AGGREGATES MANAGER
Your guide to profitable production
PULL-OUT GUIDE
by Mary Foster, Contributing Editor

OPERATIONS ILLUSTRATED

Optimizing Crusher Capacity

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All Choked Up

The ultimate goal in optimizing aggregates production is to increase the number of tons produced per man-hour. And crusher capacity is probably the first line of offense in reaching production goals.

According to Denis Osborn, production manager for United Companies — an Oldcastle Materials subsidiary based in Grand Junction, Colo. — the first question producers should ask when addressing their crusher capacity is, "Do I have the right machine for the job?" Paul Smith, director of products and sales, Johnson Crushers, for KPI-JCI in Eugene, Ore., agrees, adding that a proper configuration is also critical.

"If you're using the wrong liner, you can't choke feed the cone," he says. "Without a choke feed, you can't get good attrition (rock-on-rock crushing), which works to break the flat and elongated pieces. There's no cubicity; your end product is of poor quality." Alternately, he says to achieve cubicity, compression crushers need a choke feed to utilize rock-on-rock crushing. And to maintain a choke feed, the crusher must have the correct liner for the feed material.

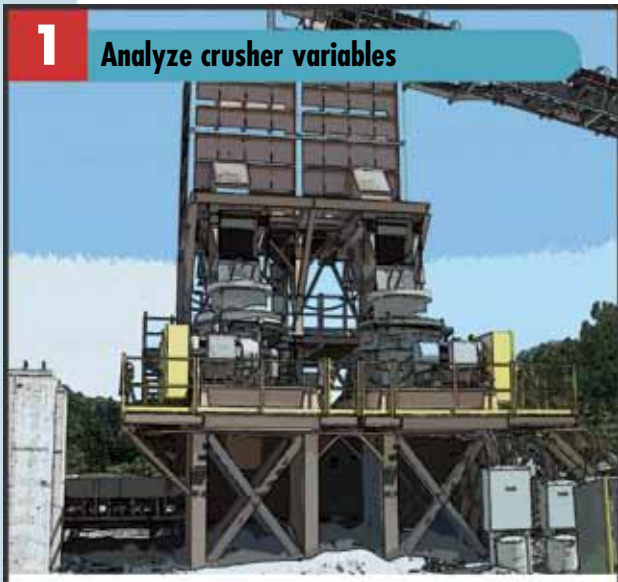
If coarse material is fed to a cone with a fine liner, the liner will wear unevenly near the top of the manganese. A feed that is too coarse will also result in low tons per hour, a non-cubical product, increased recirculating loads, and coarser gradation. A feed that is too fine for the liner will create a greater amount of irregular wear on the bottom section of the crushing chamber (known as a "hook"). This situation will also generate high horsepower consumption and high loading on the lower section of the crushing chamber — which can overload the crusher and cause the bowl or head to float, says Smith.

Osborn notes that, from an operating standpoint, crushers also need a consistent feed. "I believe that surge bins are one key to getting a consistent product at a consistent rate," he says. Osborn says surge bins can also help to better distribute the feed. "If you feed off to one side, it lowers your production and throughput. You might see the crusher amping out, but only half the machine is actually working."

Smith says that bulk-loading rock will overload the crusher and can cause the bowl or cone to float. "With float, the crusher will lose the closed-side setting (CSS) and more oversize rock will pass through and increase the amount of recirculating material," he says. "Such events can also increase fatigue and can damage the crusher or cause a catastrophic failure."

Each location presents a unique deposit that will create different variables for the producer to address, says Osborn. "Portable operations face these variables every time we move," he says. "For the portable operator, it's a real challenge to find a cone liner that works in multiple deposits."

