CRUSHING

Maximizing Cone Crusher Performance

A Superior Industries White Paper

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[Figure 1] Cone crusher in plant.

MAXIMIZING CONE CRUSHER PERFORMANCE

Every producer wants peak crushing performance, but not every producer knows how to achieve it. Getting there may require just a few tweaks– or even a total rebuild. To remain at peak levels requires proactive maintenance practices, combined with expert consultation and continuing education.

When operations truly maximize cone crusher performance, the perennial paybacks include:

- Lower cost per ton
- Greater plant uptime
- Increased production capacities of highly saleable material
- Reduced maintenance and wear costs

"Maximum cone crushing performance requires a complete understanding of the application parameters; the design limitations of the crushing machine; and the processing circuitry needed to support that machine," says Mike Schultz, crushing product manager for Superior Industries, which recently launched its new high-performance Patriot® Cone Crusher Series.

Schultz brings more than two decades of crushing industry experience to the company's veteran team of crushing product, parts, and service professionals. *"Our mission is hands-on expertise, innovative engineering, and working closely with producers and operators to fine-tune their crushing operations for long-term efficiency,"* he says.

SEEK VERSATILITY & VALUE

The cone crusher is a versatile machine that can be used in all phases of material reduction– from the rock face to product finishing– but more often than not, its duties are targeted to secondary, tertiary, and quaternary aggregate and mining applications. A cone is a compression crusher that effectively crushes abrasive material, as well as a wide variety of stone from medium to very hard compressive strength.

How can this very versatile machine deliver the most value while minimizing operating costs per ton?

From a bottom-line standpoint, Schultz says that maxing performance and cutting wear costs means "getting every stone through that cone crusher that we safely can – while preventing any machine damage – and still meeting or exceeding production goals."

From the basics to the big picture, Schultz discusses the following solutions and strategies toward maximizing cone crusher performance.

DEFINE ALL PARAMETERS UPFRONT

Whether specifying a new machine or fine-tuning an existing crushing circuit, all key parameters must be defined upfront. *"What is the true work that you're asking that crusher to do?"* asks Schultz.

Key Parameters:

- Operations must provide data on proper feed gradation, desired output gradation, tonnage requirements, and most importantly, the material type.
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- Knowing the precise composition, compressive strength (maximum force that material can withstand before breaking), and chemical properties of the stone is a huge factor in determining how much work a cone crusher needs to do.

"Many operations try to do too much with one machine, pushing it beyond its design limitations; and causing excessive component stress and wear, and the potential of serious damage," says Schultz.

All crushers are designed for certain reduction ratio limitations. In most cases, cone crushers provide reduction ratios of 4-to-1 and up to 6-to-1 (meaning the ratio of the feed size to the crusher vs the size of the crusher discharge).

"The reduction ratio design limitations; and the rated capacity (tons per hour) of the cone crusher are the most important factors to consider when designing a crushing circuit – and determining how much that crusher can safely do," he says.

With complete application data in hand, Schultz says that it's important for operations to work closely with their crusher supplier to select the right crusher.

Key Considerations:

- Crushing Speed
- Chamber design
- Liner configurations
- Crusher settings

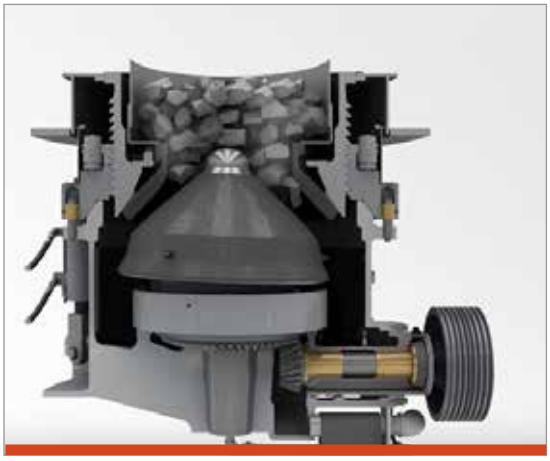
"There are myriad choices of machine configurations. Whether it's minimizing fines or maximizing fines; or trying to create the highest yield of a particular product, there are chamber and liner configurations designed specifically to meet the desired product yield," says Schultz.

DESIGN PROPER CIRCUITRY

For performance efficiencies, proper circuitry should be designed around the cone. Importantly, the circuit should be engineered to provide the cone with choke-fed material, or enough material to keep the crusher full. Having too little feed can cause the machine to side load, which stresses components. Also, having too many fines in the feed leads to premature wear issues.

Having adequate screening capacity downstream of the crushing circuit is another key factor. In a closed-circuit setup, material that is not properly sized is recirculated back to the crusher for further reduction.

"It's very common to see operations that have a bottleneck at the screening circuit. They do not have enough screening capacity, so properly crushed material is sent back to the cone. These unnecessary recirculating loads simply eat up more space and horsepower in the crusher while increasing wear," says Schultz.



