Technical Paper TE - 101

LINER SELECTION for the Gyrasphere® cone crusher

By Dudley Schaal

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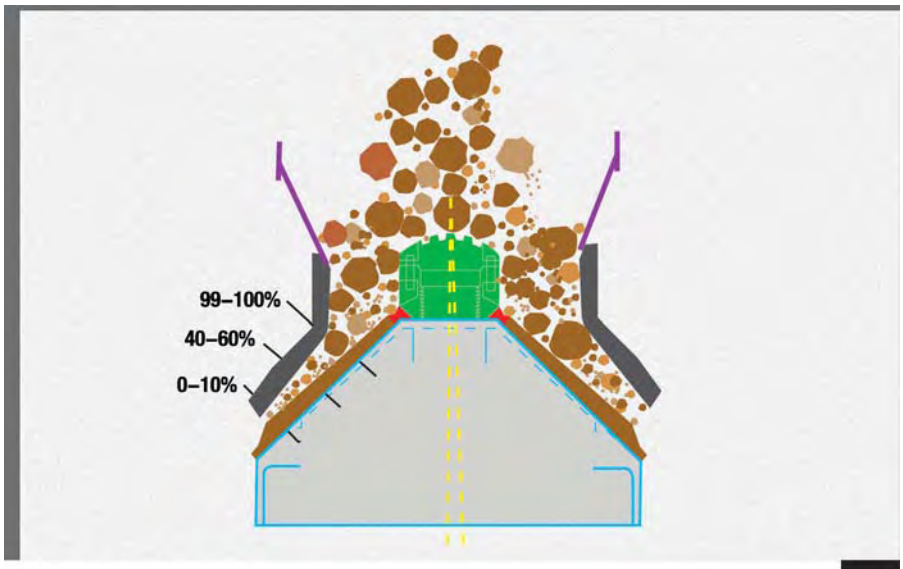
ABSTRACT

LINER SELECTION

There are a number of different criteria to consider when selecting the right chambers for your crushing needs. There is one, however, that must always be considered: That you have a well-graded feed to the chamber. A well-graded feed is generally thought to be 90-100 percent passing the closed-side feed opening, 40-60 percent passing the midpoint and 0-10 percent passing the closed-side setting **(Figure 1)**.

Before selecting a crushing chamber, you should take a sieve analysis of the feed to find out if you have a well-graded feed. Look first at the feed opening of the chamber. Take the closed-side feed opening (CSO) plus the open-side feed opening (OSO) and divide by 2 in order to establish the maximum feed size to the chamber. for example: Assume a closed-side feed opening of 6 1/2 in. (16.5 cm) and an open-side feed opening of 8 1/8 in. (20.6 cm):

