# Vibrating equipment and the development mindset

*MechChem Africa* visits the Spartan facilities of Kwatani and talks to COO, Kenny Mayhew-Ridgers, about the company's industrial offering, the research and development mindset and some key aspects of vibrating product design.

"While mining is still the biggest focus of our business, about three years ago we began to also focus on the industrial side of material sizing, which is now a fast growing area for us," begins Mayhew-Ridgers.

As well as including much finer screening requirements, the industrial side is often associated with food grade materials and standards. "We typically look at using stainless steel for the aperture screens and contact materials. Powders and dewatering applications are common."

He cites Rooibos tea as a typical example, where an evenly fine size distribution is required to give good diffusion and to remove any non-leaf material. "Sugar and salt are other examples, where all the granules must be fine enough to pour without containing powders. Good quality products have particles of very close to equal sizes, carefully packed for easy use and less mess," he says.

"Then there are the powders, such as limestone, which is used, for example, as an additive to chicken feed to strengthen the bones of heavy broilers," Mayhew-Ridgers tells *MechChem Africa*, adding that another industrial application is sizing the additives used in paint manufacturing.

"The requirements of these screens are very different to those in the mining industry and understanding them is another angle for us compared to our core mine screening strength.

Kwatani manufactures two types of industrial screens, one being circular and the other rectangular. The circular screen is driven by an unbalanced motor and exciter mounted on the vertical axis of the machine. This creates a circular vibrating motion in the horizontal plane. While the fines pass through the aperture's mesh, the 'overs' are thrown outwards by centrifugal forces, over the edge of the screen and into a separate chute.

These are low profile machines that are ideal for smaller scale batch sizing of material in the 5.0 mm to 100 µm size range. "This one has a rotating scraper underneath the mesh to prevent the screen from clogging, which is a particular problem. It is also possible to place several different screening rings below each other to sort the material into several size fractions," Mayhew-Ridgers says.

"If the material is very fine, in the 100 µm range for example, then even the weather will affect the separation accuracy. When tested on a dry day, it might work perfectly, but when the humidity is high, the fines start to bind together and the screening process may significantly be compromised. So, for some applications, we need to install the solution into a controlled environment," he advises.

Generally speaking, rectangular industrial screens are better suited to finer materials. "These also vibrate in the horizontal plane, with an eccentric shaft creating a to-and-fro movement along the length of the screen. Balls running underneath the screen mesh are bounced against the screen to shake loose material blocking apertures and a slight decline promotes forward movement of the material," he explains.

The in-line motion of the screen enables a longer screen length to be used, which, compared to circular screens, can offer better screening efficiency for finer materials.

"In both of these systems, the challenge is to keep the mesh clear and clean," he notes. "In our test laboratory, we have test screens and apertures based on both technologies for sizing material from 12 mm down to 45 µm," he notes, adding that this is as fine as the muslin cloth used to make cheese.

"We strive to help manufacturers and industry explore different aperture mesh and to test which technologies perform better on the materials they are sizing or using. This helps us to design and manufacture customised solutions optimised for a specific application," Mayhew-Ridgers informs *MechChem Africa*.

## A flexible mine screen test rig

The most recent addition to the Kwatani laboratory is a test plant for mining applications.

*Above:* Kwatani low-profile circular industrial screens use an unbalanced motor and exciter mounted on the vertical axis of the machine to create a circular vibrating motion in the horizontal plane, which moves 'overs' outwards.

*Above left:* The test screen in the Kwatani laboratory is longer relative to its width than a commercial unit to give flexibility when unfamiliar applications are encountered.

*Left:* Kwatani has developed its own motors and exciters. By moving the terminal box so that it is never on top and incorporating a double sealing system in the enclosure, cable gland leaking and rain or process water ingress problems can be overcome.

*Right:* Torsional springs can be mounted directly onto the support frame and, because they prevent sideways movement, they keep the machine in-line and more stable during start up and stopping.

