PhD Thesis Title:

An Investigation into the Use of Petroleum Coke as a Substitute for Metallurgical Coke.

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Abstract

Metallurgical coke is used primarily as a reducing agent for the reduction of iron in the blast furnace. Due to the high cost, high demand and reduced availability of high quality coking coals used in the production of metallurgical coke, alternative resources are being sought. One possible alternative is to use petroleum coke. Petroleum coke has the advantage of having a higher calorific value than traditional coke, at relatively low cost with a low ash content and ready availability. However the drawback to petroleum coke relates to its poor mechanical strength and reactivity.

The main focus of this study was therefore to develop a process for producing petroleum coke with the required qualities for blast furnace application.

In an initial series of experiments tests including proximate analysis, ultimate analysis, intrinsic reactivity test, DSC, direct tensile strength, calorific value, X-ray computed tomography, X-ray diffraction and scanning electron microscopy were used to characterise a wide range of petroleum coke and compare it with metallurgical coke properties. X-ray computed tomography methodology was also used to provide 3D information on coke lumps. Results show that none of the petroleum coke samples met the full requirements needed for use as a good blast furnace coke.

Second part of the project was to establish a suitable treatment method to enhance or upgrade the properties of the petroleum coke samples (strength, reactivity etc.) in an attempt to match the inherent properties of metallurgical coke. Three processes were attempted during this project; (1) direct heat treatment without additives (DH), (2) petroleum coke soaked in biomass (SBH) followed by direct heat treatment and (3) petroleum coke soaked in a solution of dissolved petroleum pitch (SPH) followed by direct heat treatment. The results show that there is an increase in strength with DH and SBH but neither could match the properties of standard grade metallurgical coke. SPH, however, was able to improve the quality and strength of a petroleum coke. More work, however, would be needed to demonstrate that this approach could also be applied to other petroleum cokes, particularly if it is to be applied economically.