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ISIJ International, February 2016
Evaluation of characteristics of coke degradation after reaction in different conditions.
J. An, J. Seo, J. Choi, J. Lee, H. Kim
In this study, post reaction strength under various conditions was measured to investigate effects of gasification with CO2 on coke degradation in the lower shaft of blast furnace. Post reaction strength of coke samples taken at the shaft of actual blast furnace was much higher than that in NSC tests, leading to slight change in mean size. The test for coke strength after reaction with the constant weight loss of 20% was not an effective way to evaluate commercial coke with high CSR and low CRI. When coke samples were gasified at a different temperature of 1100°C–1300°C, topochemical reaction was observed at over 1200°C by image analysis. Post reaction strength (CSRSBF) in the simulated blast furnace conditions was 14.9% higher than conventional CSRs, which is attributed to different correlation between reactivity and post reaction strength in two methods. This phenomenon seems to be caused by topochemical reaction on coke surface in blast furnaces which results into suppressing coke degradation. The post reaction strength test should be modified in accordance with the individual blast furnace operation, to simulate coke degradation due to solution loss in the shaft because solution loss in NSC tests is overestimated.

Ironmaking & Steelmaking, January 2016
Influence of charcoal replacing coke on microstructure and reduction properties of iron ore sinter. X. Fan, Z. Ji, M. Gan, X. Chen, Q. Li, T. Jiang
This study was carried out to determine the influence of using charcoal as a supplementary fuel on the microstructure and reduction properties of sinter. The primary fuel was coke breeze with 0, 20, 30 and 40% replacement of weight input with charcoal to produce sinter. Experimental results indicate that when the replacement percentage of charcoal to coke breeze increased from 0 to 40%, the porosity and FeO content of sinter also rose. These changes result in an enhancement from 79.8 to 84.3% for the reducibility index due to the increased reducing surface area. In addition, the reduction degradation of sinter also improves since degradation during crystalline transformation is restricted. Therefore, replacing coke breeze with charcoal is able to improve the reducing properties of sinter, which is beneficial to small and large blast furnace operation.

Materials Research Innovations S8, November 2015
Three-dimensional CFD modelling of a fluidised bed combustor fuelled by biomass and coal. H. Kumar, S. Mohapatra, R. Singh
A computational fluid dynamics analysis of a fluidised bed combustor fuelled by coal and biomass is performed. A discrete phase modelling approach is used to track fuel particles. Combustion is modelled using a two-mixture fraction probability density function approach. The standard k-ε two-phase turbulence model is used to describe the gas–solids flow. The residence time of coal particles is found to be greater than that of biomass particles. Contours of char burnout and devolatilisation are obtained and combustion is found to be quantitatively complete, and thus no significant change in combustion efficiency is found under full-load conditions. Velocity vectors are obtained and it is found that the velocity increases from the notch region towards the exit of the furnace, owing to the reduction in cross-sectional area. Heat exchange from in-bed superheater tubes to flue gases is greatest at the highest-temperature regions of the tubes.

Energy & Fuels, October 2015
Comprehensive Investigation of Various Structural Features of Bituminous Coals Using Advanced Analytical Techniques. K. Li, R. Khanna, J. Zhang, M. Barati, Z. Liu, T. Xu, T. Yang, V. Sahajwalla
An in-depth investigation was carried out on five Chinese coals using a range of advanced analytical techniques focused specifically on extracting structural parameters. Detailed investigations were carried out using Fourier transform infrared spectroscopy (FTIR), Raman spectroscopy, and X-ray diffraction followed by peak deconvolution and data analysis. Correlations were established for parameters determined from different techniques. The FTIR data showed good linear relationships between the apparent aromaticity ($fa(\text{FTIR})$) and $(R/C)u$ with the H/C atomic ratio for all coals under investigation. These results indicate that FTIR spectroscopy coupled with appropriate data analysis can be successfully used to determine aromaticity and the coal rank. Raman spectroscopy data showed a negative linear relationship between the GL fraction and H/C ratio; no well-defined relationship was observed between other band fractions and the H/C ratio. The decrease of AD/AG with increasing H/C ratio indicates the growth of aromatic rings; i.e., the structure of the sample was closer to that of graphite. This result is in good agreement with the decrease of apparent aromaticity ($fa(\text{FTIR})$) as determined by the FTIR spectroscopy. A good linear relationship was observed between the structural parameters ($fa(\text{X-ray})$ and RX-ray) determined with X-ray and coal rank (represented by the H/C ratio). Even though the correlations among parameters derived from three techniques showed a similar trend and were consistent with each other, FTIR, and X-ray diffraction techniques were found to be better than Raman spectra to characterize coal maturity. These findings have led to a simplified coal model based on the complementary information from different techniques on various aspects of the coal structure.