"This is a vertical vibrating screen for sizing rock of up to 150 mm – and by using modular screen panels with apertures down to 0.3 mm, we can also do dewatering," he explains.

"This is a fully adjustable test screen," he continues. "Several things have to be taken into account when it comes to screening: the drive angle of the exciter beam, which is currently set at a 50° angle from horizontal; the screen or deck angle, currently horizontal; the modular and replaceable screen panels with their different apertures; and the stroke and vibration frequencies. All of these are variables in this system," he explains.

The deck angle can be dropped or raised from a 10° incline to a 17.5° decline in steps of 5°, simply by shifting the bolts to new positions on the rear legs. "Inclines are usually used for dewatering, while the usual size screening angle is horizontal or a 5° decline. But we know that every application is different, so we wanted to create a test screen to better establish what works with specific mineral mixes," says Mayhew-Ridgers.

"Superficially, the apertures of the modular screen panels govern the sizing, but every application is unique. There may be a lot of near-size product close to the shape and size being targeted. These can easily cause blinding. There may also be some carrot shapes that will hang in the cavity. This vibrating screen enables us to vary all of the machine parameters so as to determine the optimum settings for specific minerals from a particular mine, quarry or crushing plant," he adds.

The stroke size or linear movement is adjusted by changing the weight positions relative to each other on the exciter motors. "We have also included a variable speed drive (VSD) to enable us change the speed of the motor, which governs the vibration frequency. For smaller-sized material, a higher frequency and lower stroke tends to work better, while with larger rocks, a slower vibrating speed with bigger stokes is required," he says.

A second VSD is also used for the material feed from the hopper so that the screen sizing and material feed speeds can be optimally balanced.

"With a screening area of 3-foot wide and 8-foot long, the unit is also longer relative to its width than a commercial unit would be, just to give us flexibility when we encounter unfamiliar applications. Once we have determined optimum operating parameters for the set point required, we can easily replicate these in a customised commercial unit," he notes.

Pointing to the exciter beam, he says that, based on years of experience, Kwatani has developed its own motors and exciters. "We have found that the terminal boxes on the motors can become a problem if the cable gland is on top of the motor. Over time the gland seals can wear due to vibration, dust and grit ingress, allowing rain or process water to get into the terminal box. By moving the terminal box so that it is never on top and incorporating a double sealing system in the enclosure, these problems can be overcome," he reveals.

The isolators are another key design choice for vibrating screens. "These machines are attached to rigid frame structures on the floor, but they have to be allowed to move relative to that frame. There are three basic isolator types to enable that movement: coil springs, torsion springs and rubber buffers.

"On the test rig we are using torsion springs in the four corners for most of the isolation, supplemented by rubber buffers in other areas.

"Coil springs typically give the best isolation, because their stiffness is relatively linear across the stroke range but rubber buffers, although non-linear, offer better load handling capacity and damping. Stopping and starting vibrating equipment needs to be carefully controlled and while coil springs can be successfully used, we represent a very successful torsional spring design.

"These torsional springs can be mounted directly onto the support frame and, because they prevent sideways movement, they keep the machine in-line and stable during start up and stopping. This means that the exciter motors synchronise much quicker.

"On a comparative test using two coil springs on each corner, the test screen took 50 seconds to stop. With a single rubber buffer, we stopped it within 21 seconds, but with torsional springs, the machine can be safely stopped in 12 seconds," he informs *MechChem Africa*.

"For cost-effectiveness, however, we tend to adopt a hybrid approach, with torsional springs providing the stability and coil springs adding load capacity," he adds.

"We are a local manufacturer of some of the strongest and heaviest vibrating screens ever built. We now also have expertise in the industrial sector for smaller units, for foods, powders and a host of manufacturing material sizing and sorting applications.

"We continue to have a development mindset, and our Kwatani laboratory is testament to that. It gives us the capability to test different materials and to develop new equipment ideally suited to beneficiate new material resources," Mayhew-Ridgers concludes. ❑