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HOW CUTTER CHOICE AND PLACEMENT IMPACT WASTEWATER GRINDER PERFORMANCE

When it comes to choosing the right tool for the job, a dual-shafted wastewater grinder is a good option for protecting against clogged lift pumps and overflowing manholes. However, not all tools have the flexibility to be configured to optimize their performance for the task at hand. Here is why it pays to evaluate the wastewater flow approaching the grinder as well as the cutter configuration best suited to deal with it.

A Quick Look at Cutting Dynamics

While there are multiple facets to overall grinder selection, one of the most important considerations is the cutter itself. After all, the reason for purchasing a grinder is to reduce troublesome solids and keep equipment running and protected. Here are some key performance characteristics to consider when evaluating cutters for municipal sewer grinders:

Physical Action. Dual-shaft grinders with interleaved counter-rotating cutters are used to shred wastewater debris in order to protect downstream pumps and minimize clogging issues throughout the wastewater infrastructure. Each cutter also carries with it characteristics optimized for abrasion resistance, impact resistance, and corrosion resistance. Ideal cutter construction — number of teeth, tooth profile, thickness, metal composition, etc. — changes with the requirements of the application at hand. For example, designs required for pulverizing small rocks, gravel, and other solid debris will differ from designs that work best for softer, more flexible debris such as 'flushable' wipes, rags, or other stringy materials (Figure 1).

To optimize grinder performance, look for the ability to configure the cutters throughout the cutter stack so that they are matched to the waste stream's characteristics. For instance, the lower cutters should be optimized with great resistance to abrasion and impact to deal with heavy and large solids, while the middle cutters should be able to break down resilient and fibrous material with a balanced combination of abrasion, impact, and corrosion resistance. Some challenging waste streams may even require that the uppermost cutters deal with similar solids as the middle section but have a much higher resistance to corrosion.

Dimensional Tolerances. Anyone who has ever tried to cut resilient material with a loose pair of scissors knows how easy it is for flexible materials to wedge in between the blades instead of shearing cleanly. Likewise, cutters with larger gaps across their shearing surfaces compromise the ability to shred those resilient materials, creating the potential for long strands to escape through the gaps and reweave themselves into ropes that can clog pumps, screens, and other downstream structures.

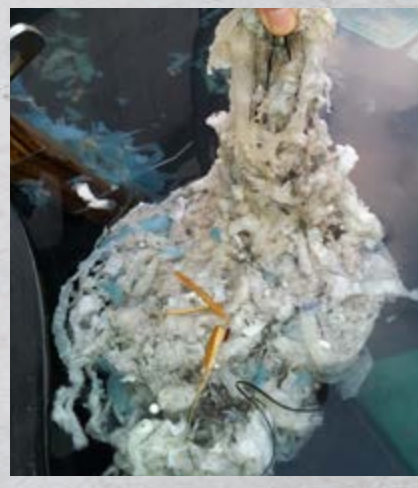

Figure 1. The tendency of long, stringy fibers and hair to weave themselves into long ropes or mats that clog pumps underscores the importance of sewer grinders and cutters that can chop debris into small pieces without letting long strands slip through.

