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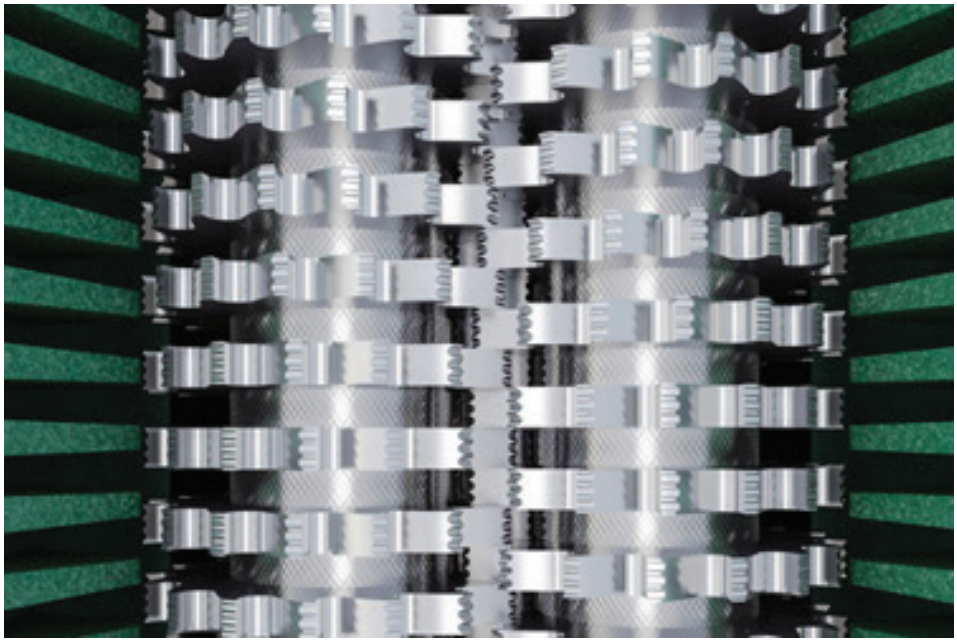
ARTICLE

The Importance Of Grinder Design In Optimal Pump Protection

Modern grinders provide a valuable insurance policy to protect municipal wastewater pump stations from the influx of materials now flowing into the waste stream.



For pump station protection, two-shafted grinders are likely the technology that makes the most sense. This equipment style, which is based on low speed and high torque, offers the necessary power to tackle the wider variety of solids that are now finding their way into waste streams. This includes rags and towels, wipes (both those marketed as flushable as well as those that are not), plastics, wood products, metal products, and just about anything else that can be flushed down a toilet or drain.

By breaking down solids into a manageable size, grinders allow pumps to work more efficiently and decrease or prevent the unwanted downtime of cleaning or repairing a clogged pump. While many grinders may look similar, not all grinders are designed the same. Here is a list of design features that are important to consider when making a grinder investment.

Examining The Technology

In other industries, grinding equipment is used to pulverize solids. In wastewater applications, meanwhile, grinders reduce solids with counter-rotating shafts and cutting blades, similar to having a giant pair of scissors in the waste stream. There are four main parts to the design of a wastewater grinder — motor drive, shafts and mechanical seals, cutters, and side rails — and each has nuances that impact performance.

Motor Drives – The motor drives, usually a motor and speed reducer combination, supply power to the grinder to process the tougher solids and break them down. Having enough horsepower to generate the required torque, coupled with a speed reducer that can handle the shock loads by distributing the load across multiple lobes instead of transmitting the torque through a single gear tooth, is key to reliable performance. In most North American non-combined sewer waste streams, a 5-HP motor coupled with a 29:1 speed reduction provides enough torque to shred the solids to a reduced non-detrimental size.

