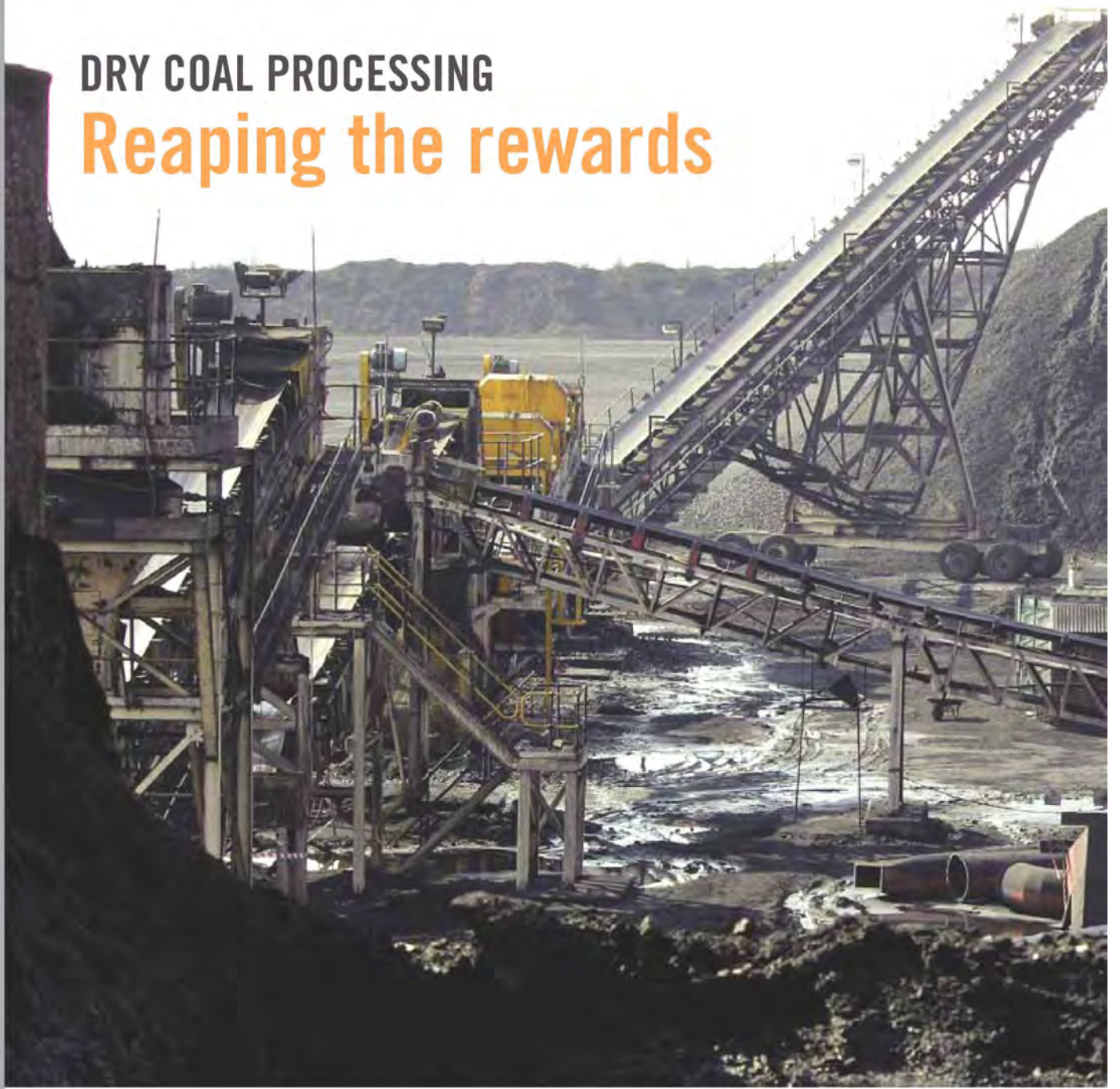
DRY COAL PROCESSING

Reaping the rewards



Shanduka Coal's Middelkraal Colliery in the Mpumalanga coalfield is reaping major cost and environmental benefits from the unique air separation unit it commissioned towards the end of 2010.

