Trunnion Magnet Technology Delivers Quick Payback

Performance Metrics Collected Through Studies Indicate A Six-Month To One-Year Payback When Compared To Trommel Screen Installations.

By Jose Marin

Using magnets to collect ferrous metal from process streams has a long history in the mining industry. This is especially true in the collection and disposal of grinding ball fragments in ball/SAG mill operations. Though often small in size, worn and broken metallic grinding balls can cause serious problems if they are not detected and removed from the milling operation.

Grinding ball fragments in the milling circuit impact two critical areas:

- In the crushing circuit, where companies have observed damage to crushers, unscheduled downtime and loss of production.
- In the grinding circuit, where companies have discovered wear to pumps, sumps, piping, hydrocyclones, mill liners, as well as inefficient grinding, power consumption and optimization of overall mill throughput.

Eriez Trunnion Magnets provide a unique system for separating and removing balls, chips or scats in a typical ball/SAG mill operation. This technology replaces the dead weight of ball magnets with fresh ore.

By effectively removing an estimated 80% or more of worn or broken media, a trunnion magnet reduces power consumption from the mill drive and prevents expensive damage to other equipment. Observations indicate a 250% increase in equipment life.

How Trunnion Magnets Work

In a typical grinding mill application, the grinding media eventually fractures and wears into a fine metallic powder because of the heavy re-circulating load in the mill. Energy is unnecessarily wasted to mill the milling media.

As shown in Figure 3, the trunnion magnet is mounted at the ball mill discharge point to replace a trommel screen. It consists of a barrel or "blind trommel" that is mechanically attached to the trunnion or discharge of a ball mill. The barrel rotates around a fixed assembly of ferrite and rare earth magnets positioned on the outside of the barrel.

The stationary magnetic assembly attracts chips and scats to the inside diameter of the barrel. As the ball mill slurry discharges through the barrel, eight strategically placed lifters inside the barrel carry the ball fragments to the top, where they fall onto a sloping discharge chute.

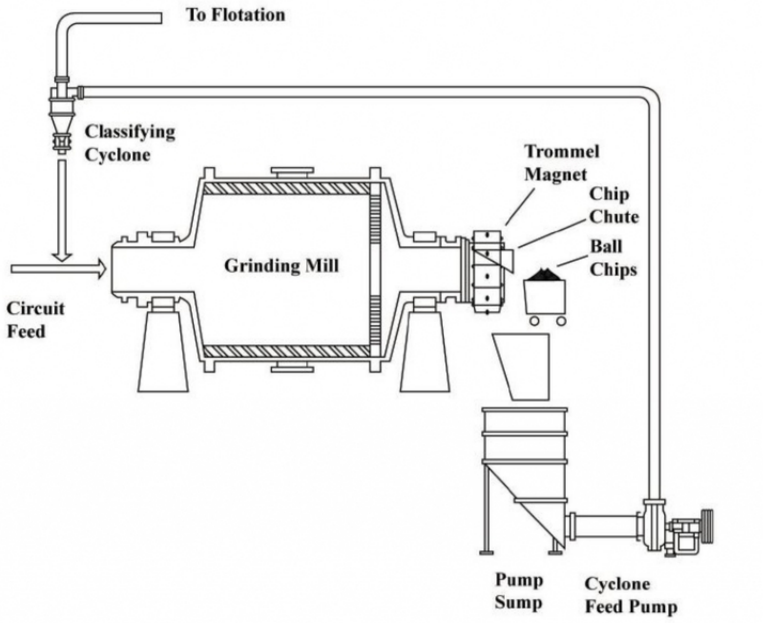

Figure 1. Trunnion magnet replaces the trommel screen.

The Trunnion Magnet System includes four basic components: the blind trommel (barrel), magnet sector, support structure and the discharge hopper.

The barrel, or blind trommel, is a short extension that bolts directly to the discharge flange of the ball mill. Its function is to transport the mill discharge material through the magnetic field. It is fabricated from stainless steel and has an abrasion-resistant wear liner. The barrel is fitted with eight equally spaced bi-metallic cleats, which assist capturing and transporting chips into the discharge area.

The magnet sector consists of permanent magnets and has approximately a 200-degree arc. This magnetic arc is mounted on a steel support pedestal and positioned around the blind trommel. The permanent magnets are enclosed in stainless steel canisters and incorporate a steel backbar for support and projection of the magnetic field. Trunnion magnets can also be installed in bi-directional mills using a magnetic sector that covers 310 degrees.

