Increasing throughput with customised grinding ball design

The sheer size and scale of new ore processing operations, with their associated desire to substantially increase product throughput, means that primary SAG mills have been able to grow to new capacities.

Paul Peng, CEO and chief metallurgist at Sino Grinding Industries (SGI), emphasises that it is critical that grinding media is designed and manufactured to cope with this increased demand. A primary influence on maximised performance is the longevity and overall health of the grinding media.

“There are standards for steel manufacturing for specific applications and each end use is covered by an ISO, AS, JIS or other basic chemistry design. However, with grinding media, there is not one specific standard that provides a basic grade for steel grinding media. SGI therefore went back to the drawing board to redefine the purpose of all media it produces,” says Peng.

SGI determined that any grinding balls it produced would need to be able to withstand high levels of impact and should possess superior abrasion resistance. The current product range includes seven different types and grades of forged steel SAG grinding media in sizes ranging from 13 mm up to 165 mm. Each grade has variations in chemistry, physical characteristics and efficiencies to suit the various grinding and impact environments of mills.

“The key to ensuring that the grinding balls will enhance throughout is to dispense with the assumption that a single ball design can work well for all sites. One needs to factor in variations such as mill size, ore type and characteristics, final grind targets and milling work practises,” adds Pieter Theunissen, SGI African Chief.

Consultative cooperation

Finding the grinding media best suited to a specific plant and application starts with an in-depth consultation between the SGI technical team and the customer. These meetings allow SGI to gather pertinent information from the operational team at the mill including the mill size and speed, ore size and hardness, ball size and consumption, as well as the operation targets of throughput and grind.

Once this data has been gathered, modelling is performed at SGI's head office under Peng's critical supervision. Various options will be presented to the customer, often with performance guarantees attached. In addition, a transitional strategy may be used which allows the customer to purge existing media and replace it with one of SGI's premium grade solutions.

"This two-way communication with the customer is of paramount importance to the success of the project. Our customers are milling specialists and we are completely familiar with steel alloying and are therefore able to provide them with a customised best practice solution. Together we can develop a ball design that will provide them with optimum throughput results," says Theunissen.

The size of grinding media plays a key role in overall performance of the grinding circuit. Larger grinding media has a smaller grinding surface area, but offers a heavier weight that's generally used to break larger ore. Small grinding media has a larger grinding surface area generally chosen to help make smaller ore even smaller.

"In some cases, we find ourselves adjusting the ball size by the millimetre to approach optimisation. This flexible and precise control approach is possible as a result of our knowledge of the ball's design and the manufacturing process. Optimising milling is part of our principle of continuous improvement. We would like to invite the market to engage with us at Electra Mining, Hall 8 Stand A16," says Theunissen.

Manufacturing excellence

SGI has two high-capacity manufacturing facilities in China that allow over 200 000 tons of grinding media to be produced annually. Each facility is characterised by the strictest quality control processes in the industry. "We verify melt shop chemistry accuracy, utilise high ratio upset multi-hammer forging, monitor heat treatment and perform ball drop tests of each batch with consistency to ensure performance. Full activation in the heat treatment process provides extremely high performance standards and the micro-alloying process is carefully measured to meet each specific ball grade's functional target," Theunissen points out.

Peng explains that the specific ball design will balance hardness and toughness according to the milling targets in the operational plan. SGI will consider all the targets and environmental factors to supply a ball with <1% breakage. "By strategically producing grinding media that factor in all the variables of each milling plant, we are able to provide customers with the throughput they require to remain sustainable in the future."