KEEP ON CRUSHING

Rick Dreyer, TerraSource™ Global, US, and Mohit Kumar Roy, Coperion Ideal Pvt. Ltd, India,

explain how coal granulators have proven their value when uptime is paramount.

Boasting millions of hours of consistent service, TerraSource Global's Pennsylvania Crusher brand of granulators have demonstrated success in the reduction of coal. More than 1000 granulators have been built since the mid-1930s and more than 800 (or higher than 80%) are still in service today. The granulator's ability to continue operating reliably for decades is one of the main reasons it has been so widely accepted by the coal and utility industries around the globe.

Figure 1. TKK 72 in. x 114 in. granulator installed at National Thermal Power Corp. Ltd in Barh, India.

Figure 2. Clean-out doors on the granulator offer easy access to clean out the tramp iron pocket.

Design enhancements, such as slotted screen plates, bolted frame liners and tramp iron pockets, as well as options like bypass chutes, synchronous cage adjustments and hinged rear quadrant with hydraulic door openers, make maintenance safer and easier, as well as helping to prolong the life of the crusher.

The Pennsylvania Crusher brand TKK Koal-King® granulator, the latest machine design, is the most widely used granulator in the world. About 95% of these machines are used to reduce coal, mainly in power plants and mines.

One such application is at the National Thermal Power Corp. Ltd (NTPC), a state-owned company in Barh, India. NTPC uses a TKK 72 in. x 114 in. granulator to prepare its coal for use in a pulverised coal (PC) boiler (Figure 1). The granulator has been successfully sizing coal from 250 mm down to less than 20 mm size (or nearly 10 in. down to less than 0.75 in.) at capacities of 1760 short tph for the last four years.

Granulators are known to handle wet, frozen, fine and dirty coals with ease. The NTPC plant crushes coal with surface moisture levels that can be as high as 15% during the rainy season and sometimes can be sticky. Because the power plant uses a granulator with non-plugging screen plates, its equipment has had no trouble in these conditions.

How granulators work

Granulators produce a consistent granular product with a minimum of additional fines. They are very similar to one-way hammermills, but they use ring hammers and operate at slower speeds. First, the material flows through the feed opening, down the breaker plate and encounters the overlapping toothed ring hammers. The hammers are attached to the rotor and break the material.

The incoming feed material is directed onto a heavy reversible breaker plate. As the hammers drive the material against the breaker plate, the material is reduced. Final sizing occurs by the rolling compression of the ring hammers as the coal passes over the screen plate. All of this is typically done in one pass through the crushing chamber.

Because the crusher reduces the coal primarily through slow-speed impact crushing, the coal will tend to break along its natural fault lines and produce fewer fines than other types of crushing techniques. This technique also means that the crusher will usually experience success with larger reduction ratios and requires less hp./t of crushed material.

The toothed profile of the hammers keeps them rotating on the suspension bar, providing even hammer wear. The uniform wear pattern results in longer service life per set, reduces downtime and provides greater machine availability.

Properly sized material passes through the screen plates. Any uncrushable material strikes the deflector plate and becomes embedded in the tramp iron pocket along with any fines. Brian Walker, international sales manager for TerraSource Global, explained: "The uncrushable material acts as a projectile and the coal fines that fill up in the tramp iron pocket absorb the energy from that projectile."

Figure 3. A Pennsylvania Crusher TKK granulator after more than four years of consistent and reliable service.

Granulators offer three methods of product size control. "First, we have the size of screen plate openings," said Walker. "Our application engineers set the size of the openings based on the type of the coal and the required product size, and all this is based on previous experience with similar applications. Secondly, there's also the speed of the rotor and finally, the cage setting."

Design advantages

In general, granulators are preferred in mining and power plant applications because they can handle larger feed sizes and higher capacities than many other types of crushers. "Granulators can handle feed sizes of between 10 – 16 in. at capacities anywhere from 100 tph – 4000 tph and at a better reduction ratio," commented Charlie Fleishman, applications manager for TerraSource Global.