The discharge hopper and support structure are positioned just inside the blind trommel to collect the grinding ball fragments. The hopper collects the grinding ball fragments as they rotate past the end of the magnetic sector at the top of the blind barrel.

Trunnion Magnet Performance Advantages

To improve performance, Eriez Trunnion Magnets are available in several design variations so they can be matched to specific ball/SAG mill operations. Mill capacity, ball size and other parameters are used to select and specify the design features for each installation.

Besides removing worn grinding media from the ball mill discharge and saving energy, trunnion magnets have other advantages that appeal to SAG mill operators:

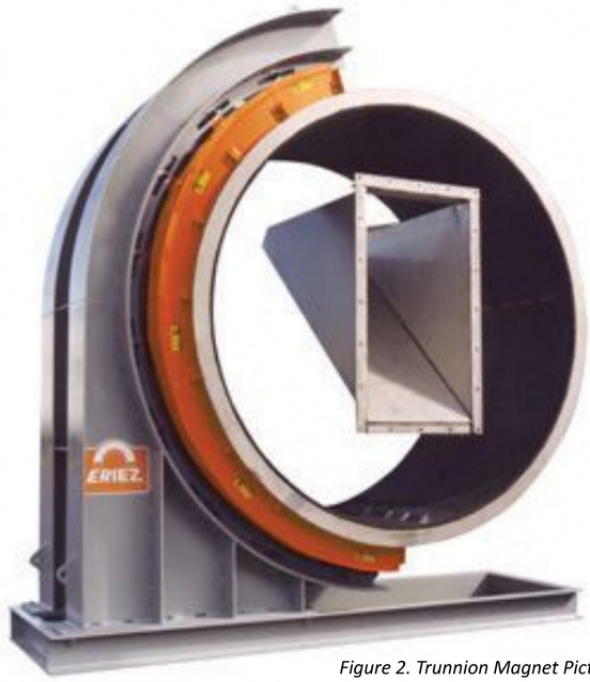

Figure 2. Trunnion Magnet Pictorial View

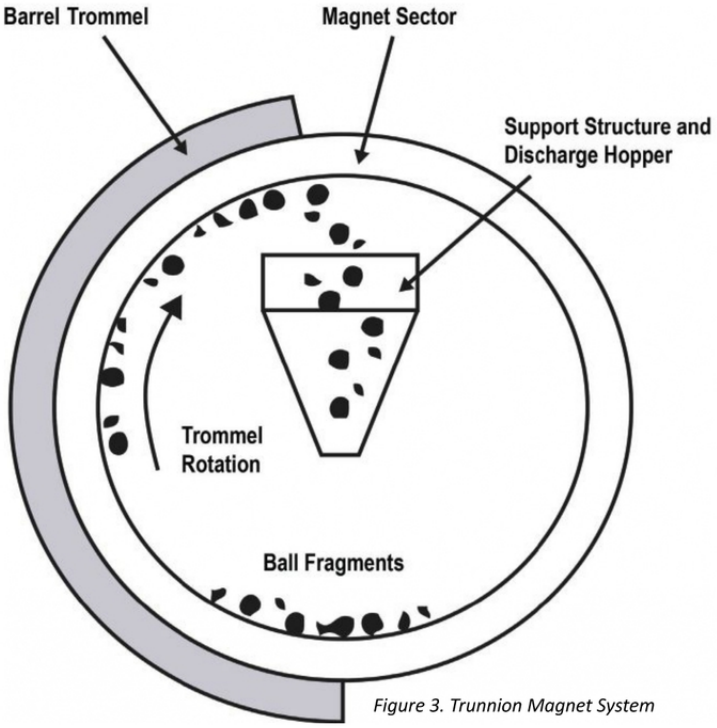

Figure 3. Trunnion Magnet System

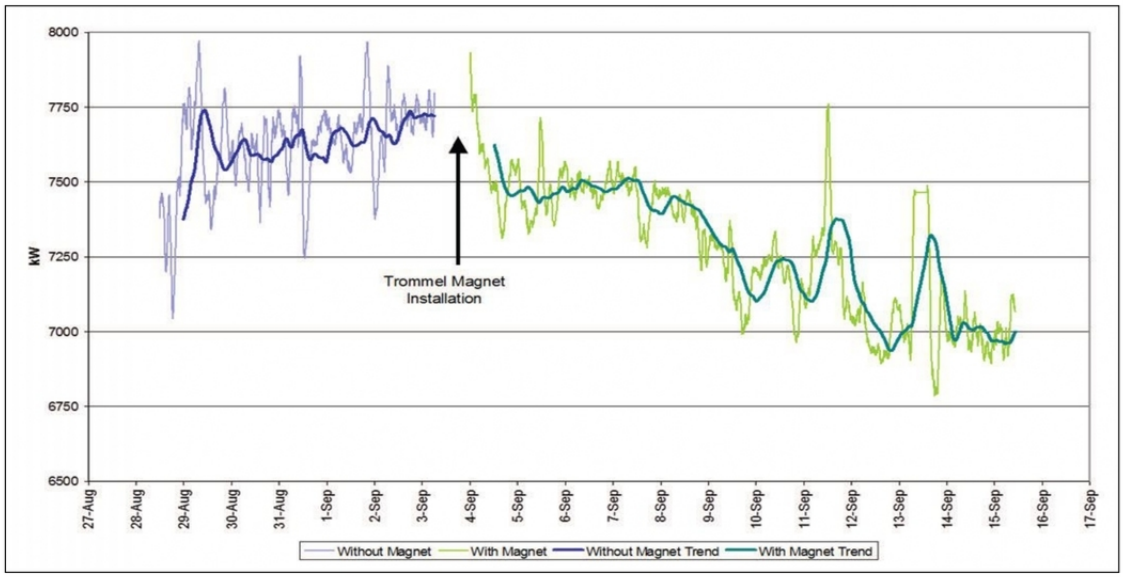

Figure 4. Ball Mill Total kW Before and After Trunnion Magnet

- They eliminate the need for a higher cost trommel screen and its associated maintenance.
- They increase mill throughput up to 5% and many installations increase their mill work index through more efficient grinding.

These advantages translate to significant savings in a yearly basis. Based on this performance, a trunnion magnet can often hit breakeven in its first year of operation.

When designing the trunnion magnet, Eriez considered the magnetic capture of grinding balls/fragments directly opposed by the drag force of the mill discharge slurry. Several techniques were used in the magnet design to compensate for the drag force:

- To increase the magnetic force, high-energy rare earth magnets are used in conjunction with barium ferrite magnets in a hybrid magnetic circuit. This produces a magnetic force that collects essentially all ferrous material, including whole grinding balls.
- To increase the time the mill discharge stream is exposed to the magnetic field, the magnetic arc is extended along the length of the magnet barrel.
