



### **Centrifugal Sieve for Gravity-Level-Independent Size Segregation of Granular Materials**

**Centrifugal force can significantly shorten the time to segregate feedstock into a set of different-sized fractions.**

*John H. Glenn Research Center, Cleveland, Ohio*

Conventional size segregation or screening in batch mode, using stacked vibrated screens, is often a time-consuming process. Utilization of centrifugal force instead of gravity as the primary body force can significantly shorten the time to segregate feedstock into a set of different-sized fractions. Likewise, under reduced gravity or microgravity, a centrifugal sieve system would function as well as it does terrestrially. When vibratory and mechanical blade sieving screens designed for terrestrial conditions were tested under lunar gravity conditions, they did not function well. The centrifugal sieving design of this technology overcomes the issues that prevented sieves designed for terrestrial conditions from functioning under reduced gravity.

These sieves feature a rotating outer (cylindrical or conical) screen wall, rotating fast enough for the centrifugal forces near the wall to hold granular material against the rotating screen. Conventional centrifugal sieves have a stationary screen and rapidly rotating blades that shear the granular solid near the stationary screen, and effect the sieving process assisted by the airflow inside

the unit. The centrifugal sieves of this new design may (or may not) have an inner blade or blades, moving relative to the rotating wall screen. Some continuous flow embodiments would have no inner auger or blades, but achieve axial motion through vibration. In all cases, the shearing action is gentler than conventional centrifugal sieves, which have very high velocity differences between the stationary outer screen and the rapidly rotating blades. The new design does not depend on airflow in the sieving unit, so it will function just as well in vacuum as in air.

One advantage of the innovation for batch sieving is that a batch-mode centrifugal sieve may accomplish the same sieving operation in much less time than a conventional stacked set of vibrated screens (which utilize gravity as the primary driving force for size separation). In continuous mode, the centrifugal sieves can provide steady streams of fine and coarse material separated from a mixed feedstock flow stream. The centrifugal sieves can be scaled to any desired size and/or mass flow rate. Thus, they could be made in sizes suitable for small robotic ex-

ploratory missions, or for semi-permanent processing of regolith for extraction of volatiles of minerals.

An advantage of the continuous-mode system is that it can be made with absolutely no gravity flow components for feeding material into, or for extracting the separated size streams from, the centrifugal sieve. Thus, the system is capable of functioning in a true microgravity environment. Another advantage of the continuous-mode system is that some embodiments of the innovation have no internal blades or vanes, and thus, can be designed to handle a very wide range of feedstock sizes, including occasional very large oversized pieces, without jamming or seizing up.

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*Inquiries concerning rights for the commercial use of this invention should be addressed to NASA Glenn Research Center, Innovative Partnerships Office, Attn: Steven Fedor, Mail Stop 4-8, 21000 Brookpark Road, Cleveland, Ohio 44135. Refer to LEW-19033-1.*

### **Ion Exchange Technology Development in Support of the Urine Processor Assembly**

**Resins can filter gypsum out of urine, improving the water recovery rate.**

*Lyndon B. Johnson Space Center, Houston, Texas*

The urine processor assembly (UPA) on the International Space Station (ISS) recovers water from urine via a vacuum distillation process. The distillation occurs in a rotating distillation assembly (DA) where the urine is heated and subjected to sub-ambient pressure. As water is removed, the original organics, salts, and minerals in the urine become more

concentrated and result in urine brine. Eventually, water removal will concentrate the urine brine to super saturation of individual constituents, and precipitation occurs. Under typical UPA DA operating conditions, calcium sulfate or gypsum is the first chemical to precipitate in substantial quantity. During pre-flight testing with ground urine, the

UPA achieved 85% water recovery without precipitation.

However, on ISS, it is possible that crewmember urine can be significantly more concentrated relative to urine from ground donors. As a result, gypsum precipitated in the DA when operating at water recovery rates at or near 85%, causing the failure and subsequent re-