Because many, if not most, pump stations are subject to flooding, the motor's ability to operate in these conditions is also crucial. While there are extended shafts that can lift the motor above the flooding, or a hydraulic torque motor that can operate submerged, the most economical solution is an electric motor that can operate continuously in air without overheating and also remain submerged for prolonged periods. When reviewing these motors, look for designs that are specifically intended for this type of operation. Avoid unmodified submersible motors that were originally designed to remain submerged continually and could experience overheating issues when operated in elevated temperatures continuously in air.

Shafts And Mechanical Seals – Transmitting the torque to the cutters are the two counter-rotating shafts along with the mechanical seals on either end of the shafts. The seals protect the bearings and properly support the shafts from excessive shaft deflection, which can lead to failure and is common with cantilevered designs. Rotating the shaft at differential speeds is needed to create the tearing of the solids as they pass through the cutting chamber. It also prevents pull-through of solids and determines the effective cleanout rate of the material. Most grinders sacrifice the cleanout capabilities for a 2/3 ratio differential for the tearing.

JWC Environmental offers a patented ratio and design that provides optimal tearing action and promotes immediate cleanout of materials using a cutter tip speed velocity on both shafts that scrapes the solids from the opposing shaft. This allows the grinder to handle a higher loading of solids more frequently and supports longer cutters by removing the abrasive solids from the cutting chamber more rapidly. Consideration should also be given to maintenance-free mechanical seals that do not require continual lubrication and can operate dry or submerged with equal performance.

Cutters – The ultimate driver of the grinder's performance, and where you find the greatest discrepancy between grinder designs, is the cutter. The number and shape of the cutter teeth, along with the thickness of the cutter, directly impact the particle size of the discharge from the grinder, and the intermeshing tolerance of the cutters is key to creating a shearing surface that handles very thin materials. Individual cutters that are surface ground to produce a precise overlap with a cutter from the opposing shaft cutter can shear these thin materials, such as cellophane.

The individual cutters also allow for customization of the cutting by stacking different cutter geometries and patterns to optimize the performance. Monolithic designs of cutters combining six or more cutters into a single part, often touted for maintenance speed, compromise the shearing ability of the cutter and lose flexibility in configurations.

While frangible material will shatter and easily break down on impact with the cutters, resilient material will stretch and pull, creating a strip. If the material is highly resilient, longer strips can be created and can combine with hair and grease to create a new clogging issue when reintroduced into a waste stream. Cutter solutions that can effectively break down resilient materials such as disposable and non-disposable wipes should be considered in applications experiencing repeated clogging at the pump station. JWC's solution is its Wipes Ready® cutter, which employs a patent-pending design of a cutter tip with serrations that puncture and weaken the wipe.

By puncturing wipes as they pass through the grinder and then using the natural tearing action of the counter-rotating shafts, Wipes Ready technology weakens the material and produces confetti-like pieces that inhibit reweaving with hair and grease.

Side Rails – Because 99 percent of the waste stream is water, the grinder's ability to handle a higher capacity of waste stream without creating high head loss that will cause material to settle out should be reviewed. Static side rails that use slots to allow the water to flow through, but block solids that are too large to pass, are common to most designs. However, designs that produce less hydraulic loss provide higher capacities and sometimes allow for a shorter, more economical grinder to be used in the application. JWC's Delta P side rail provides the highest hydraulic performance on the market. Its patented design creates a pressure gradient that moves solids toward the cutters from processing, keeping the slots open and free to pass flow without degradation like other designs.

When the flows exceed the capacity of the static side rails, dynamic side rails provide increased capacity. These designs use a rotating perforated screen to filter the majority of the water through the screen and divert the solids to the cutters. This provides a very economical and proven solution to larger pump stations. JWC's Channel Monster® products have been the preferred solution for these pump stations for over 30 years.

The bottom line is that grinders provide the best insurance policy to protect the wastewater pump and other downstream equipment from clogging and damage. Still, technology options within the design require careful investigation and consideration for the product that will best provide the reliability, performance, and support to effectively meet and exceed the needs of an application. ■