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Mineralogical analysis of a fluorspar deposit: A case study from three ore zones at the Okorusu fluorspar Mine, Namibia

Sebola T.P. [1], Gryffenberg L.[2]
[1]Mineralogy Division, Mintek, 200 Malibongwe Drive, Randburg, 2125, South Africa, piets@mintek.co.za
[2]Stitchwise, 1 Nursery Rd, Western Levels, Carletonville, 2499, South Africa

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The Okorusu fluorspar mine has been a producer of pure acid-grade fluorite concentrate for over 25 years, with an annual production of about 120 000t. The mine depleted its high grade zones (35 – 40% CaF_2) with low grade, potentially uneconomic zones (17 – 25% CaF_2) remaining. A mineralogical study was undertaken to determine the reasons for the decrease in fluorite recoveries in the flotation plant on production from the low grade zones. Thirty-three drill core samples from three different mining pits, namely, D-Top, D-Bottom and E pits, and six plant samples were assessed in order to establish an economic, alternative processing method.

Scanning electron microscopy (SEM) results of three samples from E Pit show an average grain size of liberated fluorite of ~2 mm to 3 mm, with minor occurrence of fluorite containing inclusions of barite, apatite and synchysite, but high association of fluorite grains with these minerals through grain attachment. These associations do not affect the purity of the fluorite grains and the gangue can be separated from the fluorite grains. From the four D-Top samples that were assessed, one sample is barren of fluorite. There is little association of fluorite with barite and strontianite in the other three D-Top samples; these gangue minerals occur as minor inclusions and veinlets within the fluorite grains. The matrix in the D-Top samples is mainly composed of ankerite and K-feldspar. Good fluorite liberation is exhibited in 26 samples from D-Bottom pit. Fluorite grain size ranges from 150 µm to 3 mm. These well-developed fluorite occurrences are generally from the centre of the D- Bottom area. In seven of the samples, fluorite grains show inclusions of apatite, ankerite, strontianite and barite; these inclusions affect the quality and purity of the fluorite; fine grinding can be applied to separate fluorite from these gangue mineral inclusions.

Six pilot plant samples were analysed using the Mineral Liberation Analyzer (MLA). The samples are feeds and concentrates from the D-Top pit. The feed samples show low grades of 23.48% CaF_2, 10.08% CaF_2 and 12.91% CaF_2, respectively. They were upgraded to concentrates of 77% CaF_2, 85% CaF_2 and 43% CaF_2 respectively, with the latter affected by high presence and association of phosphates. The presence of clay minerals in these samples increases the flotation reagent consumption and therefore negatively affects the economics of the plant operation.

Despite the coarser fluorite grains (up to 3 mm) in the E Pit, the mineralogical analysis revealed that the D-Top and D- Bottom ores have become more complex with increased overgrowths and inclusions within the fluorite grains. The ore will need to be ground to at least 100% passing 80 µm in order to

recover cleaner fluorite grains with few impurities from the gangue mineral. A different flotation reagent could also be considered to reduce the clay mineral reagent consumption in ores from the D-Top pit. This study therefore shows that mineral properties such as grain size, liberation and associations of fluorite with gangue minerals play a significant role in the recovery of fluorite.