LUNAR CONCRETE AS A MEANS OF REDUCING THE DUST HAZARD. J. C. Boulware[1] and F. Angomas[2], [1]Mechanical and Aerospace Engineering, Utah State University (j.c.boulware@aggiemail.usu.edu), [2]Civil and Environmental Engineering, Utah State University

Abstract: The threats and hazards associated with lunar dust are arguably the greatest challenge towards surface operations and a sustained presence on the Moon, perhaps secondary only to costs and launch capabilities. Designing components and machinery which shield the dust can also be costly and often may sacrifice capability. This paper proposes creating a thin layer of lunar concrete applied over a large area designated for base operations.

Typical terrestrial dust suppression consists of spraying water over dirt and dust kicked up by machinery either accidently or intentionally. Clearly this is not possible on the Moon, but lunar dust suppression is vital to sustained lunar presence. By sending a rover to pave a large area years before other equipment arrive, a firm, stable, and known platform would be established. Aside from the obvious benefits from lack of dust, this stable platform would also assist in landing/takeoff operations, mobile surface rovers, and could give scientists a wealth of data on regolith years before humans ever arrive.

Concrete engineering has evolved for thousands of years and is today taking advantages of breakthroughs in chemistry and structural dynamics. Since the return of the first lunar sample with Apollo 11, scientists have theorized creating concrete from regolith[1-10]. Many have succeeded, thus showing its feasibility, however most have had the intention of creating large, habitable structures for that sense never made it into application. Using concrete for a paved lunar surface greatly reduces the constraints, and the studies transition from feasible to practical.

Currently, the amount of water within the lunar surface is being investigated by satellites, astronomers, engineers, geologists, chemists, and potential astronauts among others. Clearly, water within the surface is the key to survival and a geographic location for the lunar base will be chosen based on water content. Therefore, it is safe to assume that the regolith to be converted to concrete will have ice within it in the form of crystals. A lunar rover sent to the surface could scoop up a small sample (~1ft^3), close it off into a sealed volume, pressurize it, heat it, mix it, and then release it back to the surface to let it dry. The rover may have to stay in place to maintain the pressure over the sample as it dries, but considering the timeline for establishing a sophisticated lunar base, this is minute.

Once finished, the rover moves onto the next spot and repeats the process. Running off of solar power and fuel cells, the rover could pave a large area almost autonomously for as long as needed; all the while sending back data on soil composition. Depending on the amount of water in the soil, additional feedwater could be required, however, it is also likely extra water could be extracted, absorbed and stored by the rover during the drying process. Other chemical admixtures may also need to be resupplied, however the volume fraction is small.

This idea was presented at the 2008 Lunar Ventures Student Business Plan Competition in Golden, Colorado and there was suggested as a topic of discussion for the Joint Annual Meeting of LEAG-ICEUM-SRR. It is hoped the idea will ignite a dialogue which leads to the next stage of development and the concept is carried out to synthesis.

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