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ABSTRACT

THE APPLICATION OF DUAL ENERGY X-RAY TRANSMISSION SORTING TO THE SEPARATION OF COAL FROM TORBANITE

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Dual Energy X-Ray Transmission (DE-XRT) Imaging is a multi-sensor technique employed to conduct particle-by-particle sorting. The system makes use of a dual energy x-ray line scan sensor, which generates images of the transmitted x-rays, similar to images generated for suitcase inspection in airport security applications. The dual energy x-ray system allows for rapid approximation of atomic number range, which is utilised to evaluate the mineral and maceral content of a variety of minerals, including coal. The process is independent of particle surface condition, and can thus be utilised as a dry process.

A unique application of this technology is in the removal of torbanite from a coal deposit located in Mpumalanga, South Africa. The separation of coal from torbanite has been a problem for the coal industry for a long time. The separation of coal and torbanite by conventional gravity separation techniques is difficult, due to the overlapping densities of torbanite and coal. The commercial value of both commodities is significantly compromised if contaminated with the other, thus impacting negatively on the financial viability of mining such a deposit.

Preliminary laboratory DE-XRT testwork results on high quality coal and torbanite products were promising. In order to evaluate the separation of typical Run of Mine (ROM) material on pilot scale, a production scale Mikrosort X-Tract Sorter was purchased. This was the first DE-XRT sorter available in South Africa, and was housed at Mintek in Johannesburg. A 150t sample was provided from a box cut adjacent to the coal deposit under investigation in order to conduct bulk and pilot sorting tests, the focus of which was on obtaining coal products of low ash and torbanite content.

Clear distinctions between the coal, torbanite and shale fractions were observed using this technique. The sorter feed (-80mm+20mm) could be upgraded from a CV of 22MJ/kg to 28MJ/kg. Ash content could be reduced from 26% to 10%, which meets export quality standards.

Petrographic analysis of the coal product indicated that a high purity coal product (in terms of torbanite and ash content) was attainable (91% by volume) at a mass yield of 42.9% to the coal product, with shale and mixed humic/sapropelic coal as contaminants. Under these conditions, torbanite contamination was marginal.

It was demonstrated that shale could be removed from the torbanite product via a second sorting stage. This however was not the primary focus of the study, and was not optimised for this investigation.

Two major limitations of the sorting process were identified, viz.; poor liberation and limited sorter feed size range. These impacted on the process as follows:-

- The effects of poor liberation on coal quality could be counteracted by adjusting the sorting criteria of the algorithm to reject additional material. This would result in a lower coal product mass yield. In addition, interlocked coal/shale particles would report to the torbanite fraction.
- A significant proportion of the ROM feed reported to the -20mm size fraction, and therefore did not fall part of the sorter feed. This resulted in a very low coal mass yield as a proportion of the ROM feed. If this process were to be adopted, means of minimizing fines production during mining and crushing would need to be investigated to improve overall yield to coal product.

The capability to process coarse materials (-80mm+20mm) allows for throughputs in excess of 40t/hr. Consequently, this technique may be applied in simpler coal upgrading processes, such as coal deshaling in arid regions.