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Weir Mineral's Cavex® Hyrdocyclone Shines In Diamonds

The successful performance of Weir Minerals' Cavex® hydrocyclones at a diamond mine in South Africa's Northern Cape Province has proved the technology's applicability in dense medium separation (DMS) plants treating diamondiferous material.

In her presentation to the Southern African Institute of Mining and Metallurgy (SAIMM) diamond conference in Johannesburg in 2018, Weir Minerals Africa's Senior Process Engineer, Boitumelo Zimba, said the hydrocyclones improved plant efficiencies and produced 40% more tonnage than the mine's target.

"As the Cavex hydrocyclone is tried and tested in hard rock mining and coal classification, the Cavex 360° laminar spiral inlet profile was used as a basis for the development of a dense medium cyclone," Zimba said. "Individual casting patterns were developed and produced in order to fabricate the Cavex dense medium hard chrome cyclone with the exact laminar spiral feed chamber that exists when moulded out of rubber."

The customer required a solution that could offer at least six months wear-life, and a probable error of separation (Ep) of no greater than 0,08 at a cut density of 3,1 tonnes per cubic metre (t/m^3). Tracer tests were used to monitor the efficiency of the separation achieved by the Cavex® hydrocyclones to ensure all of these requirements were met.

"Ep values achieved were 0,042 for the 4 mm tracer tests and 0,035 for the 8 mm tracer tests, which were below the set maximum target of 0,08 from the mine," Zimba said. "This highlighted the benefits and improved efficiencies of the Cavex laminar spiral feed inlet."

The lower the Ep – or probable error of separation – the more efficient the separation; it is defined as half the difference between the density at which 75% is recovered to sinks, and that at which 25% is recovered to sinks.

“The customer’s tracer tests on the Cavex hydrocyclones showed that cut points of 3,08 t/m^3 were achieved for both the 4 mm and 8 mm tracers,” Zimba said. “This was within the performance levels of 3,1 t/m^3 that the customer had specified.”

Initially, the hydrocyclones were commissioned to treat only fines at the diamond plant – the minus 8+1 mm material. Later however, the mine decided to run a combined DMS, after which the full DMS size range of minus 20+1 mm was treated through all the fines DMS hydrocyclones.

The unique design of the laminar spiral inlet geometry delivers sharper separation and maximises capacity while delivering a longer wear-life than conventional involute or tangential feed inlet designs. By providing a natural flow path into the hydrocyclone body the design allows the feed stream to blend smoothly with the rotating slurry inside the chamber, reducing turbulence and improving separation efficiency.

“Combining our cone and spigot components in the hard metal range is an important contribution to the reduction in turbulence,” Zimba explained. “Another vital factor is the Cavex inlet design with 360 degree scroll; this design was proven through extensive computational fluid dynamics (CFD) analysis as well as our multiple installations to date.”

Weir Minerals also conducts ongoing research and development on methods to minimise turbulence on assembled casted components. The Cavex® hydrocyclones are designed with a variety of inlet sizes to accommodate a wide top size at specified medium-to-ore ratios. The inlet sizes range from 0,2 to 0,33 as a function of the hydrocyclone diameter.

The Cavex® CVX hydrocyclone also has a wide range of vortex finder sizes to maintain separation efficiency at different operating yields and spigot sizes. The vortex finder sizes range from 0,4 to 0,5 as a function of cyclone diameter, and are designed to maintain a strong air-core at different spigot sizes.

To prolong life and efficiency, the hydrocyclones can also be manufactured with different materials. Cavex® CVXA hydrocyclones are hard-wearing and are cast in 27% chromium iron for maximum abrasion resistance; components are designed for ease of maintenance, with all surfaces joined with a layer of epoxy cement.

“Our focus on supplying best-in-class technology includes developing components that offer low wear rates,” said Zimba. “This is achieved by using a combination of materials with different wear rates in a range of hydrocyclone parts. This is made possible by our global technological expertise that allows us to cast components using various alloys, depending on the type and abrasiveness of the ore being treated.”

Weir Minerals Africa operates two foundries in South Africa - one at its Isando facility and the other at its Heavy Bay Foundry in Port Elizabeth. This allows the organisation to cast items in-house leveraging its local foundry personnel’s knowledge, experience and expertise, ensuring that the highest standards are maintained.

This approach ensures optimal life of the hydrocyclone in operation, and reduced maintenance costs by replacing worn parts in situ. It also eliminates the risk of any adverse effects on performance arising from mixing old and new hydrocyclone components. Further, safety on site is enhanced by minimising the maintenance work necessary on the installed hydrocyclones.

“Future work will include the investigation of various alloys to combat high wear rates on some of the hydrocyclone components, in particular the vortex finder and the cone sections,” Zimba said. “This will allow longer operation and plant stability.”

CAVEX PIC 01 : The Cavex CVXA dense media cyclone.

CAVEX PIC 02 : Two Cavex CVXA20 hydrocyclones installed at a diamond mine.

CAVEX PIC 03 : Regular wear rate measurements are taken using a thickness gauge.

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