1 Analyze crusher variables



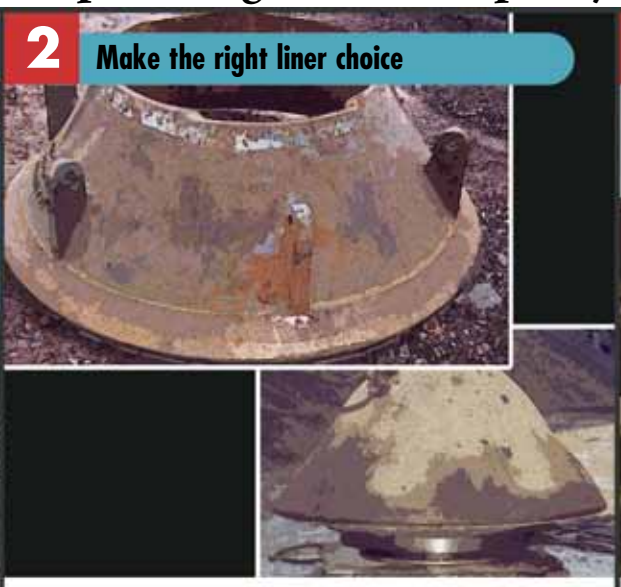
Numerous variables can affect crushing capacity, including proper liner choices, consistent or inconsistent feed, crusher speed, closed-side setting, screen capacity, and adherence to maintenance schedules. These variables all can be manipulated to fit your unique application and give you the best quality product at an optimum production rate. An obvious variable is making sure you have the right crusher for the application, and the wrong crusher might just as easily be too big as it is not big enough.

4 Adjust the crusher speed

Increasing the pinion rotations per minute (RPM) decreases horsepower consumption, and it also decreases crusher throughput capacity. But longer material retention creates a finer output gradation with greater percentage passing the closed-side setting. This is helpful in situations where the cone has the correct liner, but the crusher can't produce enough power to maintain a choke feed. Increasing the speed chokes the cone, producing more material of the proper gradation for better overall throughput.

Optimizing Crusher Capacity

2 Make the right liner choice



Proper cone crusher liners are paramount to maximizing your tons produced per man-hour. Too coarse of a feed will result in low tons per hour, non-cubical product, coarser gradation, and irregular manganese liner wear concentrated at the top of the liner. A feed that is too fine for the liner will cause high horsepower consumption, increased and irregular wear on bottom section of the crushing chamber, and high loading on the lower section of the crushing chamber, which can overload the crusher and cause bowl float.

3 Choke feed the crusher

Installing incorrect liners can actually affect the ability to choke feed the cone. In a nutshell, choke feeding a cone allows it to best do its job. A choke feed will provide rock-on-rock crushing for best cubicity, best liner wear, and best use of power. Another common mistake is allowing the feed to enter the cone off-center, which will affect throughput. The operator might see the crusher amp out, but only half of the machine is truly working. Surge bins help to feed the cone at both a consistent rate and distribution.

5 Maintain your machine

The only way to achieve 90 percent uptime is to schedule preventive maintenance. Many producers can relate experiences where a catastrophic failure actually provided prior indicators that were ignored. It's imperative that you know your machine. Conduct daily, weekly, and monthly pre-start checks. Grease the machine according to factory guidelines. Take regular oil samples. Brass in the oil, for example, should raise a red flag that a bearing could fail.

6 Address your screens

Any time you boost crusher throughput, you also need to address an increase in screening area. Wider screens can raise capacity by better spreading the load. Screen length will increase efficiency because the material has more time on the deck to stratify. Expanding the open area on your screen media also can help to increase throughput. Other screening variables that affect throughput are speed and the length, type, direction, and angle of the screen's throw.

OUR EXPERTS

As production manager for United Companies — an Oldcastle Materials subsidiary based in Grand Junction, Colo. — Denis Osborn calls upon 33 years of experience in operation and maintenance of aggregate equipment. Osborn has been with United Companies for 16 years and currently works with the company's large fleet of portable processing equipment. He has previous experience with portable contracting and stationary aggregates processing in California.

Paul Smith is the director of products and sales, Johnson Crushers, for KPI-JCI, an Astec company. Smith has worked in the industry since 1989 for Kolberg-Pioneer and Johnson Crushers. During his 20 years of experience, Smith has contributed to the design, promotion, training, and sale of the company's products and services. He has also been an editorial contributor in the industry press and is a regular speaker at national, state, and corporate industry events.

Voices of Experience

Denis Osborn

"I think people in the industry — operators — have a fear of pushing their machines," says Denis Osborn, production manager for United Companies — an Oldcastle Materials subsidiary based in Grand Junction, Colo. "Maybe they've had a bad experience in the past, but I often see operators running their crushers at 65 percent. It seems to be a common comfort level. They definitely don't push them as hard as they can be pushed."