The Shanduka Coal operations comprise the Graspan, Townlands and Springlake collieries. Umcebo Mining in turn comprised Middelkraal, Kleinfontein and Klippan collieries – these operations are now all managed by Shanduka Coal.

Middelkraal Colliery is south of Optimum Coal's Koornfontein operation on the Bethal road in Mpumalanga.

The satellite operation supplies 565-million tonnes of coal per annum (mtpa), predominantly as domestic product to Eskom. It is an opencast mine, and mines the number two coal seam (reaching a thickness of as much as 16 m in some places).

Middelkraal outsources most of its mining and processing activities to Genet Mining and Genet Mineral Processing and employs 783 contract workers and 30 permanent employees.

The most unique feature of Middelkraal Colliery, however, is its FGX air processing plant.

THE VALUE OF DRY PROCESSING

The plant was commissioned in 2010 and started operating early in 2011.

Article by Nicola Theunissen

Photographs by Nicola Theunissen

The capital cost of the project amounted to R55-million (about US$6,2-million), including all ancillary screens, crushers and conveyor systems.

The capital cost of the plant is therefore significantly lower than that of a similar sized, conventional dense media separation (DMS) plant. Bearing in mind that the process does not require any magnetite or water, the operating costs are, in principle, also lower than that of traditional DMS technology.

"The technology provides a cost-effective solution for upgrading low ranking coal through de-shaling. No water is used in the process and subsequently no slurry or polluted water is produced. Capital investment costs are, as such, also reduced, as there is no requirement for pollution control and slurry management facilities," says Johan Cowan, processing manager for Genet Mineral Processing, who developed and commissioned the plant at Middelkraal.

Shanduka Coal's chief operating officer Zirk van der Bank informs that the air plant runs at a third of the costs of comparative DMS plants.

In terms of maintenance, the plant does not have any pumps, screens or other high-care equipment, so maintenance is a relatively straightforward job, which further reduces operating costs over the long-term.

The technology is unique to South Africa, informs Cowan. "The plants are manufactured abroad and imported, erected and commissioned by Genet Mineral Processing. Genet Mineral Processing has four air plant units in South Africa, one FGX-1 test plant and three FGX-24A production units".

The technology is utilised widely in China, particularly in arid areas and areas that experience extreme cold, where the use of conventional dense medium separation is not possible.

Middelkraal Colliery is located close to Bethal in Mpumalanga. The operation supplies 565-million tonnes of coal per annum (mtpa), most of it as domestic product to Eskom.

Photographs by Nitolia Theunissen

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QUANTUM PRODUCTION LEAP

In May 2012, the air plant achieved a remarkable production target of 400 000 tonnes (t), which Van der Bank describes as a "quantum jump in production." The highest output the plant achieved prior to its May milestone was 336 000 t. As such, Middelkraal colliery is one of the best performing operations inside the Shanduka Coal/Umcebo stable.

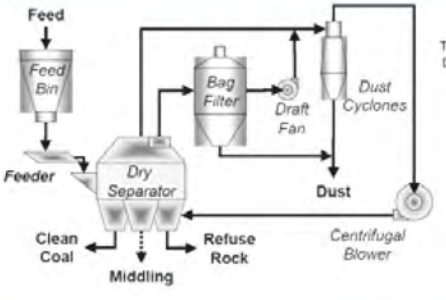
In terms of in-pit and stockpile blending, Cowan says any process prefers a constant feed as this allows for the optimisation of settings, and that the blending requirements of the air plant do not deviate majorly from the blending specifications for conventional DMS processing.

However, Thys de Bruin, the general manager of Middelkraal Colliery, points out that the biggest challenge of operating the plant is to ensure that you obtain the right coal mix, before feeding the run of mine (ROM) coal to the plant. "The plant can handle a certain band of qualities and once you go outside those bands, you do not get the desirable end-product. We have to carefully blend the ROM tonnages," says De Bruin.

