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The geometallurgy of the Namakwa Sands heavy mineral deposit: challenges and solutions

Philander, C.[1] and Rozendaal, A.[2]

[1] Tronox Limited, South Africa, carlo.philander@tronox.com
[2] Stellenbosch University, South Africa, ar@sun.ac.za

Geometallurgy offers significant value to the mineral processing industry, and as a result Tronox Namakwa Sands, a mineral sands producer of global significance followed a novel approach to cost-effectively incorporate geometallurgy into its mineral resource management strategy. Geological qualifiers and XRF analyses augmented by XRD, QEMSCAN, electron microprobe and LA-ICP-MS analyses were used to characterise the Namakwa Sands mineral resources into statistically defined domains and zones.

The Namakwa Sands mega-deposit hosts a diverse heavy mineral assemblage that exhibits striking variations in mineral chemistry and physical characteristics. Contrasting valuable mineral and gangue THM relationships, unfavourable mineral liberation characteristics, miscellaneous clay minerals, varied magnetic susceptibilities, dispersed particle size distributions as well as considerable oversize and slimes quantities indicate a challenging processing character [1].

The impact of these ore/mineral characteristics on process performance indicators such as throughput, grade, recovery and quality will be illustrated during the presentation.

Duricrust (cemented ore) presents the most significant throughput constraint and five duricrust types differing in geochemistry, mineralogy and grindability were identified, which helped with a project to improve commuinition.

Only mineral grade, liberation, magnetic deportment, particle size and particle chemistry were established as meaningful mineral recovery drivers. The recovery of valuable minerals during primary concentration, which entails wet spiral separation, is mainly an inverse function of gangue grade. This study confirms that duricrust cementing agents are the key contributor to poor mineral liberation, which result in significant tailings losses during spiral separation. Variations in the magnetic susceptibility of the heavy mineral fraction, subtract significantly from mineral recoveries during wet magnetic secondary concentration.

Particle chemistry becomes an important recovery driver during final mineral separation due to the sensitive trade-off between stringent product quality specifications and mineral recovery. Ilmenite recovery for instance is mainly controlled by the intricate deportment of SiO2, a key product quality penalty that is intimately locked with the ilmenite host as surface coatings and silicate inclusions. Similarly, the deportment of the penalty elements Fe, Ti, U and Th, which reach high concentrations in coloured zircon varieties, are complex and present major constraints to the recovery of the current zircon population.

Several proposals to address these constraints are mainly directed to better align mineral resource characteristics, processing technology and market dynamics. Currently, there is a methodical focus to investigate alternative technologies and research the latest developments in heavy mineral separation to help narrow the gap between actual mineral recoveries and determined recovery potential [2].

References:

[1] Philander C and Rozendaal A (2008) 9th ICAM Proceedings: 459–464

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