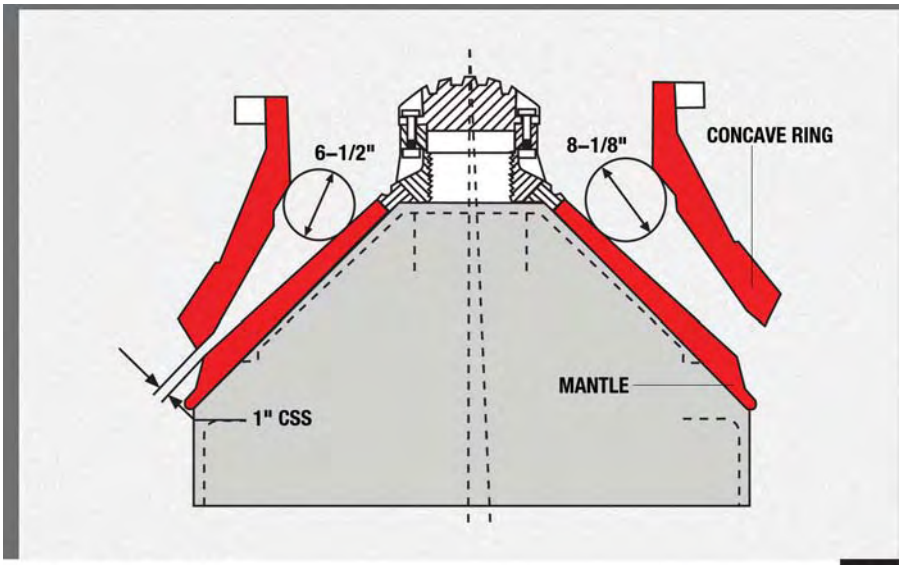


A WELL GRADED FEED F1

Max Feed SIze = (CSO + OSO)) 2
Max Feed Size = (6 1/2 in. + 8 1/8 in.)) 2
Max Feed Size = 14 5/8 in.) 2
Max Feed Size = 7 3/8 in.

The maximum feed size to this chamber would be 7 3/8 in. (18.6 cm) and not more than 10 percent larger than the closed-side feed opening.

To determine the midpoint of the crushing chamber, take the closed-side feed opening (CSO) plus the closed-side setting (CSS) and divide by 2. Assume, for example, a closed-side feed opening of 6 1/2 in. (16.5 cm) and a closed-side setting of 1 in. (2.5 cm):



CRUSHER SETTINGS F2

Midpoint = (CSO + CSS)) 2
Midpoint = (6 1/2 in. + 1 in.)) 2
Midpoint = (7 1/2 in.)) 2
Midpoint = 3 3/4 in.

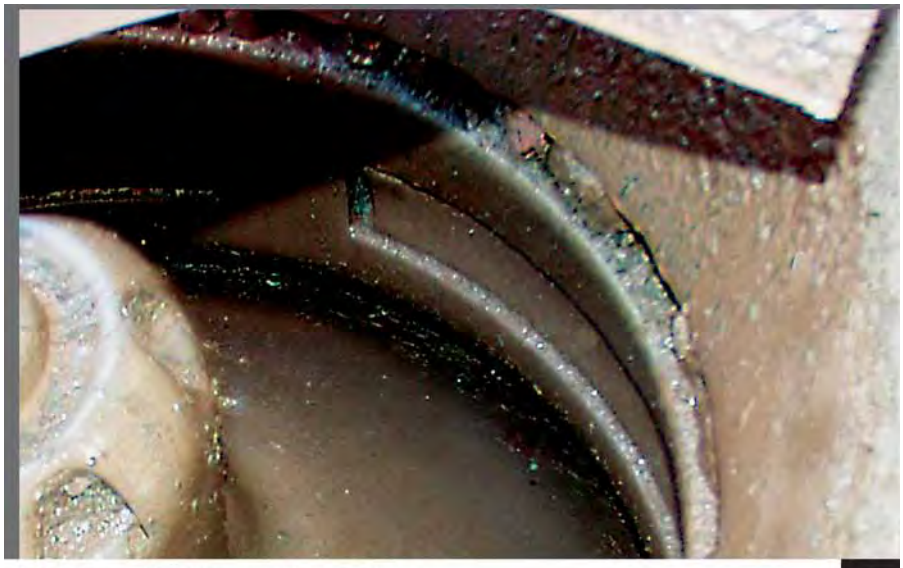
In this hypothetical case, between 40 and 60 percent of the material should pass 3 3/4 in. (9.5 cm) in feeding this chamber **(Figure 2)**.

FEED PROBLEMS

A feed that is not well graded will invariably cause one or more problems with the crushing operation. That is the first thing you should carefully examine. If the feed is too coarse **(Figure 3)**, one or more of the following problems can develop in the operation:

- There will be reduced tonnage through the crusher;
- Low horsepower consumption;
- The product from the crusher will be coarser than it should be;
- The product will not be as cubical as it should be;
- The upper part of the crushing chamber will wear out **(Figure 4)**

COARSE MATERIAL WITHIN CRUSHER F3



CRUSHER SHOWING SIGNS OF WEAR F4

If the feed to the crusher is too fine, you will notice one or more of the following problems:

- There will be reduced tonnage per hour through the crusher;
- High horsepower consumption;
- Upper frame movement;
- High oil temperature;
- The difference in capacity from a new liner to a worn-out liner can be as much as 50 percent less. (The reason for this reduction in capac ity is that the lower portion wears faster than the upper portion which caus es the feed operation to close off).