[Figure 2] Internal bypass pressure relief valves

TAP INTO AUTOMATION

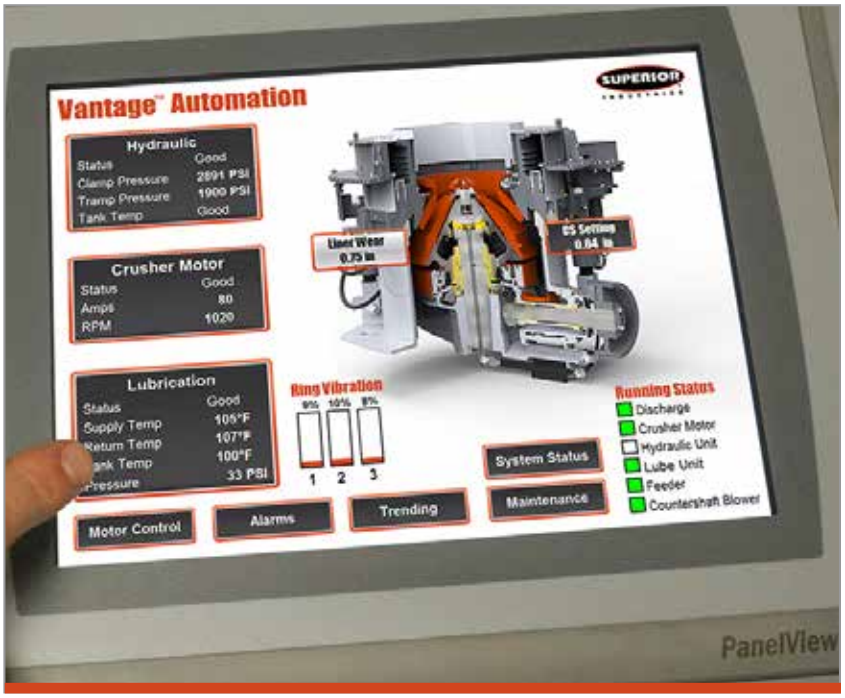
"To significantly affect cone performance, automation doesn't need to be over-the-top and super complicated, but rather quite simple and very easy to control," says Schultz, adding that one of the biggest things that automation delivers is protecting the machine from damage by acting as a warning system that alerts operators to conditions such as bowl float, excessive amperage or temperatures, and lubrication or low-flow oil issues.

For example, Schultz points to Superior's Patriot Cone series, which features a three-sensor "bowl float" or "ring bounce" monitoring system that alerts the operator if conditions are over exceeding the design limitations of the cone. He explains that the top and the bottom of the cone are basically held together by hydraulic cylinders.

When the crushing action on the cone exceeds the pressure that is holding those two pieces together, it causes bowl float or ring bounce, which is any movement at all (even slight) between the top and the bottom of the crusher. Undetected bowl float will eventually lead to component failures. *"When operating a cone, preventing bowl float is arguably the single most important thing you should ensure,"* adds Schultz.

Most cone crushers are designed to open up due to tramp metal or an uncrushable situation. However, no cone crushers are designed to operate under normal conditions with ring bounce.

"There should be zero ring bounce or bowl float under normal operating conditions. Without an automation package, it can be difficult to detect ring bounce at times. You can literally be standing on the machine, and you cannot detect even the slightest ring bounce – so having that automated warning system is an enormous advantage," he says.



[Figure 3] Vantage Automation screen

Schultz also encourages operations to tie an automated warning system into the designed amperage utilization of the machine.

"Our automation package works in conjunction with the drive motors and essentially reads the amp draw of the machine. If the motor and the machine are being overworked, the system will either take steps to reduce the amp draw, or will send an alarm to the operator," he says.

Automation features are also designed to maximize the life of wear components. For example, the Patriot Cone's automation package includes auto-wear compensation. As liners begin to wear, the crusher is designed to automatically compensate for that wear in order to maintain the same settings in the machine. With liner wear, the space between the two compression components expands. At the same time, the auto wear compensation system automatically closes the machine down to maintain proper settings throughout the life of the wear components.

KNOW THE TRUE LIMITING FACTORS

One of the major misconceptions Schultz encounters in the field, he says, is the way operators may view the closed-side setting (the material discharge opening from maximum to minimum) of the cone. Operators often try to maintain a specified closed-side setting, assuming they will yield the desired product output no matter what. Often, they close the setting down to the smallest point possible and then let the machine beat itself up.

Schultz suggests a better approach to setting up a cone for maximum performance:

- First, consider that the true limiting factors of any cone crusher are attached power and crushing force.

- After determining the proper speed and liner configuration, it is possible to "dial in the proper settings of the machine" based on maximizing the amp draw to a desired set-point – while making sure that the machine does not incur ring bounce at that point.