In Pennsylvania Crusher brand granulators, the screen plates are interchangeable. This maximises plate life and reduces inventory requirements. The slotted openings allow for greater capacities to be achieved in equivalent size crushers and keep material from building up inside the screen plate openings.

The company's patented, toothed ring, forged steel hammers have a special profile that crushes efficiently, while the alloy forged hammer provides extended service life of the hammer. Tighter tolerances on weight allow the unit to operate with less vibration than with cast hammers. The hammers are arranged for full coverage of the cage, producing consistent crushing and uniform wear of the screen cage.

Bolted frame liners protect the frame during the reduction process. Properly maintaining the liners and replacing them when necessary permits a very long life for the crusher frame.

Bypass chutes are available as an option for customers who have already-to-size coal as part of their feeds. With the bypass chute installed, the pre-sized feed material can be routed around the crushing chamber and returned to the normal discharge area, thus avoiding additional wear to the crusher.

Additionally, customers have the option of choosing thicker and improved wear materials, as well as liners made from harder steels and hydraulic door openers.

Customers also have the option of more than two dozen sizes, from 26 in. x 20 in. to 72 in. x 147 in., where the first number is the diameter of the hammer circles and the second number represents the nominal width of screen plates. Granulators with 26 in. dia. hammers feature two in-line rows of hammers. With 36 in. dia. hammers, the setup is three in-line rows of hammers. In machines with hammers of 44 in. dia. and larger, the granulators use four rows of staggered hammers.

"The biggest advantage of our design is that it is made specifically for our customer's application," says Fleishman. "We've been doing this for a long time. We've listened to our customers and made the changes they've asked for. And we custom design our equipment to meet their requirements."

Maintenance

"One of the best things about granulators is that they're very reliable," said Walker. "They tend to remain up and running with downtime reserved only for planned maintenance."

Planned maintenance might include lubricating the bearings, adjusting the cage to compensate for wear of the crushing elements, replacing the hammers or cleaning out the tramp iron pocket. Because proper maintenance is so important, Pennsylvania Crusher granulators have been designed to make accessing certain areas easier.

The split design of the bearing housings allows the bearings to be flushed and lubricated easily without removing them from the shaft.

Hinged rear quadrants swing completely open and expose the entire rotor assembly and much of the crushing chamber. This produces full and unhindered access for complete removal of the rotor assembly and hammer replacement without disturbing other elements of the feed system.

Clean-out doors, which are shown in Figure 2, make it easy to empty out the tramp iron pocket. This must be done periodically for optimal performance. "This could be once a day or once a week," explains Walker. "It really depends on the plant's operating procedures and their experience with how much tramp iron they receive."

According to Fleishman, if maintenance is kept up and the crusher is fed properly, the equipment can be reasonably expected to last 25 – 40 years. Refurbished machines may get an extra 15 – 20 years of service. Walker agrees with that timeline. "We actually have a granulator out in Birdsboro, Pennsylvania, that's been running for nearly 60 years," he says.

Case study

NTPC is India's largest power company, set up in 1975 to accelerate power development in India. It is emerging as an integrated power major with a significant presence in the entire value chain of power generation business. NTPC is currently generating a capacity of 42.5 GW and plans to triple that production and become a 128 GW company by 2032.

On the basis of experience with similar applications, NTPC chose to run a Pennsylvania Crusher TKK model granulator. TerraSource Global is one of very few crusher manufacturers to have successfully installed capacities of 2000 tph in India. Since late 2009, NTPC has relied on its TKK granulator crusher and it continues to run successfully.

NTPC has experienced that Pennsylvania Crusher models "are more sturdy" and that features like the tramp iron pocket and forged hammers "give the best life in terms of tonnage handled," according to N. K. Verma, AGM (O&M/FM), Barh super thermal power project, NTPC.

Conclusion

Downtime can be extremely costly for miners and power plants. If a machine breaks down, the costs of service to the machine, in addition to lost income, add up very quickly. It is therefore important to have the best equipment in place to get the job done with very limited downtime. Pennsylvania Crusher granulators have proven reliability with decades of recorded service all over the world in all types of coal applications. WC

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