Osborn says there is a fine line between use and abuse. But to get more production out of a cone crusher, the operator must look at the closed-side setting (CSS) and ask what he or she is getting out of the crusher, as well as what is returning. An operator might see that the crusher is running at 80 percent, but it's also getting 35 percent going back through the chamber. "The cone is shaped like an egg," he says. "It's natural to get some return. But you want to try and get that return to 20 to 25 percent."

Osborn explains that operators can gauge their return by shutting off the raw feed to the cone and analyzing what is returning to it as recirculated feed.

"If you're making 3/4-inch aggregate and the cone is set at 1-inch, you're not using it well," he says. "If you're making 3/4-inch or 5/8-inch material, don't set the cone at 1-inch. But you'd be amazed. So many times, I ask an operator, 'What's the cone set at?' And he'll guess: 'Oh, 3/4-inch.' And he's wrong."

Osborn notes that automation technology has made a difference with this challenge. But he says it's frustrating that many long-time operators will not use the technology that is available to help them with their crusher settings. "You take away their push buttons, and they're lost. But use the technology. The readouts will tell you what your CSS is. Often, it can adjust CSS automatically," he adds.

Proper preventive maintenance is another key to getting the best and most production from crushers, Osborn says. And he feels at the very root of this practice is familiarity with the machine, which will make daily pre-shift walk-around checks more meaningful. "If you know your machine, you'll know the signs that something is wrong," he says, adding that proper greasing and regular oil sampling will also keep machines running well. "Every single time we've ever lost a bearing or had a failure, there was some sort of indicator before the fact that we didn't catch," Osborn explains. "If you do an oil analysis and there's brass in the oil, it raises a red flag.

"The saying 'If you take care of it, it'll take care of you,' definitely applies," he adds.

Paul Smith

According to Paul Smith, director of products and sales, Johnson Crushers, for KPI-JCI in Eugene, Ore., because every deposit is unique, the variables that affect crusher and liner choices can be numerous to achieve the desired product. But he says, in addition to feed and closed-side setting (CSS), operators can also change the revolutions per minute (RPM) speed of a cone to improve performance.

Smith explains that increasing the speed of the eccentric retains material longer in the chamber. This will increase production of fine material, consume less power, increase crushing efficiency of the desired gradation, and produce more quality (cubical) material. The tradeoff can be reduced volumetric throughput. "All things being equal, at a 1-inch CSS, you're going to produce a higher percentage of minus 1-inch material in a single pass at a higher crushing speed," he says. "The opposite is true at lower crushing speeds."

But even when the crushers are running at their fullest potential, an inefficient screen can bottleneck the entire operation. Because a cone crusher typically represents the most expensive asset in the system, a plant should be designed so that the bottleneck is at the last crusher in the circuit, not the screen. "If you're optimizing crushers, you also have to optimize screens," Smith says. "If a 200-ton-per-hour screen deck is suddenly asked to produce at 300 tons per hour, you're going to overload the screen. It won't be able to separate the undersize material, and that undersize rock will carry across the end of the screen, recirculating back to the cone. The only way you can get that material to the pay pile is to get it through the screen surface."

Obviously, more screen area spreads the load better and gives the material more time to stratify. But not every situation requires a new screen to match a crusher's increased capacity. Other variables that can affect a screen's efficiency include the speed, as well as the length, type direction, and angle of its "stroke," or throw. "By design, screens are out of balance," Smith says. "The speed and stroke pattern can be manipulated to affect how material behaves on the screen."

"Coarser screening applications generally favor a more aggressive, slower speed and a longer, steeper stroke. A longer stroke generates higher Gs needed to dislodge coarse particles from screen openings. Finer applications favor a thinner bed depth, which is achieved by higher speeds and flatter, shorter stroke patterns. Finer material needs more contact with the screen surface, and a shorter stroke does not allow material to bounce as high," Smith says.

"There's a science and an art to improving your crusher capacity and your screening efficiency," he continues. "Optimization is dependent on the ability to configure the equipment appropriately for your deposit."