

Electrostatic Separator for Beneficiation of Lunar Soil

Process complexity may be significantly reduced.

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A charge separator has been constructed for use in a lunar environment that will allow for separation of minerals from lunar soil. Any future lunar base and habitat must be constructed from strong, dense materials to provide for thermal and radiation protection. It has been proposed that lunar soil may meet this need, and sintering of full-scale bricks has been accomplished using lunar simulant. In the present experiments, whole lunar dust as received was used. The approach taken here was that beneficiation of ores into an industrial feedstock grade may be more efficient. Refinement or enrichment of specific minerals in the soil before it is chemically processed may be more desirable as it would reduce the size and energy requirements necessary to produce the virgin material, and it may significantly reduce the process complexity.

The principle is that minerals of different composition and work function will charge differently when tribocharged against different materials, and hence be separated in an electric

field. The charge separator is constructed of two parallel copper plates separated by a variable distance in a vacuum-compatible box. The top and bottom of the box are designed so that the separation and angle between the plates can be varied. The box has a removable front plate for access, and each plate is connected to a high-voltage, vacuum-compatible connector that connects to feedthroughs in a vacuum chamber. Each plate is respectively powered by positive and negative high-voltage regulated DC power modules. Tribocharged dust is fed into the top through a small hole, where it is subjected to an intense electric field generated between the plates. Positively charged particles will be attracted to the negative plate, while negatively charged particles will be attracted to the positive plate. Dust collected on each plate and on filter paper in the collection box at the bottom of the plates can then be weighed to determine the mass-fraction separation.

Because this device is meant for use in a lunar environment, much higher

voltages can be used where there is no gas breakdown. Special care was taken in the design of the high-voltage connections to the separator plates. Pure copper plates and other materials were chosen for their low outgassing properties. Modeling of particle trajectories within the plates showed that for the Q/M (charge to mass ratio) measurements of the charged particles in vacuum, a smaller, more compact separator can be used on the Moon compared to the same device on Earth. Another advantage of this design is that, in the lower gravity environment of the Moon, particles will spend more time falling between the plates. Again, a smaller device and higher voltages can use this advantage to increase the efficiency of the lunar soil beneficiation process.

This work was done by Jacqueline Quinn, and Ellen Arens of NASA Kennedy Space Center, Steve Trigwell of ASRC Aerospace, and James Captain of the University of Central Florida. Further information is contained in a TSP (see page 1). KSC-13007