THE USE OF A TREE-LIKE POROUS STRUCTURE MODEL FOR ANALYSIS OF THE INTERACTION OF O_2 AND CO_2 WITH A SOLID CARBON RESIDUE

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The tree-like porous structure model is used to analyze the interaction of oxygen and carbon dioxide with the carbonaceous residue. In this case, we proceeded from the following provisions: the average length of the pores (of a certain radius) is proportional to the radius; the area occupied by the inlets on the surface of the carbon residue is equal to the volume fraction of the corresponding pores. When calculating the reaction rate of molecules O_2 and CO_2 in micro-, meso- and macropores, Knudsen diffusion, physical adsorption on the pore surface, and the corresponding rate constant of the heterogeneous reaction with carbon were taken into account. In the first approximation, the concentration of non-localized mineral impurities in the carbonaceous residue is taken into account. The effective rate constants of the reaction of O_2 and CO_2 for the inlet holes of the pores were obtained in the form of the product of the reaction rate constant for a dense surface and a factor (multiplier), which depends on the dimensionless parameters of the process: the ratio (length / radius) of the pore, (thermal rate of molecules / reaction rate constant), volume fractions of micro-, meso-, macropores and non-localized mineral impurities. The limitation of the reaction rate in the pore by the value of the chaotic flux of molecules in the pore inlet is taken into account, the analysis of the model applicability limits for the reactions of oxygen and carbon dioxide in the pores of the carbonaceous residue is carried out. For the surface of the pores of the carbon residue, the dependence of the effective rate constant of the heterogeneous reaction of the compound on the parameters of the multilevel porous structure and the reaction rate constant for the dense surface of carbon was obtained. Analytical expressions are obtained. They relate the depth of penetration of the reagent into the pores and the effective inner surface of the carbon residue with the parameters of the tree-like porous structure and the rate constant of the heterogeneous reaction. The effect of the porous structure on the character of the dependence of the effective rate constant of the reaction of O_2 in the pores of the carbonaceous residue on the concentration of non-localized mineral impurities has been demonstrated.

Keywords model of a tree-like porous structure, coke residue, concentration of the mineral component, reaction rate of O_2 and CO_2, ignition temperature.

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