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An investigation into the use of borates to improve coke CSR/CRI when blending metallurgical coal to make blast furnace coke

Musiiwa, Admire

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ABSTRACT

The availability of prime metallurgical coking coals is limited in Africa. This lack of good coking coals results in steel manufacturers (ArcelorMittal in particular) incurring high costs when importing the necessary prime coking coals from abroad. Such products are then mixed with local partially-coking "blend" coals. The need therefore is to find alternative methods to obtain substitutes for imported costly coking coals or to blend local coals in a manner that would achieve the same technical properties of products comprising prime coking coals in a blend. If achievable, this would have the added benefit of reducing expensive imported prime coking coals (mainly from Australia) and would ensure a more cost-effective product for use in the vital iron and steelmaking process in South Africa. Most imported coals from Australia are three times more expensive compared to local blend coking coals.

ArcelorMittal has been using blends that contain prime coking coals from Mozambique, North America and Australia and have so far only been able to incorporate up to a maximum of 30% of the local South African "blend" coking coals, these arising primarily from Grootegeluk Colliery, Lephalale in the Waterberg region of the country. Such low proportions of local content with high proportions of imported products have led to ever-increasing high costs in recent years, prompting research into blend optimisation to enable the incorporation of higher percentages of local coals to produce cheaper and more cost-effective blends. The current research, in attempting to address this issue, focused on the evaluation of coke qualities from blends that contained increased proportions of Grootegeluk blend coking coal (GG), ranging from 31% and incrementally up to 40 %. In each case, samples of the resultant coke products were split into separate sub-samples with one sub-sample quenched using normal water while another sub-sample was quenched by water containing a solution of sodium tetraborate. A similar process was used successfully in China and Russia and this yielded very positive coke CSR/CRI results.

Results showed that, for each blend with an incrementally increased proportion of GG coal, the coke strength properties improved by 17% when the sub-sample was quenched by the borate solution. There was no change in coke strength properties in the sub-samples quenched by water. The ultimate cut-off point at which the blend coke quality properties would still be usable in a blast-furnace process was achieved when the proportion of GG coal

in the blend was 37% after quenching by the borate solution. The 7% increase of GGcoal in the blend from 30% is likely to lead to considerable saving in blend coking production due to the reduction of imported coking coal in the mix.