ABM Week 2015 - 34º Seminário de Logística – Suprimentos, PCP, Transportes, August 2015

Port logistics efficiency. J. Rolim (in Portuguese)

In a globalized world, arose the needs of a new order in terms of productive spaces and commercial dynamics, leading to new paradigms in the port system, especially in cities with ports. Starting from the premise that the ports have not only a technical-operational characteristics, but represent a tool to sustain the development, connecting systems of cities and economically strengthening a region, it was sought to describe the main aspects of a port system in general, giving examples of efficient ports worldwide. It was evaluated the impacts and interactions with the cities, and the conditions necessary to ports. This work aimed also to identify the state of the art of the Rio de Janeiro port, as well as to provide a more modern and decentralized attitude with respect to the port management. It was especially taken into account the importance that this port adds to the country, because the economic activities within a radius of 500 km are responsible for 67% of the Gross Domestic Product (GDP). The used methodology in this work was literature exploratory research in documents with content updated on the proposed topic. As a result, it was pointed out the possibility of implementing a new automation technology used in various ports in the world, that prioritizes speed connections that carry goods or services, making them more efficient and effective processes related to port-city. It was also discussed and proposed improvements related to a possible upgrading of the infrastructure in logistics of port, flows, in socioeconomic and public policy, aiming at to improve port productivity, and to identify solutions for the development and reapproximation of the port of Rio de Janeiro with the city. It was also verified that the port of Rio de Janeiro is underutilized, with lack of an efficient access, and has a poor infrastructure.

METEC & 2nd ESTAD, June 2015

Laboratory method for coking pressure determination. B. Mertas, M. Sciazko, A. Sobolewski

One of the most important phenomenon occurring during the coking process is coal plasticizing. Consequence of this phenomenon is caking and formation of the final
product - coke. It is inextricably connected with the phenomenon of pressure generation inside bed of plasticizing coal grains. The generated pressure improves the mechanical properties of the produced coke. However, it creates at the same time a danger of deformation and even destruction of the chamber wall of coke oven battery. The article puts in order terminology related to pressure developing during coking process. There are also presented factors significantly affecting the coking pressure generation in terms of a new laboratory method for determination of expansion pressure called PresTest.

Dispersion and monitoring of fugitive emission from coke oven battery. R. Bigda, J. Telenga-Kopyczyńska, A. Sobolewski
Within Polish R&D project “Smart Coke Plant” system of on-line monitoring of fugitive emission from coke oven battery (EMI-BAT) has been developed. It is mobile and compact system with set of measuring instruments, which measures concentrations of PM10, VOCs and CH4 found in the air above battery and using mathematical model calculates concentrations of anthracene, naphthalene, benzene, toluene and 4PAHs. The model was verified on the basis of series of continuous measurements over battery roof. The system is tool for verification of battery condition and compliance with production procedures. Simultaneously the numerical model for fugitive emission dispersion around coking plant (COPDIMO) was developed. Continuous measurements of selected meteorological parameters, observations of the real elevation of plumes above battery and a series of measurements of marker substance (SF6) concentrations on the coke plant have been carried out. It was basis for development of numerical model of fugitive emission dispersion pollutants. The model is based on the classic Gaussian plume model, which uses modification of the equations describing the phenomenon of propagation and meteorological correction exponent. Introduced changes increased accuracy of modelling. The COPDIMO can be used to assess the impact of the coking plant on the environment for short and medium distance, to take action to rationalize the reduction of emissions from coking plants into the air and to conduct proper environmental policy of the plant.

Industrial study on coal handling bulk density control. K. Ng, L. Giroux, T. MacPhee, T. Todoschuk
Coal bulk density is controlled at coal handling station in industrial coke plants and is measured following ASTM D291-07 standard. Usually, a bulk density target is set and the set point is attained by either adding oil or water. In this study, the influence of coal flowability through the cone on resulting coal bulk density was investigated. Experiments were done on two coal blends with coal moistures ranging from 3% - 15%. Bulk densities measured with cones of various bottom diameters were compared. At high moistures, the ease of coal flow impacted the resultant coal bulk density values leading to the recommendation of a new cone design. The impact of oil addition on bulk density control was also studied.

Study of PCI coals in new injection rig at CanmetENERGY (Ottawa). S. Ray, L. Giroux, T. MacPhee, K. Ng, T. Todoschuk
With the increased use of coal injection in BF Ironmaking, there is a need by the steel industry to study various coals and to evaluate their potential as possible candidates for PCI. The existing large-scale pilot coal injection facility at CanmetENERGY has a high operational cost. With the aim of achieving reasonably high heating rates and corresponding short particle residence times, a smaller, easier and less costly to operate bench-scale injection unit has been built. All experiments reported in this work were carried out in this new test rig. Different injection conditions were used and the char samples collected were analysed. With the objective of evaluating coals on a relative basis, a set of coals were examined and PCI relevant parameters like Total Burnout’ (TB) was calculated. Samples were also examined for BET surface area and various carbon
forms using a new TGA technique developed at CanmetENERGY (Ottawa). Quantities of these different carbon forms were estimated and related to the injection conditions.

