Alert Coal & Coke (September 2016)

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Ironmaking & Steelmaking, October 2016

Increasing the sustainability of steel production in the electric arc furnace by substituting fossil coal with biochar agglomerates. T. Demus, T. Reichel, M. Schulten, T. Echterhof, H. Pfeifer

Biochar fines from a wood gasification plant and from pyrolysis of agricultural residues were investigated as substitutes for fossil coal used in the steel production in the electric arc furnace (EAF). During previous tests biochar fines with high specific surface showed problematic burnoff behaviour. Therefore the agglomeration behaviour of the biochar fines was investigated. Different binary and ternary mixtures of biochar with water and binders were tested in a hydraulic stamp press and evaluated with regard to green strength and fatigue strength of the briquettes after 3 days. One selected mixture was used to produce pillow briquettes in a double roll press. The abrasion behaviour of the produced briquettes was tested and compared to an anthracite reference coal (RC). Melting tests in a pilot EAF showed that the agglomerated biochar reacts similar to the RC. The briquetting leads to reduced reactivity and slower burn-off compared to the biochar fines.

Fundamental research on iron coke hot briquette – A new type burden used in blast furnace. H. Wang, M. Chu, W. Zhao, R. Wang, Z. Liu, J. Tang

In order to improve blast furnace efficiency, reduce CO2 emission and accelerate energy utilisation, a new preparation process of iron coke hot briquette (ICHB) based on the raw materials conditions in China, a new type blast furnace ironmaking burden, was experimentally investigated in this paper. The new preparation process was researched and optimised through single factor experiment and orthogonal experiment. Meanwhile, the reactivity and the post-reaction strength of ICHB prepared under the optimised conditions were tested and the effect of ICHB on the thermal performance of conventional coke was researched. In addition, softening and dripping properties of mixed burden with optimised ICHB charging were simultaneously investigated. The results showed that the optimised preparation parameters of ICHB include 15% iron ore, 65% bituminous coal, 350°C hot briquetting temperature, 1100°C carbonisation temperature and 4 hours carbonisation time. The reactivity and the post-reaction strength of ICHB prepared under the optimisation conditions are 62.4 and 10.6%, respectively. ICHB has protective effect on conventional coke and the protective effect is more obvious with 10% ICHB adding. With the increase of ICHB charging ratio, softening interval T40–T4 of mixed burden is widened while melting interval TD–TS (namely cohesive zone) is narrowed. Additionally, the permeability of
mixed burden becomes better and dripping ratio is first increased then decreased. The suitable charging ratio of ICHB in mixed burden is about 30%.

**Utilisation of semi-coke as by-product derived from coal-based direct reduction process in iron ore sintering.** Y. Luo, D. Zhu, J. Pan, X. Zhou

Solid wastes derived from metallurgical industries have created threats to the environment and their disposal is a major concern for the World. Semi-coke generated in the coal-based direct reduction process of iron ore is a solid waste and its effective utilisation has not been developed so far. In order to develop it properly, the characteristics of this semi-coke have been comprehensively studied and an investigation was carried out into the use of semi-coke as an alternative fuel in iron ore sintering. It is shown that the semi-coke could be substituted for coke breeze without affecting the sintering and metallurgical performances by adjusting its size distribution to offset the adverse effect of its superior combustion properties. In addition, the application of semi-coke in sintering could decrease SOx and NOx pollutants by 66 and 25%, respectively, in waste gas compared with coke breeze as solid fuel.

**Metallurgical Research & Technology, June 2016**

**Effects of coking coal properties on coke pore structure: prediction models.** R. Guo, W. Hu, Y. Liang, Q. Wang

The porosity, pore size, and specific surface area of coke significantly affects its strength and thermal properties. To investigate the factors affecting the pore structure during the carbonization of coking coal, experimental studies were performed using 18 types of single and mixed coals. Based on the experimental results of the structure and properties of coke pores, regression equations were developed to predict the structural parameters. The structural parameters include porosity, average pore size, volume ratio of pores with diameters >150 μm, volume ratio of pores with diameters.

**Taikabutsu Overseas, October-December 2015**

**Effect of silica phase transitions on the bond strength of silica mortar during heating.** A. Kasai

The relationship between phase transformation of SiO₂ phases contained in two different silica mortars during heating, and their adhesive (bond) strength to silica brick, was investigated. Adhesive strength measurements and observations on thermal expansion behavior and SiO₂ phase transformation upon heating showed that one type of silica mortar, in which quartz was the main SiO₂ component, easily transformed to tridymite and cristobalite, and exhibited bond strength of 2 MPa for samples heated at 1400°C under no compressive stress. The reasons for such high adhesive strength is considered to be chemical bonding at the interface between mortar and silica brick, and identical thermal expansion behavior between the silica brick and mortar after the first heating. However, another silica mortar, in which liquid phase sintering was observed and the SiO₂ phase transformation was quite slow, exhibited a bond strength of <2 MPa, even for the best samples, heated at 1400°C with compressive stress. The bonding mechanism for this type of mortar can be simple mechanical bonding which results from the anchoring effect of mortar adhering to the surface roughness on the silica brick.

**Taikabutsu Overseas, July-September 2015**

**New thermite welding repair technology - high strength gunned body and highly safe equipment.** K. Honda, K. Matsunobu, S. Yamamoto, H. Ito

At many coke ovens around the world, various types of repair methods are conducted due to the aged deterioration of oven furnaces. As one of the repair methods, thermite welding is applied to carbonization chamber walls. In this method, two concerns have been recognized. One is the low repair life, especially at the oven outlet portion where
refractory damage is severer than at other portions. Another is the occurrence of fire accidents during repair work, as the thermite welding repair material contains large amounts of flammable metallic powders. Focusing on these two issues, an improved thermite repair material and repair equipment are described in this report.

Journal of Analytical and Applied Pyrolysis, January 2015
Three phase transient model of wet coal pyrolysis. S. Polesek, K. arczewska, D. Kardas, P. Cizminsńki, B. Mertas
A onedimensional transient mathematical model was developed to describe the thermal and flowphenomena during coal pyrolysis in a coke oven. The model was solved numerically using partly implicit methods for gas flow and heat transfer problems. It was successfully validated with industrial scale measurements of temperature change in the middle plane of the coke oven chamber. The evolution of temperature and pressure, distributions of gas and steam generation rates were presented and analyzed. Special emphasis is put on the progress of vaporization and condensation fronts and their impact on the moisture levels within the coal charge. The obtained results show that moisture content determines the coking process dynamics, lagging the temperature increase above the boiling temperature and in consequence the start up of pyrolysis. The effect of low permeability of coal in its plastic stage on the internal pressure peaks in a coke oven is discussed.