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AUGUST 2024

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Shaking Out the Sand

Quality Vibration And The Dewatering Process.

By Larry Horrie

After fresh water, sand is the most widely consumed natural resource on the planet. The annual global consumption of sand is estimated to be >15 billion tons, with a respective trade volume of $70 billion. [1][2]

It is valued for different grades and qualities due to its wide application across nearly every manufacturing, scientific, and construction process from laser lenses to microchips to cement.

Whether extracted from a dry inland quarry or underwater resource, impurities and biological material must be removed, otherwise the sand can contaminate the end process. Removing impurities from the product further saturates it, causing it to enter the processing and drying system as a slurry.

Liquid adds tremendous weight and sand is generally sold as a commodity with a very low moisture level. Although some end users don't require dried sand, most do, so the water needs to be extracted.

Inland sand is extracted and placed in stockpiles for transport to the processing plant.

To remove water, the sand is passed through a screening process involving industrial vibrators. The volume and sustained operation of the process can put a lot of strain on the vibrators, so it is not uncommon for them to break down. This is accompanied by downtime and lost production which makes lead time in being able to replace units and reliability of the vibrators extremely important.

This article walks through the process of one of the largest sand mining operations in the Southern United States and discusses the impact that quality vibration has on the operation.

Clean Sand Makes Strong Concrete

The first stop for mined and quarried sand is the sanitization plant where the sand is washed of impurities including clay, silt, salts and mica, as well as organic matter, which can propagate the growth of bacteria.

Along with improving the adhesive quality of the end product, the removal of organic impurities and bacteria can eliminate odor, reduce the potential for illness and remove other elements that can hinder the curing of concrete or mortar, weakening the final product.

For construction purposes, 75% to 85% clean sand is sufficient enough for cement.[3] By having a larger surface area than sand, clay creates a filmy barrier around sand particles, which prevents or reduces the adhesion of cement by increasing the amount of water needed, lessening the strength of concrete or mortar.

A high presence of mica can have structural implications due to the smooth surface of the particulate. Because of the corrosive effect on reinforcement, the sand also needs to be tested periodically for coal residues.

Amounts of Impurities in Processed Industrial Sand

Source: Acta Geotechnica volume 16, pages1127–1145 (2021)

Although most purified sand is used for voluminous applications – cement, golf courses, playgrounds, etc. – some industrial applications such as the manufacturing of optical lenses and microchips require a greater purity devoid of iron, titanium and aluminum oxides. This detailed processing may not be done by the mine or quarry but is often performed by a specialist entity catering to specific industries.

Dancing Sand

Leaving the sanitation process as a slurry, the sand is conveyed to hoppers connected to rubber tubes, which direct the gritty flow to the screening racks. Several tons per hour of heavy wet granules are vibrated across the screens, so the water extraction process needs to be fast to meet production demands. It is then dropped on a conveyor to be transported to either the drying kiln or the outdoor storage area.

The processing plant that services the sand mine has three dewatering racks with sloped screens covered with a specially made porous cloth that allows moisture to pass through, but none of the fines.

The racks sit on spring stabilizers to absorb the force output of the two high-powered electric vibrators mounted on top that counter-rotate to create a linear force through the rack's center of gravity. With enough torque to move tons of wet material up and down, the vibrators cause the sand to "dance" down the screen with the help of gravity.

The wet slurry jumps across the screen as moisture drains through the fine mesh cloth.

Each impact against the screen cloth forces water from the material and through the screen openings, which then runs into troughs and is collected for proper treatment and disposal. By the time the material skips down to the end of the screen and discharges onto the next conveyor, it has the consistency of a dense meal.

Breakdowns, Downtime and Maintenance

The intense demand and stress on the vibrators can be punishing, sometimes causing them to break down. To shut down a single rack translates to a proportional loss in production, so to avoid downtime, operators have the option of recalibrating a single vibrator when backup units are unavailable.

In this instance, although production is reduced considerably, the material still passes slowly through the process, releasing considerably less water and putting a tremendous strain on the shaker screen and the single vibrator, reducing their operational life.

Maintenance on the unit is also a burden and a possible safety concern. When one breaks down it must be sent to a local motor repair shop to be fixed, which can take weeks. Weighing more than half a ton, a crane is used to remove the vibrator and load it for transport. Removal requires several employees, and working around unsupported heavy equipment can be hazardous.

The difference between the two units is apparent in the design.

