The sky isn't the limit for global sieving and filtration specialists Russell Finex

Following successful trials on the size sorting of 'lunar soil' by the University of Wisconsin – Madison, NASA purchased a Russell Compact Sieve® to continue exploration work investigating the feasibility of mining on the moon.

For over 20 years it has been known by scientists that lunar regolith or 'lunar soil' contains valuable resources that if mined and processed effectively, could provide a number of important uses on Earth. One of the trace constituents of lunar regolith is helium-3, which can be used to produce energy. Extensive research has been conducted to show how helium-3 can be used in a nuclear fusion reaction with deuterium. 1kg of helium-3 burned with 0.67kg of deuterium can produce approximately 19 megawatt-years of energy output (source http://www.asi.org/adb/02/09/he3-intro.html). To put this in perspective, this offers an energy resource 10 times more valuable than all the fossil fuels currently being mined on Earth put together.

In addition to helium-3, silica oxide is also present and following mineral extraction, oxygen can be obtained for use in life support and propulsion systems. With all of this potential, coupled with increasing pressures to seek alternative energy resources for generating electrical power on Earth, interest into the feasibility of mining on the moon has increased. In January 2010, the University of Wisconsin – Madison carried out new research looking into the feasibility of using existing mining technologies used on Earth within lunar gravity with a particular interest into the size sorting of the soil. "One of the keys to efficient extraction, is to ensure the soil can be sieved removing oversized and undersized particles to obtain the narrowest particle size distribution possible", says Nathan Wong, project team leader and senior engineering mechanics and astronautics student. "Therefore, our primary focus was to find out whether a mechanical sieve used on Earth for size sorting powders & liquids could perform as effectively in lunar gravity".

With one trip to the moon costing an estimated $3 billion, travelling to the moon to carry out the

Figure 1. The test-rig containing the Russell Compact Sieve® to carry out the experiments

- With its compact design the sieve fits neatly within the test-rig
- No tools required makes the sieve quick to strip down
- Minimal parts makes it easy to clean

experiments was not an option. This meant that Wong and his team of 10 students had to tackle three main challenges. Firstly, they needed to simulate lunar gravity. This would be achieved using a specially adapted aircraft named 'G-Force One', officially nicknamed as the "Weightless Wonder" by NASA but more widely referred to as the "Vomit Comet". The craft briefly provides a weightless environment in which research can be conducted. To achieve this the plane starts at an altitude of 20,000ft, it then climbs at an angle of 45 degrees to an altitude of 32,000ft at which point it reduces thrust and pitch angle; during this 1/6g manoeuvre the lunar gravity will be simulated for approximately 25-30 seconds. This is when the sieving experiment would need to take place.

The second main challenge was to obtain a suitable sample of lunar regolith for the experiment. This was supplied by Orbitec, a national leader in aerospace research and development who were able to produce a lunar regolith simulant – a synthesized, terrestrial material to replicate that of soil found on the moon.

The third challenge was to find a suitable sieve that could size sort lunar particles both on the ground at the airbase (to provide a control comparison) as well as in lunar gravity. Due to space limitations the sieve needed to be small and compact as well as simple and easy to clean during flights. For this, the research team contacted Russell Finex. After careful consideration, a Russell Compact Sieve® was chosen due to its straight-through design. This would allow the unit to fit neatly into the purpose built test rig which for containment purposes was fully sealed prior to being placed in the aircraft (see figure 1). "The regolith simulate is a very fine powder and therefore the sieve unit must be easy to clean." Wong explains, "having a quick release clamping system along with very few components makes the sieve a lot easier to clean between test flights".

With the three main challenges resolved experiments could commence. To ensure results produced representative data a controlled environment within the test rig was required. Therefore, 12 small canisters were charged with equal amounts of lunar regolith simulant and placed directly above the sieve. Then, each time the plane achieved lunar gravity, a canister of lunar regolith would be released into the sieve. Empty canisters underneath the machine would collect the sieved product while particles above 75 micron were discharged from the sieve and collected in a separate container. The complete system was connected to a computer enabling the research team to release the lunar regolith simulant at the desired time as well as being able to control the feed-rate. A video camera was also installed inside the sieve to record product flow characteristics.

With the first phase of the trials complete, the results of the sieve trials provided some promising findings, suggesting that the Russell Compact Sieve® could be used successfully within lunar gravity. The video footage also showed that the product flow within the sieve was very similar when compared to the same sieve trials carried out at the airbase. "The results were encouraging and signify an early indication that one-day sieving on the moon could be possible. It is hoped that further experiments will be undertaken in the following years." Wong concludes, "It was good to establish connections between NASA, the University of Wisconsin – Madison and Russell Finex. Our relationship with Russell Finex will be something we can look on in the future."

Following the success of this research NASA purchased a double deck Russell Compact Sieve® (see figure 2). With this machine they aim to continue the research that the University of Wisconsin – Madison started.

Figure 2. A cross-sectional view of a typical Russell Compact Sieve®

For over 75 years Russell Finex has manufactured and supplied filters, screeners, and separators to improve product quality, enhance productivity, safeguard worker health, and ensure powders and liquids are contamination free. Throughout the world, Russell Finex serves a variety of industries with applications including coatings, food, pharmaceuticals, chemicals, adhesives, plastisols, paint, metal powders and ceramics.