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Identifying the mineral drivers of abrasiveness in the Waterberg coal reserve

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Coal has an inherent quality of abrasiveness that results in the damage of equipment in coal processing plants and also in the process of the end-client that will burn the fuel. Grootegeluk coal mine measures the Abrasiveness Index (AI) of the products dispatched, and it has been observed that the trend of AI spanning over the last 2 years is increasing. Previous work around the problem has focused on the AI test procedure accuracy and sample collection procedures, however, there has been limited work conducted from a mineralogical perspective to allow for improved scientific insight.

In this paper it is proposed that an AI predictive tool can be developed utilising mineral concentrations as inputs. The scientific basis for the proposed approach is supported by the notion that the mineral matter found in the coal is harder, and therefore more abrasive than the carbonaceous material found in coal.

21 samples of a known abrasiveness were dispatched for X-ray Fluorescence (XRF) and X-ray Diffraction (XRD) analysis. The XRD analysis provided insight into the mineral phases common within the samples which included kaolinite, pyrite, siderite, mica, quartz and apatite. With knowledge of the minerals present and the corresponding AI, a model was developed using the mineral concentrations as inputs. Figure 1 shows the predicted and measured AI values.

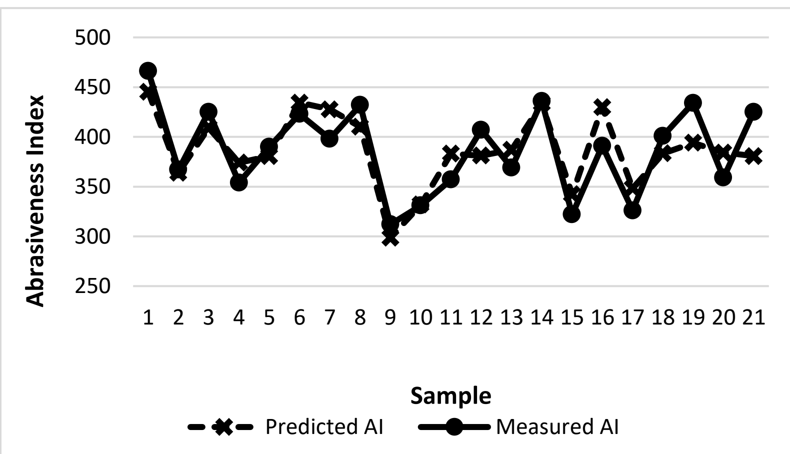

Figure 1: Predicted and measured AI value for 21 samples

In addition to this, further work demonstrated that it is possible to predict the mineral concentrations in the reserve using the XRF data from the geological drill core samples. By applying stoichiometric calculations to the elemental data supplied by the XRF analysis, a spreadsheet was developed to translate elemental inputs to mineral concentrations. This was validated using the elemental and mineral concentration data from the 21 sample set. The calculated mineral concentrations of the reserve provided the necessary insight to confirm the main contributing mineral drivers of abrasiveness.

It was found that the AI could be predicted using mineral concentrations as inputs with limited accuracy. A recommendation for an improved model is provided - further tests such as QEMSCAN analysis must be included to provide insight into the particle mapping and spatial arrangements of the minerals within the sample. The main mineral constituent attributing to the AI problem in the Waterberg coalfield was found to be quartz, which exists in higher concentrations in the upper benches and is spread homogenously throughout the coal samples. This finding is aligned with the observed trend – plants processing top bench material have more abrasive products.