The first coke making plant in Indonesia – technological highlights. A. Esposito, F. Cerutti, B. Otten, M. Petzsch
PT. Krakatau-POSCO coke making plant, located in Cilegon, Indonesia, is the result of the know-how and experience of Paul Wurth Italia in coke making field. The plant has a capacity of 1,321,000 t/y of gross coke achieved by two coke oven batteries with 42 top charging Paul Wurth “Jumbo” ovens each. PW “Jumbo” oven with a useful volume of 78,92 m³ allows decreasing drastically the number of pushing/charging operation per day with a consequent reduction of the diffuse emissions. Gas treatment plant with a capacity of 88000 Nm³/h has been designed in collaboration with DMT GmbH & Co. KG, adopting the latest technologies with specific design know-how. PT. POSCO-Krakatau plant has been successfully commissioned and started-up in October 2013. The present paper will highlight the main technology features applied in PT. Krakatau-POSCO project for both coke oven and gas treatment plants.

Commissioning of two complete sets of coke oven machines during the start-up of a new coke making complex. A. Molinari, G. Siri, K. Nowitzki
Present paper will describe the main steps usually performed during erection, commissioning and final tests for the two full sets of machines relevant to a green field Coke Making plant. As an example will be used the project recently realized in Indonesia for P.T. Krakatau POSCO in cooperation between Schalker Eisenhütte Maschinenfabrik GmbH as machines supplier and Paul Wurth Italia S.p.A. as Coke Oven Batteries technological supplier. A short explanation of the plant will introduce the contest in which the above activities have been performed, some data relevant to the machines will be given in order to explain their configuration, the step by step description of the various phases will explain the workflow adopted.

Stamp charging coke oven battery – state of the art. A. Esposito, M. Bisogno
Availability, quality and cost of the coal are the key factors for coke making plant operators. Nowadays, the optimization of raw material cost in integrated steel works has further gained priority in particular with regards to coking coal that represents about 20% of the cost of steel. Stamp charging technology is technically and economically an effective and proved solution in order to maximize the low quality non-coking coal in the coal blend with consequent economic benefit. In such scenario, PW has developed an own battery design specifically dedicated to stamp charging batteries in order to overcome peculiar problems related to this technology and to comply with stringent environmental regulations. In this paper an overview of the PW stamp charging design that represents the state of the art in the stamp charging technology will be described.

Maximization of clean coal ash of Indian medium coking coal in stamp charged coke making at Tata Steel. H. Tiwari, S. Haldar, R. Sharma, P. Mishra, A. Das
The strategy called “Trilema” i.e. cost-quality-volume optimization to achieve maximum benefit in steel business and its expansion at Tata Steel become a focal point. In Tata Steel, captive coking coal is used at a large proportion (~50%) in the coal blend of stamp charged coke making. With this in view, consumption and preservation of the Indian medium coking coal by modulating clean coal ash was the subject of the study. In this investigation, optimization of the ash percentage of Indian medium coking coal (captive coal) in stamp charged coal blend without affecting the quality of coke. Results show that up to ~55% high ash (~17%) Indian medium coking coal in stamp charge coal blend may achieve desired quality of coke with improvement in the production of clean coal yield and reduce the cost of coal blend. This paper described
in detail the effect of different ash of clean coal of Indian medium coking coal in the blend on the lateral expansion and coke quality in terms of coke CSR.

Journey of excellence in operating non-recovery stamp charged coke oven batteries at Tata Steel. H. Tiwari, S. Haldar, S. Verma, S. Paul, R. Sharma

The effort is being made worldwide to produce quality of coke to improve the blast furnace performance with a view to reduce coke rate and improve productivity. Apart from impacting cost, this improves the CO2 footprints. This is facilitated by proper selection of coke making technologies. The selection criteria of coals for different coke making technologies and their operating conditions are the prime driver. Each technology has its own set of design objectives to fulfil and primarily those are cost, quality of product and environmental impact. Recently, Tata Steel introduced world largest single location annual capacity 1.6 MT of non-recovery coke plant. This paper described the operation philosophy of non-recovery coke plant to produce superior quality coke at comparatively lower cost through operational excellence which includes reduction of imported prime hard coking coal in coal blend up to 30% without sacrificing the quality of coke. Understanding the operation process and mastering non-recovery coke making technology was also part of this study.