THEORETICAL ANALYSIS OF THE PROCESSES OF COKE ELECTRICAL CONDUCTIVITY FORMATION

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A theoretical analysis of the processes of coke conductivity formation based on modern ideas about the molecular structure of coal is carried out. It is shown that, according to the zone theory of solids, the conductive properties are determined by the energy of electrons and their ability to perform work against the forces of binding with the nuclei of atoms. It is shown that coal is a dielectric due to the presence in the side chains of the macromolecule of a large number of σ-bonds formed by carbon in the sp^3-hybridisation state, characterized by a significant width of the forbidden energy band (up to 6 eV), and therefore the electrons of these bonds cannot practically enter the conduction zone and become carriers of electric current. In industrial coking, macromolecules are almost completely stripped of their side chains as a result of deep cracking. In this process, coke acquires semiconductor properties. The carriers of electrical conductivity in coke are: ordered carbon of graphite-like blocks, whose electrons provide their own conductivity; coke minerals – p-elements with a lower valence than carbon (primarily aluminum) – impurity (so-called "hole") conductivity. The factors affecting the resistivity and electrical conductivity of coke, as well as for any other solid, are determined by the general zone theory of the physical structure of solids. A theoretical analysis has been carried out, according to which both intrinsic and impurity electrical conductivity of semiconductors increases rapidly with temperature, varying according to an exponential law. At the final stages of the coke formation process, this dependence can be accepted as a working hypothesis that requires experimental verification by pilot coking.

Keywords: hard coal, coke, electrical resistivity, temperature dependence, solid structure, carbon, impurities, zone theory, coke readiness.

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