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Rajoo, Priven

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THE APPLICATION OF PILOT SCALE COAL EVALUATION TO FULL SCALE BOILERS

ABSTRACT

South Africa will continue to have a reliance on coal-fired power for the foreseeable future, given that coal is abundant, inexpensive and available. As much of the country's good quality coal becomes depleted, the qualities available for power generation is fast declining. Therefore, pilot scale tests will be crucial in the development of methodologies for predicting coal performance in specific power plants. The main objective of this research is to validate the coal combustion performance of the Pilot Scale Combustion Test Facility (PSCTF) against four utility boilers to determine it's scale up capabilities. Coal samples obtained from the operating feeders during each utility boiler test were evaluated at the PSCTF under conditions of similitude and at variations in excess air levels.

This dissertation details the comparison of pulverized fuel (pf) burnout and gaseous emissions between the pilot facility and four coal-fired boilers of different configurations. The pilot furnace was able to simulate the pf burnout for the three full-scale wall-fired and the tangentially fired boilers at elevated excess air levels and under conditions of similitude respectively. The pilot carbon monoxide (CO) and sulphur dioxide (SO_2) emission results were simulated under conditions similitude for all four boilers. The quantitative determination of the pulverized fuel burnout, CO and SO_2 was found to be dependant on the boiler configuration (boiler size, burner type and burner arrangement) of the full-scale boiler which indicated the setup conditions at the PSCTF. The pilot furnace produces higher flame temperatures than the utility boilers which results in thermal NO_x and inevitably significantly higher NO_x emissions.

The results emanating from this research has shown that the PSCTF is an effective tool for the evaluating and characterising coal combustion performance on a quantitative basis. Validation of more boilers is required to increase the degree of confidence in the PSCTF results and understanding the impact of the full-scale boiler configurations. All future validation tests should incorporate other pf combustion aspects. A quantitative methodology for the NO_x emission should be further investigated.