- To assist the collection of ball chips, magnetically induced lifters inside the magnet barrel are used.

Economic Justification

The expenses to continue to use a trommel screen should be considered when comparing against costs to buy a trunnion magnet. Potential trunnion magnet users are using the following guidelines to assess the savings possible after installation:

1. Decrease in power consumption of the mill (estimate: 4% to 8%).
2. Replacement cost of trommel screen.
3. Annual maintenance of trommel screen.
4. Reduction in mill work index (estimate: 10%).
5. Replacement cost of hydrocyclone lines or pump components. Mill operators estimate hydrocyclones last 2.5 times longer when a trunnion magnet is used.

As shown in Figure 4, kilowatt usage can be reduced by as much as 750 kW/day or 8%.

A review of these expenses indicates the savings possible by purchasing a trunnion magnet. Some estimates indicate trunnion magnets save as much as $100,000 annually.

Retrofitting With Trunnion Magnets

Depending upon user requirements, several variations and modifications of the Trunnion Magnet System are possible. For example, the magnetic circuit is designed to provide maximum strength for high slurry throughputs and up to 4-in. diameter grinding balls. The trunnion magnet can be configured for reversing or bi-directional mills. In addition, the ball retention ring is fitted in the barrel to prevent full-size balls from exiting the mill.

Conclusion

There are hundreds of installations of Eriez Trunnion Magnets worldwide. This system for separating and removing balls, chips or scats in a typical ball/SAG mill operation replaces the dead weight of ball magnets with fresh ore.

By effectively removing 80% or more of the worn or broken media, the trunnion magnet reduces power consumption from the mill drive and prevents expensive damage to other equipment, such as pumps and hydroycyclones. Cost estimates of a typical 18-ft. diameter mill indicate savings of up to $100,000 per year. ▲

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