application of dust removal technologies for future lunar exploration

AAAR 28th Annual Conference

Presented by the **American Association for Aerosol Research**

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Application of dust removal technologies for future lunar exploration

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Abstract Number: 1440
Last modified: July 24, 2009

Preference: Poster Presentation
Working Group: Control Technology

Abstract

The purpose of our work is the individuation of a possible lunar dust filtration system that can be used on a lunar base or on a pressurized rover fore to the next return of humans on the Moon.
While efforts were made to remove the dust during Apollo missions by brushing the suits prior to reentering the lunar module or vacuuming once inside, a significant amount of dust was returned to the spacecraft, causing various problems. We are investigating on new and alternative methods that can be used to mitigate or remove the dust before it can enter in contact with human lungs or skin. Our attention will be focused on the regolith ultrafine particles (5 - 0.1 micrometer), because they are toxic for humans. There are documented effects of the regolith toxicity.

We are projecting a filtration system that should be compact and that can be used on a pressurized rover for human exploration of the lunar surface with 4 crew members that will live on this rover for missions from 14 to 37 days.
The idea is to prepare a first stadium with a series of cyclone separators that can easily filtrate particles up to 5 micrometer diameter. Then we are still investigating about a second stadium that could be constituted of an electrostatic or thermophoretic separator that can filtrate smallest particles: thanks to the first cyclonic stadium, the second one will not clog up due to the amount of dust, because the ultrafine particles (< 5 micrometer) are the smallest fraction. The system will end with a HEPA filter that will intercept the few left particles.
The system will also be as much maintenance-free as we can due to the adverse conditions in which it will operate.
We will conduct experiments to test the effective filtration action of our system. The experiments will be conducted using the lunar simulant JSC-1.

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