Crushing and Screening for Ore Sorting Success

What does an efficient crushing and screening setup look like in order to get the most out of your ore sorting system? Why is ore sorting becoming a more sought-after method in the industry? Throughout this paper, we will explore the principles of ore sorting and how crushing and screening can impact ore sorting performance.

Why use ore sorting?

Ore sorting is one of the oldest methods of mineral processing - there are documents from antiquity that show people hand-picking rocks containing valuable metals and minerals, while discarding the barren ones. The principles behind modern particle sorting remain the same. Essentially, your aim should be to collect the valuable particles and discard the barren, or low-grade ones, in order to generate more metal per tonne. When processed, this can improve mine economics and reduce environmental impacts like energy consumption and tailings footprint. While the principles remain the same, particle sorting methods have become a bit more sophisticated; we now have high-tech sensors to detect a variety of different rock properties and fast-acting air ejectors to separate ore from waste. We also have a better understanding of the factors that affect performance of modern ore sorting machines.

What are some important considerations?

While it's difficult to control the composition or mineral makeup of the feed to the ore sorter, you can have significant influence on one major performance factor: particle size.

From a process point of view, it's necessary to make sure the rocks being fed are sufficiently heterogeneous to enable separation. This means the ore and waste rocks need to be liberated from one another so they can be identified by the sensors in the sorter and then separated. Not all ores lend themselves to particle sorting, but simple bench-scale tests can be conducted to estimate the economic benefit of a sorting system.

From a more practical point of view, ore sorters can generally process rocks from 30-120mm; however, a good rule of thumb is to make sure the largest particle is no more than three times the size of the smallest particle for sorting. You want to minimize the number of oversized particles being sent to the sorter to prevent damage and reduce the likelihood of misplaced particles. You also want to minimize the creation of fines, which can impact the separation efficiency as well as create dust issues. Ensuring appropriate particle size distribution, again, comes down to correct crushing and screening ahead of your ore sorting system.

What's important about the crushing circuit setup?

The type of crusher selected will play a role in the shape of the rocks generated from crushing, which may affect sorting. For example, jaw crushers and unloaded cone crushers will produce particles that are flat and elongated while impact crushers and choke-fed cone crushers will make more cubic-shaped particles. The creation of fines is also an issue – impact crushers typically generate the largest amount of fines compared to other types of crushers. Given the particle size range most appropriate for ore

sorting, it is a good idea to use a cone crusher for size reduction. A vibrating screen in closed circuit with the cone will also help control the particle sizes being fed into the sorter.

The best way to minimize fines production in a cone crusher is to slow the crusher down and use a coarse liner that has a wider feed opening and closed side setting. To slow the crusher, you could replace the sheaves and belts, but it may be easier to use a crusher with a variable speed drive so it can be easily adjusted to the optimal operating speed. We recommend choosing a crusher with coarse liners readily available from a manufacturer who understands the particle size requirements for sorting. Some industry experts may advise against choke-feeding the crusher in order to minimize the production of fine particles; however, this can have serious impacts on mechanical availability and operator safety. If you choose this route, make sure the cone crusher has a robust mechanical braking system.

When looking at overall crushing circuit design, having the correct number of crushing stages also helps minimize fines production. A typical crushing circuit will generate a reduction ration between 5:1 and 7:1 for maximum efficiency. For example, to generate a 10mm particle, you'll want to feed the crusher particles between 50 and 70mm. However, to minimize fines, design the crushing circuit with a reduction ratio between 3:1 and 4:1 at each stage; this could mean an additional stage of crushing, compared to a traditional circuit.

A screen also plays a critical role in minimizing the generation of fine particles. A double deck screen is the correct choice for this application so particles that are too big for sorting are sent back to the cone crusher, and particles that are too fine are removed. The screen panel openings for the two decks need to be sized correctly to ensure the success of both jobs.

Finally, the screen area size should also be sufficient. There needs to be enough open area so no sortable particles are being sent back to the crusher, and all fine particles are being removed from the sorter feed.

Bringing it all together

Once the correct particle sizes have been identified for sorting, the quality and efficiency of your crushing circuit setup comes next. To give your business the best chance of success:

1. Choose a crusher that can operate at slower speeds with a coarse liner in order to minimize fines creation.
2. Choke-feed the crusher for maximize uptime and operator safety.
3. Select a double deck vibrating screen with enough screen area to remove fine particles before they get to the sorter.

For more advice and tips like these, feel free to reach out to our experts, and we'll be happy to help you and your sorting system achieve the best possible results.