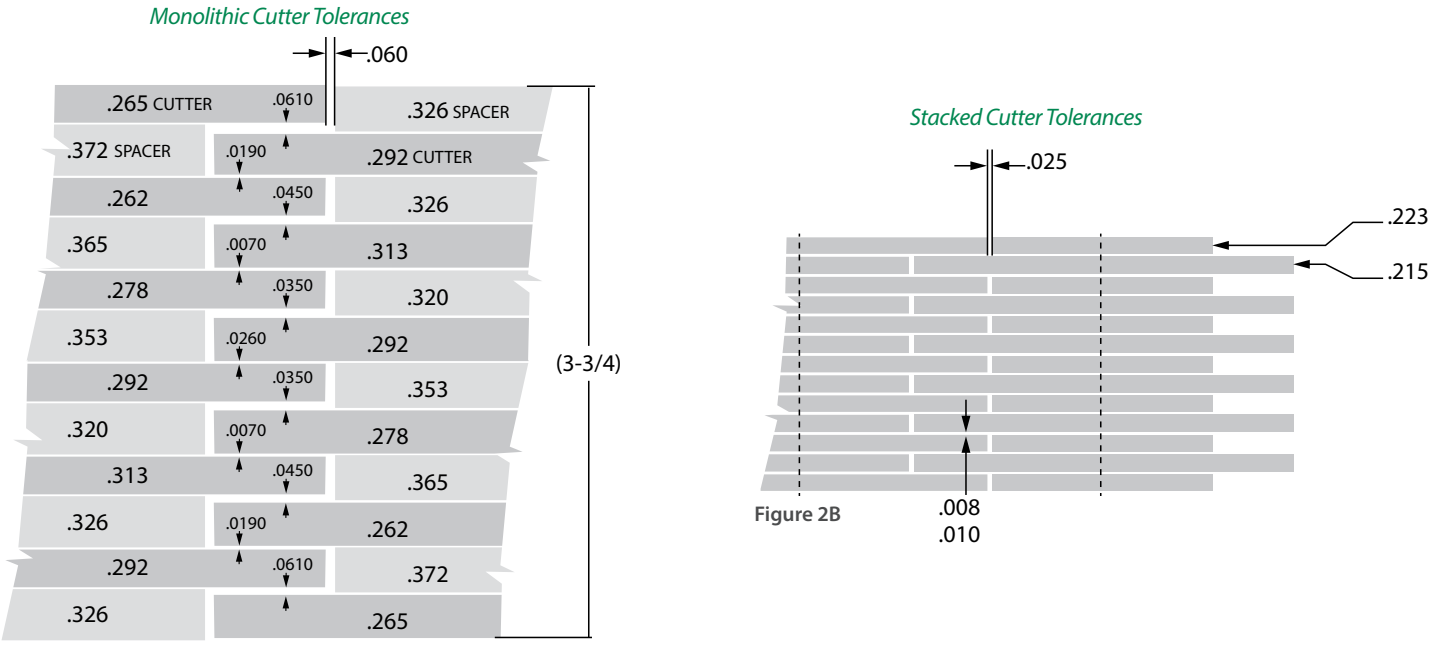

Figure 2A

Figure 2B

Figure 2. This representative diagram of dimensional gaps between rows of cutter teeth on monolithic cutter heads (left) shows variability from 0.007 to 0.061 inches, with 0.060 inches between ends of its teeth and the opposing shaft — enough to let longer strands of resilient materials slip through and clog downstream infrastructure. By contrast, stacks of individual cutters smoothed by flat grinding (right) have been shown to maintain tolerances at 0.008 to 0.010 inches between stacked cutter blades and at 0.025 inches between the end of cutter teeth and the opposing shaft.

Monolithic Cutters. Predominately marketed for decreased maintenance time and fewer parts, the nature of their design limits the precision of the interleaving of the cutters and can result in inconsistent and unwanted larger gaps between their shearing surfaces. This can cause limited reduction in flexible fabrics such as wipes and allow them to reweave with hair and grease to form rag balls. (Figure 2A).

Stacked Cutters. Creating stacks from a series of individual cutters offers several advantages. First, there is the matter of precision. Individual cutters that have all their teeth on a single plane can be finely ground to very close tolerances that ensure resilient materials won't have room to slip between the interleaved cutters (Figure 2B). Second, the ability to configure a stack with different cutters at different levels enables it to deal with different types of debris at different levels in the wastewater channel. Whatever cutter designs are chosen, precision-ground cutter blades with close tolerances between the interleaved stacks provide better shearing action, especially with lighter, more resilient materials such as wipes, pantyhose, or cellophane. Before specifying a new grinder or replacing the cutting blades on an older one, be sure to ask suppliers about the tolerances between opposing cutters in dual-shaft configurations.

Important Stages in Cutter Selection

The best grinder performance comes from creating consistently smaller particle sizes across all the materials flowing through the sewer system. Here are some key factors to keep in mind and some good reasons to evaluate actual sewer flows and debris patterns before selecting cutter options:

Not all waste streams are identical…or even consistent. Therefore, it is important to evaluate the operating environment and the unique demands of actual wastewater flow before selecting grinders or cutters for the best overall performance and longevity.