The operations team managed to achieve the 400 000 t milestone production target because of the good blending practices they applied. According to De Bruin the team had a 100 000 t stockpile of varying qualities to work with which enabled a record production output from the plant. "Blending is absolutely critical," he says.

The plant has some operating limitations. "It cannot upgrade coal to export qualities, but it is a very effective de-stoning plant, and well suited for lower-grade coal beneficiation. With a DMS plant you can cut at an exact density, and get the precise quality you require. With the air plant you operate within a range of specifications, and you can only produce quality within that range," notes Van der Bank.

Compared to DMS technology the air plant may therefore not be as sufficient, and it is only suitable for specific densities. "The plant is slightly less efficient when compared with dense media separation and it is only suitable for high cut densities," Cowan confirms. The minimum separation density that the air plant is able to cut at is -1.80.



Photographs by Nicola Theunissen

THE DE-SHALING PROCESS

The separation process is relatively simple. Coal is de-shaled over a vibrating screen used in combination with high volumes of air. The method integrates the separation principles of autogenous medium separation and conventional table concentration. Three product streams are obtained through the process namely de-shaled product, middlings and discard.

"The plant also employs two dust collection systems to prevent dust from being emitted into the atmosphere, which makes the technology environmentally friendly," Cowan informs.

In terms of using the technology for other commodities Cowan informs that various test work has been conducted at the Genet mineral processing test plant on duplicating the process. The research is conducted in partnership with CoalTech 2020, and the Council for Scientific and Industrial Researches' (CSIR) coal research arm.

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Description	Air plant	DMS plant
Process Water	None required	Requires water
Thickeners and flocculant dosing	None required	Require thickeners and flocculant dosing
Slurry ponds	None required	Requires slurry disposal
Dewatering of fine product – (Centrifuges)	None required	Requires dewatering of fine products
Maintenance of slurry Pumps, CM pumps, etc.	None required	Requires maintenance
Installed power	Less than DMS plant of similar capacity	Higher than air plant of similar capacity
Capital expenditure	Less than DMS plant of similar capacity	Higher than air plant of similar capacity
Rehabilitation liability	Limited – no slurry ponds	Rehabilitation of slurry disposal system
Operation and maintenance costs	Less than DMS plant of similar capacity	Higher than air plant of similar capacity
Beneficiation of near dense material	Application limited	Suitable for beneficiation of near dense material
Feed material fines moisture >10%	Prefer to screen out fines with moisture >10%	Suitable for beneficiation wet fines

A SOLUTION FOR WATER-SCARCE REGIONS

For some time now, the Waterberg coalfield has been described as a viable solution to South Africa's depleting coal resources. Estimates put the Waterberg coal reserves at about 75 billion tonnes – making up 40% of South Africa's remaining coal reserves.

Mining companies in the area are investigating several alternative water supply sources in partnership with government, and continuously investigate water-saving technologies to increase the viability of mining in the environmentally sensitive region.

In a previous interview in *Mining Mirror*, Peter Shepherd, partner and principal hydrologist at SRK said although underground aquifers are a potential source of water in the Waterberg, it will not be enough to sustain a series of coal mines in the Waterberg over the long-term.

The solutions are:

1) an inter-basin water transfer, and
2) smarter water usage by mining companies.

Cowan believes that dry processing technology such as air separation will become a viable processing technology for the Waterberg coalfield in the future, because of its water scarcity.

"It is a low-cost dry process with easy operation and low maintenance. It is environmentally friendly and able to remove pyretic sulphur in high-sulphur coal," he concludes. ✪

Operating principles:

- The feed enters the table from the far-right corner;
- fluidisation air is injected through holes in the table;
- light particles (coal) becomes fluidised with the assistance of autogenous medium (-6mm material);
- fluidised coal is transported toward the front of the table and discharged on the right side;
- high-density material remains in contact with the table;
- vibration motion moves the heavy material back and to the left, and
- product, middling and tailing.