dry cleaning

In the light of increasing pressures when operating wet processing plants, Dr B.K. Parekh, FGXSepTech LLC, US, explores the development and benefits of dry coal separation technology.

Interest in dry coal cleaning technology has increased significantly in recent years due to difficulties in obtaining permits for wet processing plants and the scarcity of water around the world.

One such technology, FGX, has been designed to employ the separation principles of an autogenous medium and a table concentrator (Figure 2). The feed is introduced into a surge bin from which the underflow is controlled using an electro-magnetic feeder. The separation process generates three product steams: clean coal, middling and tailings. Two dust collection systems are employed to clean the recycled air and to remove dust from the air emitted into the atmosphere. The separating compartment consists of a deck, vibrator, air chamber and the suspension system.
A centrifugal fan provides air that passes through holes on the deck surface at a rate sufficient to transport and fluidise the particles. Riffles located on the deck direct material toward a back plate. The deck width is reduced from the feed end to the final refuse discharge end. Upon introduction of feed coal into the separation chamber, a particle bed of certain thickness is formed on top of the deck. The presence of about 10 – 20% < 0.25 in. material in the feed is needed to develop a fluidised autogenous medium particle bed. By controlling the frequency of vibration of the table, as well as its horizontal and longitudinal angles, the low density particles (such as coal) that form the upper layer of particles are collected along the front length of the table. The upward fluidisation velocity is insufficient to fluidise the high density particle (such as rock) and thus they maintain contact with the table surface. Here, both vibration and the continuous influx of new material move the material to the narrow end of the table where the final refuse is collected.

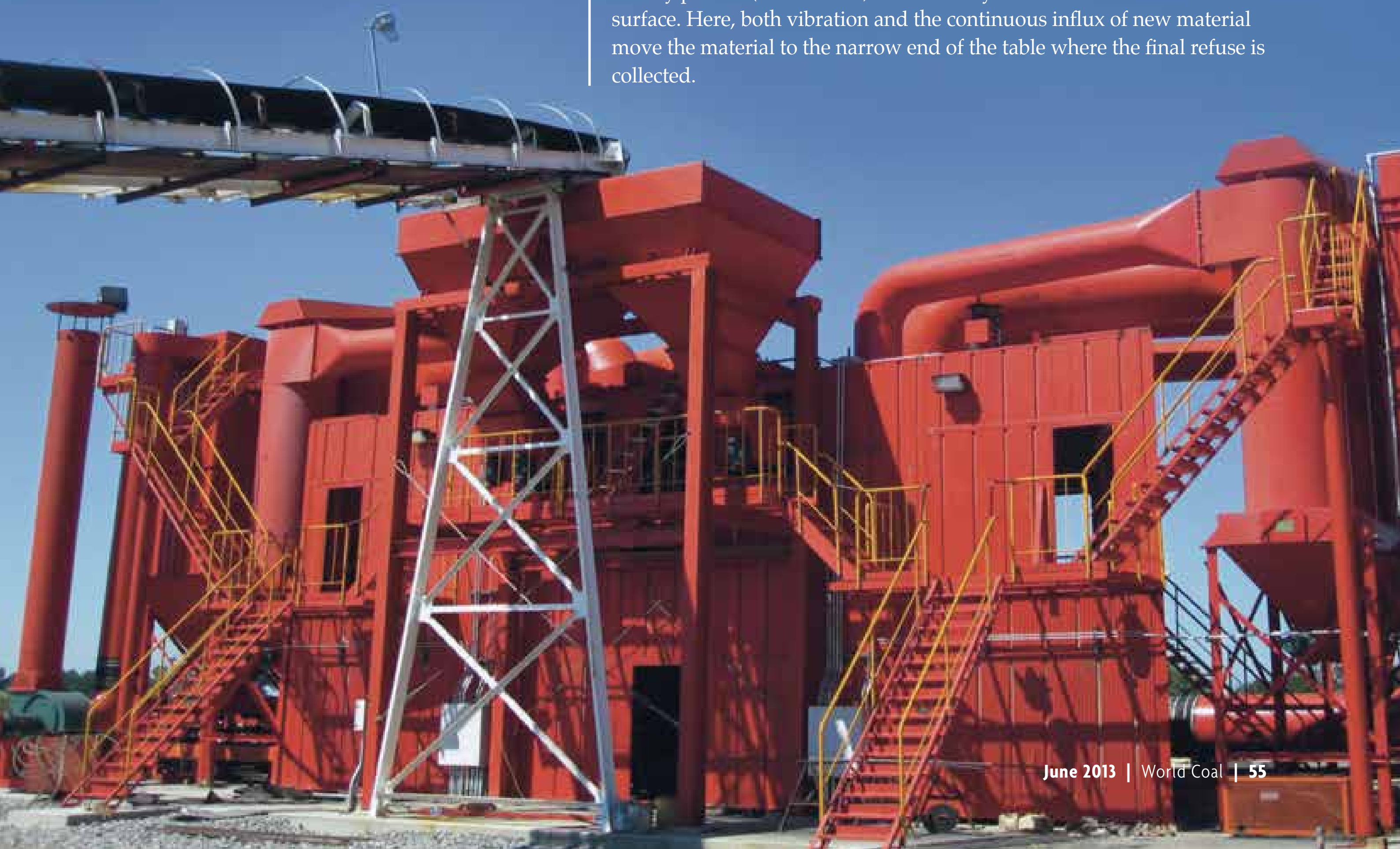

Figure 1. The FGX dry coal separator at Eagle River Mining.

