Introducing micro-pelletised zinc concentrates into fluidised solid roasters

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Research conducted in the Department of Materials Science and Metallurgical Engineering at the University of Pretoria focused on the introduction of micro-pelletised zinc concentrates into the fluidised solid roasters at Zincor, a refinery in South Africa.

Zincor uses the conventional roast-leach-electrowinning process to produce zinc metal. The roasting process of ZnS concentrate makes use of four Lurgi fluidised bed roasters to produce calcine (which contains ZnO and $ZnFe_2O_4$ as zinc products) and SO_2 gas. The roasting plant consists of two 18 m^2 and two 35 m^2 cross-sectional area roasters.

Prior to 1996, Zincor utilised air as the only oxidant and fluidising medium in its roasters. The maximum dry feed rates that the roasters could process were 6.5 t/d.m^2. In an attempt to increase production, oxygen enrichment was first trialed. The ability of oxygen enrichment to increase the rate of the ZnS oxidation reaction allowed higher feed rates to the roasters. This was successful and oxygen enrichment of the fluidising air up to 26% of total oxygen was permanently implemented. That enabled dry feed rates to be maintained at 7.0 t/d.m^2 and 7.3 t/d.m^2 for the small and big roasters respectively. Due to the highly competitive nature of the zinc industry, innovative processing techniques are necessary.

The aim of this study was to determine whether oxygen enrichment could be reduced by introducing micro-pelletised concentrate into the roaster feed blend, while maintaining current roaster feed rates and calcine quality. This study was executed in four parts. Firstly, the role entrainment plays in influencing average particle residence time was considered. Secondly, a study was made of production methods for stable micro-pellets. Thirdly, the influence of oxygen enrichment and particle size on the roasting rate of micro-pellets was studied. The fourth part of the study was a pilot trial for the introduction of micro-pellets into the Zincor roasters.

The particle size distribution of a typical blend of feed concentrate to the roasters has been decreasing with time, and 50% is now passing approximately 48 µm. This leads to entrainment values between 87% and 91%. The micro-pelletisation process reduces the –500 µm fraction from 87% to 10%, which degrades to 30% during roasting. This requires that approximately 48% of the concentrate needs to be micro-pelletised to restore the 70% designed entrainment target.

It was determined that entrained particles spend 0.46 to 2.44 hours on average in the roaster bed, compared to particles in the bed overflow that have residence times between 3.93 and 4.00 hours. The experimentally determined reaction time for micro-pellets was found to be far below their actual residence time in a Zincor roaster. Thus complete conversion of micro-pellets can take place.

With a load of 20% micro-pellets introduced into the feed concentrate, it was found that the oxygen enrichment could be reduced by 60% to 23% of total oxygen. The quality of the calcine produced was maintained above the target of 98.8% ZnS to ZnO conversion. The results of this study have shown that the use of the micro-pelletisation of concentrate at Zincor successfully reduces the entrainment of particles. The manipulation of entrainment through micro-pelletisation can be used successfully to reduce oxygen enrichment, while improving production and maintaining quality at Zincor.

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