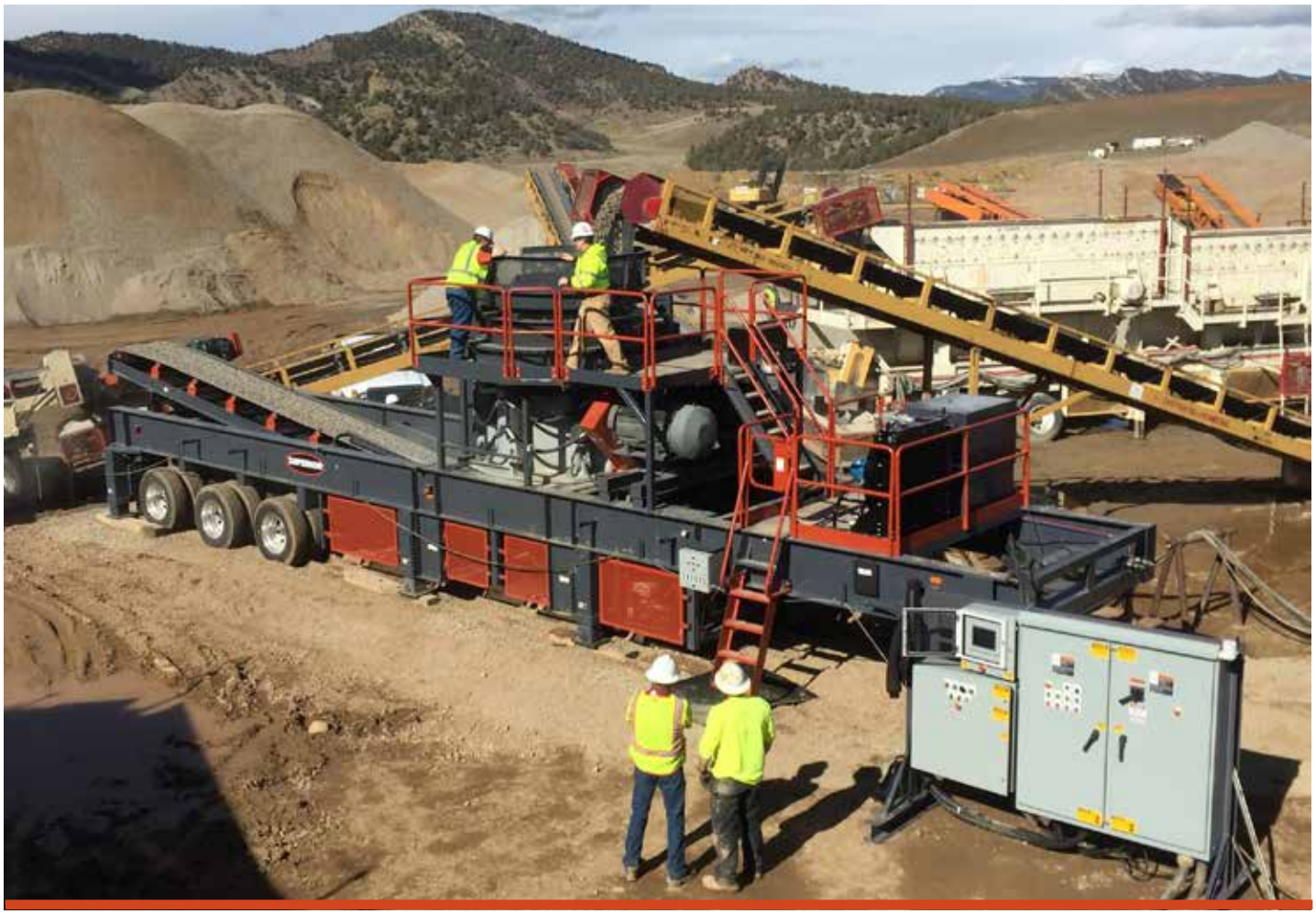
PRACTICE PROPER LIFECYCLE MANAGEMENT

Throughout its lifecycle, a cone crusher needs to withstand daily abuse. Operators should practice the following to optimize crusher performance:

1. Investing in high quality equipment and components upfront will save big bucks over the long haul.

2. Next, maintaining ongoing preventive, predictive and reactive maintenance programs are an imperative to optimum plant availability and minimized maintenance and wear costs. The proper training of personnel is also key to overall performance and efficiency, and especially to consistently safe operation.

3. Lastly, operations should partner with crushing experts and equipment suppliers who are accurate, accessible, and are willing to offer hands-on, onsite troubleshooting, service and parts support over the total life of the machine. That is proper machine lifecycle management, and that is what ultimately ensures maximum cone crusher performance.



[Figure 4] Application specialist in the field with a crusher.

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