Practical Analysis of the Contemporary New Technology of Coking Coal

Chengtao Chen

School of Environmental Science and Engineering, North China Electric Power University, Baoding
071000, China.
370277383@qq.com

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Abstract. In recent years, the demand for coke increased greatly in the modern industry, while the number of coal which is suitable for coking fell sharply and the quality was declining. Based on this background, the coal coking industry had to start the new energy more efficient and energy saving. We all know that in modern coking industry, the new technologies which have been widely used roughly contains tamping coking, coal blending coking, adhesive adding, inert material adding, coal moisture control process and so on. In this paper, at the beginning, we will analyze the main factors that affect the range of coking coal, then learn the changes of various coals in the coking process. After that we will make a further analysis on the microcosmic improvements in contemporary coking industry with the application of new technology, based on the analysis of the experimental data from a series of experimental results to grasp the practical feasibility of contemporary coal coking process.

Introduction

In recent years, the sustained and rapid development of China's national economy, made a greatly stimulated demand for steel. With the increase of steel production, coke demand is increasing, and the quality of coking resources gradually reduced. Meanwhile with the depth of exploitation of coal resources, coal quality deterioration degree has increased. The fact that coal reserves is decreasing also led to the rising prices of coking coal and increasingly fierce competition in coking industry. Therefore, in order to make the coking industry sustainable development, some measures must be taken for the improvement of coking process to expand the scope of coking coal source, searching for new ways, and by the way to make full use of coal resources to reduce the cost of coking coal resources and to promote the sustainable development of coking industry.

Symbols, Terminology Definitions

Symbols and Definitions

Table1 Some parameters of the coking

Parameter	Meaning	Units
<i>CSR</i>	The intensity of the coke	%
<i>CRI</i>	The reactivity of the coke	%
<i>M</i> ₁₀	The coke in a specific particle size	mm
<i>M</i> ₂₅	The coke in a specific particle size	mm

Factors affecting the scope of coal for coking

Bulk density of the coke. There will be a great influence on the gap between coal caused by material bulk density of the coal, when the coal density of bulk is large, the gap between coal material will be smaller, then the same dose of colloid can not only fill more coal particle gaps, but also do a great influence to enhance the adhesion of coal material interface. Meanwhile, the gas came from the coking can not only strengthen the connection between coal particles, enhance the resistance of the escape of gas pressure and expansion, but also contribute to colloid stability enhancement and number increasing in a great extent.

Coal heating speed. The quality and quantity of colloid will be affected in the process of coal

material when it is in softening because of the heating rate changes of coal material. This leads to a fact that the expansion and mobility of a coking coal will change with the change of heating speed. The yield of the liquid colloid will always increase with the increasing of speed of coal material heating. Then as the heating rate increases to a certain degree, the yield rate of the products will subsequently to slow down and gradually in a relatively stable state. So the heating rate of coal has an important role in improving the adhesion property of coal.

Experimental scheme

Stamp-coking technology. According to the investigation of China Coking Industry Association Professional Committee, tamping coking technique can be equipped with a large number of low price of coal, three points of coking coal, lean coal, and so on, which can significantly reduce the cost of production, make a better use of coal resources. For the enterprise, it has brought obvious economic benefits and good social benefits.

The aim of this study was to explore the changes of the coke quality when we use lean coal, gas coal, 1/3 coking coal to replace different proportion of coking coal. Kongs have done an analysis in detail under certain experimental conditions of two cases, which consist of lean coal replacing coking and gas coal replacing 1/3 coking coal. Then they check the CRI and CSR of coke produced in different alternative ratio, and finally evaluate the quality of coke.

Adding inert material for coking. Inert matter has a poor bonding property, it cannot produce colloid in coking process but it can adsorbent excess adsorption in liquid phase, so it can hold the flow degree and expansion in an appropriate scope. Meanwhile, it can reduce the volatile amount of precipitation and make an improvement of coal thermal stability which can make pore wall thickening, the porosity decreasing, thus improving the quality of coke.

We know that the coke powder, in principle, is in agreement with what we are saying. So in our experiments, we use coke powder as raw material according to a certain proportion when they are added to coking coal, Reference to the coking experiment on a 20kg coke oven which has been done by Suns, we will analyze the result with their experimental data.

Result analysis of stamp-coking technology

Lean coal replacing coke. According to the data obtained from Kongs' we make the corresponding diagram (Fig 1), from which we can draw a conclusion when coal ratio increased from 8% to 14%, the reaction of the resulting coke strength (CSR) increased gradually. When the proportion in 14%, CSR has maximum 68.1%, reactivity (CRI) is on the decline. When the ratio increased from 14% to 16%, the CSR of coke decreased sharply, while CRI was significantly increased. When the ratio of lean is 14%, the minimum value of CRI is 26.5%. This shows that when the proportion of lean coal for coking coal is 14%, the index of coke is the best.

Figure 1 The CSR and CRI of different ratio of lean

Gas coal replacing 1/3 coke. After Kongs' experiments, we did a analysis on the data from the experiment which can meet the conditions of the ratio, after that we made the figure two (Fig 2). By Figure 2 we can see, coke strength (CSR) changed little after the reaction of the resulting when coal ratio from 2% increase to 10%, coke reactivity index (CRI) is also a slight fluctuation. And obviously, CSR has a great value in the ratio of 8%, at the same time, CRI also has a minimum value of 8%. It is

not difficult to draw the conclusion that in the experiment 1 / 3 coke coking is instated by gas coal, when the ratio of gas coal at 8%, the coke quality is the most ideal.

Figure 2 The CSR and CRI of different ratio of gas coal

Adding inert material for coking

Through analysis on the principle of the above, we can know the possibility of the reaction in which some inert is added into coal for coking. To validate the experimental results, we learned Suns' experiment, experiment research of adding coke powder blending coking on 20kg coke oven. The results show that, in order to improve coke powder mixing quantity, activity and inertia ratio must be within a reasonable scope, in order to ensure coke quality must be guaranteed. The research shows that when coke powder mixed with a certain amount, the particle size controlled in less than 0.2mm, the coke quality are improved obviously, the intuitive performance is the M25 has increased by 1.5%, the M10 has reduced by 1.5%, 1.8% boost in CSR, CRI decreased by 3.8%. At the same time, in the Yangs' experiment of adding coke in coking process, they have changed the conditions and finally come to the conclusion that with the use of coke powder blending coking and income of the coke block rate increased significantly. Secondly, to guarantee the coke quality, controlling granularity of coke powder is essential.

Summary

On the above, we have analyzed two new coking processes which are being used in the coking industry today or are in the research stage. They are the tamping coking and adding inert material for coking. Through learning the above principles and coke quality analysis, we can realize that no matter which of these new coking methods for improving the quality of coke has very good effect, they can effectively improve the thermal properties of coal, decrease the CRI of coke and improve coke CSR.

The emergence of new coking process for coking industry brings new ideas for energy saving and emission reduction, which is also helpful to the development of China's iron and steel industry. It can help to further optimize the energy use structure, improve the utilization of energy. Therefore, it is necessary to use the new process to the actual production after appropriate optimization, with a high practical.

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