A DUST MITIGATION VEHICLE UTILIZING DIRECT SOLAR HEATING. E. H. Cardiff[1] and B. C. Hall[2], [1]NASA GSFC, Building 11 Room E135, Greenbelt, MD 20771. Eric.H.Cardiff@nasa.gov, [2]University of Maryland, College Park, MD 20742. hall@umd.edu.

Introduction: Lunar dust contamination is one of the paramount problems that need to be addressed before NASA returns to the surface of the Moon. One way to reduce the problem is to remove the source of the dust by paving the surface. A dust mitigation vehicle (DMV) is currently being developed at NASA Goddard Space Flight Center that utilizes only the native solar flux present *in-situ*. Concentrated solar flux has enough power to sinter and melt lunar regolith simulant [1]. This resulting surface provides a hard, dust-free platform for surface operations.

During the Apollo program, lunar dust was the cause of several technical problems; these included losses in radiator efficiency, loss of traction, damage to gauges and visors, seal contamination, and adverse health effects for astronauts. The primary dust transportation mechanisms were observed to be rover and foot traffic, and the ascent and decent of spacecraft. Natural mechanisms, including electrostatic levitation, have also been observed [2]. In order to mitigate the lunar dust, vehicles have been proposed that would 'pave' select areas of the lunar surface, specifically areas around habitats and landing pads [3].

Vehicle Design: The vehicle consists of a chassis that supports a ~1m lens used to focus the solar flux. The position of the vehicle and of the lens is determined remotely via the radio control system.

Design Variants. Several variants of the dust mitigation vehicle have been designed. The testing version, denoted 'variant A', is designed to opeated in the solar environment present at NASA GSFC (Fig. 1). Variant B was designed to operate where incident sunlight is nearly horizontal, such as is the case at the lunar poles. This variant features a large aluminum mirror that redirected the solar flux through the Fresnel lens. Preliminary work has begun on variant C, which would replace the planar mirror and Fresnel lens with a single low-mass parabolic reflector with a linear focus.

Figure 1: Variant A of the Dust Mitigation Vehicle.

Testing: A high-vacuum, large-aperture vacuum chamber was constructed in order to better simulate the lunar environment. The solar flux was focused through a large quartz window, heating the simulant inside. By manipulating the lens, the focal area and intensity can be altered – thus allowing characterization of the effectiveness of direct solar heating as a dust mitigation method. In the first round of testing, the lens was articulated to provide the smallest, most intense focus possible (~0.5 MW/m^2); a single pass was made on the sample, resulting in a linear area of melting and sintering (Fig. 2, left). Later tests aimed to sinter/melt larger areas (Fig. 2, right). Testing has yielded rates as high as 13 cm^2/min. Instantaneous as well as average rates were measured during the tests – the coverage rate was principally determined by the solar flux. Rate control was maintained by visual inspection of the regolith surface by the operator.

Figure 2: Two examples of sintered & melted lunar regolith samples (crucibles are 8.25" in diameter).

Discussion and Conclusions: Current testing has yielded rates that could produce a 100 m^2 landing pad on the Moon in as little as 55 days using the current DMV. In addition, this rate may be artificially low due to the lower solar flux present on Earth, as well as low-vaccuum conditions present during testing (1 E -3 torr). Additional work is required to further characterize and optimize the direct solar heating technique for dust mitigation.

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