9th International Freiberg Conference on IGCC & XtL Technologies
Closing the Carbon Cycle
3-8 June 2018
Berlin, Germany

Catalytic gasification of crushed coke and structural characteristics

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Abstract: The influence of the catalyzer on crushed coke gasification reactivity and its structural variations during steam gasification was studied in the present paper. Crushed coke samples were loaded with three kinds of catalysts, CaO, Na_2CO_3, and Fe_2O_3, and then dried at 950℃. The coke gasified with steam in a thermogravimetric analyzer was used to study the influence of catalyzer loading on the gasification reactivity. Coke samples under different reaction times were prepared using a tubetype furnace. A specific surface area and porosity analyzer, an X-ray diffraction apparatus and a Raman spectra apparatus were characterized by the structure of the cokes. Comparison of the reactivity of coke loaded with different kinds of catalyzers revealed that the coke with Na_2CO_3 exhibited higher gasification reactivity, and the optimum load of Na_2CO_3 on the coke was 5%. BET data showed that the addition of Na_2CO_3 can effectively corrode the pores on the surface of the coke to produce many small pores on the surface of the coke and widen the aperture of the coke. When Na_2CO_3 is added to the channel of the coke, the smaller porosity of the coke becomes more crowded. Coke loaded with Na_2CO_3 has a larger average pore diameter, which is more beneficial to the reaction with steam. Raman spectra analysis showed that the degree of graphite-like structures in the graphite layer increases as the reaction proceeds, and that Na_2CO_3 inhibits the growth of large aromatic ring structures decreaseing the content of graphite-like crystal structures. The XRD results suggested that some of the sodium atoms are inserted into the coke matrix distorting the orientation of carbon crystallites, thus effectively hindering the trend of carbon graphitization in the process of gasification. The XRD analysis result agreewith the results of Raman analysis.

Keywords: Catalytic, Gasification, Crush coke, Structure, Raman spectroscopy