"When the customer contacted us, it was one of those impossible situations with a screen out of commission, no backups left, the OEM unable to respond to their needs and nothing returning from the repair shop for weeks," said Grant Burton, vibration account manager for Martin Engineering. "The sand mine participates in Martin's Mr. Blade program for conveyor cleaning equipment and service. Through this program they'd learned we also manufacture industrial vibrators and could get a replacement unit on a hot shot truck right away, so they decided to try our product."

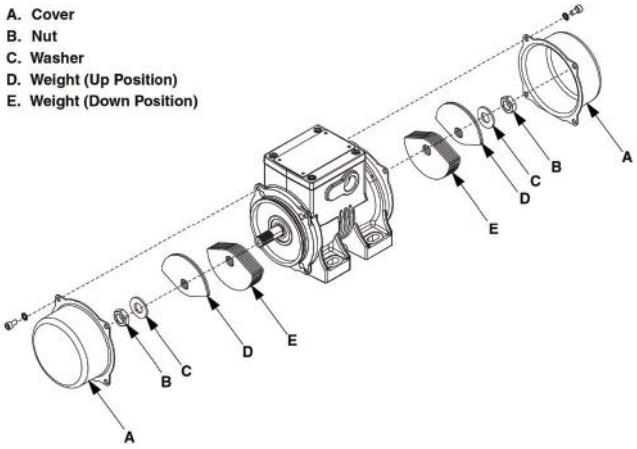
Counter-Rotating Forces

Martin Engineering technicians matched the type of electrical vibrator with the correct output to that of the previous manufacturer. "OEMs often promote the myth that only their equipment will effectively operate their machine when the

reality is that all another vibrator needs is similar horsepower, speed and torque," Burton explained. "Properly wire the vibrators to counter-rotate and match the force output by adjusting the eccentric weights, and the two units will naturally synchronize. By doing this we found that our MM-series vibrators fit nicely within the customer's existing parameters."

With two sets of weights mounted on each end of the motor's shaft, as the vibrator shaft rotates, the unbalanced mass of the eccentric weights is used to generate centrifugal force. [Fig. 1]

To produce the proper force in a single vibrator, the two sets of weights can be adjusted so they are a mirror image. When synchronizing two vibrators, it is important to ensure the vibrators are counter-rotating and that the weights are properly adjusted to the same value. Once mounted to a piece of equipment, any adjustment made to one unit must also be done to the other.



While the internal components may look slightly different, the operational concept is largely the same.

Although the function and general design are similar to competitor units, what sets the Martin Engineering designs apart is durability, service life and the fact that Martin is the only U.S. manufacturer that offers a three-year guarantee on its continuous-duty, high-output/low-frequency industrial vibrators.

Engineered to stay running for long periods under punishing conditions, the Martin MM-Series Electric Screen Vibrators use only the highest quality components, such as SKF or FAG bearings with a C4 clearance and Kluber grease. A 10- to 11-hp (7.5 to 8.2 kW) motor produces a centrifugal force of 31,000 lb. (14,061 kg). The unit incorporates O-ring seals and machined surfaces for a dust-tight/water-tight enclosure. The extended equipment life and reduced maintenance requirements deliver a fast return on investment due to reduced downtime.

The glossy finish helps protect the unit from dust, moisture and other elements.

Results

The vibrator was delivered and mounted more than a week faster than expected, bringing the operation up and running to full production. The customer replaced the old units as they broke down with Martin Engineering MM-Series vibrators in two of its plants. Having already installed 10 more units since the initial order, operators were impressed with the quality, service and long life of the equipment.

"It goes beyond just initially helping us get back to production," a manager close to the project said. "The vibrator lasts longer and Martin is more responsive to our needs because lead time is so crucial to our operations. This is the level of service and type of relationship we extend to our customers and it's nice to have partners who demonstrate the same values."

Resources

[1] "Sand, rarer than one thinks," UN Environmental Programme - Global Environmental Alert Service (GEAS). Nairobi, Kenya. March, 2014 https://wedocs.unep.org/handle/20.500.11822/8665.

[2] M. Garside, "Worldwide industrial sand and gravel production 2022, by country", Statistica. March 2023 https://t.ly/ZyCf.

[3] "7 Types of Sand Used In Construction", Builder Space. March, 2023. https://www.builderspace.com/types-of-sand-used-in-construction. ▲

Larry Horrie joined Martin Engineering in 2010 and has been in integral part of the Vibration division ever since, extensively writing and performing training on vibration. Along with overseeing a variety of sales channels within a geographic territory, he manages existing distribution, key resale accounts, OEM accounts and direct end-user accounts. Prior to joining Martin Engineering he worked as a territory manager and production control manager, with extensive experience in logistical and distribution networks for industrial resources.