Dense rocks, sticks, sugar sand, and road construction debris are often more prevalent at the bottom of the channel in combined sewer systems.

Plastics and other mixed debris can be scattered throughout the flows in combined sewer systems or sanitary sewer systems and are often found downstream of locations that tend to abuse toilets and sewer systems — such as schools, retail locations, correctional facilities, etc.

Lighter, floatable debris such as hair, wipes, feminine products, diapers, etc. tend to make their way to the top of the flow. These can represent the biggest challenge in areas downstream from residential developments, hospitals, nursing homes, and other institutions.

Of course, these conditions can vary over time or by season of the year, challenging wastewater utility operators to keep pace with evolving demands as this case study describes. It shows how grinder and cutter technologies designed specifically to cope with wipes enabled one utility serving 380,000 customers to achieve significant reductions in cleanout and maintenance headaches.

Figure 3. Dual-shaft grinders utilizing custom stacks of varying cutter configurations are better equipped to handle a mix of wastewater debris while improving efficiency and extending grinder longevity. Here, 7-tooth cutters made from abrasion-resistant alloy steel accommodate rocks and heavy debris at the bottom of the wastewater flow, while 17-tooth cutters with special wipe-shredding features break down wipes, diapers, and other floating debris near the top of the flow.

Figure 4. This 17-tooth cutter (left) features a smooth, ground-surface finish that assures close-fitting tolerances between the alternating counter-rotating cutters of dual-shaft wastewater grinders. Note the grooves cut into the leading edge of each tooth, which work to shred accumulated wiper debris off the knurled spacer of the interleaved mating stack. This Wipes Ready® technology serves to shred wipes and other wastewater debris into consistently short fragments (right) that minimize the likelihood of combining with hair and other wastewater debris to reweave into pump-clogging strands.

One size does not fit all. Designs that enable wastewater utilities to stagger the composition of their cutter stacks to match the composition of their wastewater will provide better performance and longevity (Figure 3). Larger, harder materials such as rocks, wood, and other debris are best handled by extra-thick, abrasion-resistant, alloy steel cutters using fewer teeth. Cutters specifically formatted with tighter tolerances, more teeth, and serrations to deal with high concentrations of wipers or cloths in wastewater flows (Figure 4) will shred debris into consistently smaller pieces. Smaller pieces are more likely to stay suspended in the wastewater flow and not re-form into ropes or clogs downstream of the grinder as longer strands can do.

Cutting is not the entire story. The metallic composition of the cutting blades can be an important factor in performance longevity. Look for the hardness of alloy steel cutter blades to provide important abrasion resistance against grit, rocks, and heavy debris at the bottom of the wastewater stream. By contrast, choose stainless steel for the longevity of cutters exposed to corrosive hydrogen-sulfide atmospheres above the water line.

Finally, look for cutter attributes that aid in better clearing of shredded materials — for reduced flow restriction and less wear on moving parts continually exposed to abrasive materials.

JWC Environmental, a Sulzer Brand, is a world leader in solids reduction and removal systems for municipal, industrial, and commercial applications. Our solutions include our legendary Muffin Monster® and Channel Monster® sewage grinders, Auger Monster® all-in-one headworks, Monster Wash Press and Monster Separation Systems®, Monster Industrial shredders, and IPEC industrial screens to solve unique wastewater processing situations. We partner with our customers to help them run efficient and compliant wastewater treatment operations as well as solve challenging size-reduction problems in industrial processes. JWC Environmental is headquartered in Santa Ana, California and has a global network of representatives, distributors and regional service centers to meet local customer needs. More information on JWC Environmental is available at www.jwce.com

JWC Environmental®
A Sulzer Brand

Headquarters
2850 Red Hill Ave., Suite 125
Santa Ana, CA 92705 USA
toll free: **800.331.2277**
phone: **949.833.3888**
fax: **949.833.8858**
email: **jwce@jwce.com**

www.jwce.com

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