The second thing to evaluate is the reduction ratio of the plant. An open-circuit Gyrasphere® cone crusher or the second-stage of crushing should have a reduction ratio of 6:1 to 8:1 in a single-pass operation. If this crusher is in a closed-circuit operation, the reduction ratio should not exceed 6:1. The reason for this limitation is that the recirculating load is filling in some of the void area within the chamber. Material needs room for expansion; therefore you are unable to crush at the higher reduction ratio. trying to do so will cause your

CUBICAL PRODUCT F5

COARSE PRODUCT F6

crusher to pull higher amperage man may cause the upper frame to move.

A closed-circuit Gyrasphere crusher or third-stage of crushing should have a reduction ratio of 4:1 to 6:1, maximum. In most cases, 3:1 to 4:1 will work out to be the proper reduction ratio.

A MISTAKE TO AVOID

One thing you should never do is place a new concave liner in a crusher with a worn mantle - or a new mantle in a crusher with a concave liner. Why? If you have properly selected the replacement component, you will change the complete profile of the crusher by mating new and worn components. The recieving opening will tend to close down, thereby restricting the feed form entering the chamber - and causing a reduction in tons per hour.

For example: Let us assume that you have a crusher with the capacity of 300 tph (272 tonnes per hour). And let us further assume that the feed opening is restricted by inproper replacement components, reducing the capacity by 10 percent - which is a 30 tph (27 tonnes per day) reduction. Over the next four weeks (160 production hours), it will cost your company 4,800 tons (4,354 tonnes) of production. At a cost of $6.50 per ton, that will amount to a loss of $31,200.in revenue.

This initial lost revenue does not take in consideration the fact that four weeks later you will probably have to shut down once again to replace the other liner component. For an investment of just two additional hours, the second liner could have been replaced. Changing both liners simultaneously would have saved your company at least four hours of complete shut-down time - which is additional lost revenue.

TIMING IS CRITICAL

When should you replace a liner in your crusher? It is a frequently asked question. Here is the answer:

If the liner is wearing evenly throughout the chamber, you should consider changing out the maganese when it has worn down to about 1 in. (2.5 cm) thickat the bottom. At about 3/4 to 5/8 in. (1.9 to 1.6 cm) thick, the maganese will crack, causing the backing material to begin to disintegrate. And this, in turn, will cause the liners to break loose. If this should happen, continued operation could destroy the seat on the support bowl or the head of the crusher. And repait to these items i very costly.

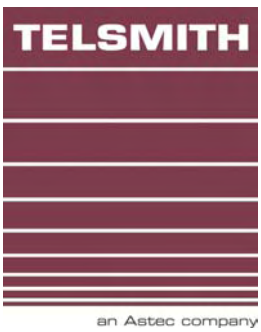
CHOKE–FEEDING IS A PROVEN AID

In order to maintain the masimum levels of capacity, gradation, and cubical product, a crusher must be choke-fed at all times. The best wya to keep a choke-feed to the crusher is with a surge bin (or hopper) and feeder that are located prior to the crusher. Choke-feeding is almost impossible to achiebe without a hopper and feeder.

When the crusher feed is reduced, the product tends to become coarse, with slivers and flats occurring. Today, the new Superpave specifications tend to require more cubical products. The photos below show a product that has been choke-fed **Figure 5** and a product that has not been choke-fed **Figure 6**. In the latter photo, you will notice that the product appears to be more coarse, with a higher percentage of slivers and flats.

THE BOTTOM LINE

These guidelines might seem to be elementary to veterans in the industry. But there is one thing that should be remembered: Selecting the proper liner and maintaining a consistent feed pattern to your crusher are proven ways to put more rock on the pay-pile - and more revenue in your company.



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