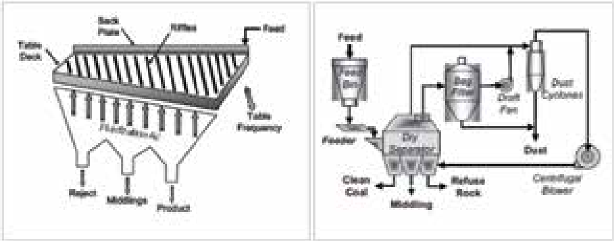

Figure 2. Schematics showing the basic operation of the FGX separator unit.

Figure 3. Distribution of clean coal and tailings on the FGX unit.

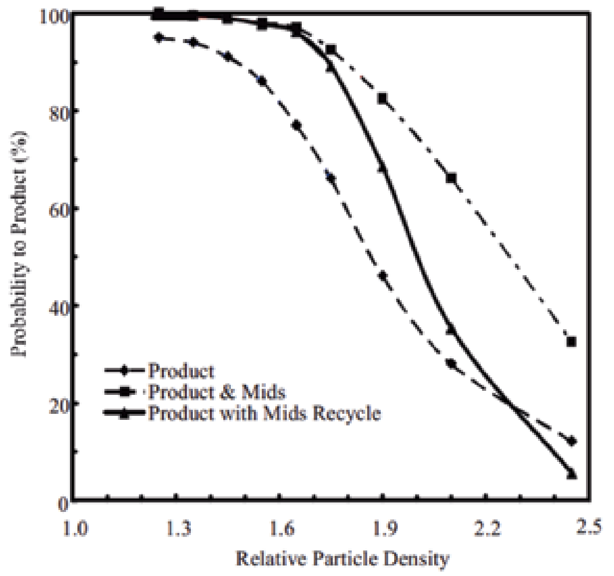

Figure 4. Partition curves for the FGX separator.

Pilot-scale testing

At present, there are more than 1000 installations of FGX units throughout the world, with the majority of these in China. Pilot-scale testing of the FGX unit has been conducted by various researchers globally. Honaker *et al.* conducted a detailed pilot-scale study on the beneficiation of bituminous, low rank coals and coal from gob piles.[1] The study concluded that the FGX system provided clean coal from the bituminous coal: average feed ash content was reduced from 18.21% to 10.76%; sulfur content from 1.61% to 1.49% in the clean coal; and the mass yield averaged 76.8% of the total feed weight. The average ash and sulfur contents in the tailings stream were 72% and 2.67%, respectively. For another Central Appalachian coal, the FGX system reduced ash content from a feed of 49.27% to about 15% at a yield of 49.5%. The ash content in the reject averaged 89.17%. A typical separation is shown in Figure 3.

In addition, the process efficiency of the system was evaluated. Partition curves from the washability data obtained for samples collected for a test concluded that ash was reduced from 16.44% to 9.87%, while recovering 82.9% of the feed coal. The experimental data produced two partition curves (Figure 4):

- Curve 1 represents the separation between the product and middlings streams (i.e., middling and tailing material combined as total reject).
- Curve 2 reflects the separation between the middling and tailing stream (i.e., product and middling combined) as a total clean coal product. By recycling the middling stream, the separation density was approximately 2 RD and the Ep value was 0.17.

When tested on Powder River Basin low-rank rib coal, which is normally kept in the pit as fill material, a feed ash of 20.79%, a clean coal containing 8.4% ash at an yield of 78.96%, and an energy recovery of 90.84% was obtained.

For Gulf Coast lignite, the ash content was reduced from 6.59% to 4.86%, while sulfur was reduced from 1.91% to 1.23%. Despite the low feed ash, the average mass yield to the product stream was 79%. The most significant impact was the reduction in sulfur and mercury. The average total sulfur reduction was 34.8%, which equates to an average SO_2(lb/Mbtu) reduction of 35.8%. Mercury reduction averaged 54.4%.

Installation

In 2011, a commercial FGX plant capable of processing 250 tph of high sulfur coal was installed at the Eagle River mine near Harrisburg, Illinois, US, (Figure 1). The plant has now been in operation for more than a year, providing a clean coal from a feed ash of 18% to 9%, and sulfur from 4.9% to 3.5% at a yield of 80%. The plant flowsheet involves screening the ROM coal at 3 in. The > 3 in. material is fed to the accelerator, which breaks coal and provides < 3 in. material for the table. The accelerator rejects the > 3 in. rocks and pyretic sulfur. The accelerator provides consistent feed (3 in. x 0) to the FGX unit.

Economics

It is estimated that for a FGX-12 unit processing about 120 tph of raw coal, the total capital, installation and operating cost for cleaning coal will be US$ 0.91/t of raw coal and US$ 1.56/t of clean coal. The operating cost itself was estimated to be US$ 0.69/t of raw coal and US$ 1.19/t of clean coal.[2] WC

References

1. HONAKER R., *et al.*, "Development of an advanced deshaling technology to improve the energy efficiency of coal handling, processing, and utilization operations", US DOE ID Number: DE-FC26-05NT42501 (2010). Available at: http://sciencepolicy.colorado.edu/students/envs_5720/honaker_2010.pdf
2. MOHANTY, M.K., *et al.*, "Evaluation of FGX Dry Separator for cleaning Illinois coal", ICCI Project No. 08/4.1A-4 (2010).