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Research of the Coal Grade and Coal Particle Size Influence on Thermal Properties of Coal-Water Fuels

According to its thermo-physical, thermo-technical, rheological and electrical properties coal-water slurry - type of fuel, which characteristics differ greatly from those of its constituent materials. From the standpoint of thermal processing technology the greatest interest is the data on the specific heat, thermal conductivity and thermal diffusivity of coal-water fuels and their changes during thermal processing, as these properties are largely determined by the duration, the process parameters and the energy efficiency of the process.

Analytical description of the thermal conductivity dependence of coal-water fuel on quantity of the aqueous phase is difficult because of the lack of physical model relevant to the real structure of coal-water fuel. Available theoretical results show very complex mechanism of heat transfer in coal-water fuel and the need for experimental studies to determine the regularities of thermal processes in coal-water fuel and its thermal properties.

In order to determine the values of the thermal conductivity of coal-water fuels made from different grades of coal, an experimental installation was developed. The experimental installation is not bound to a specific type of coal water fuel, but allows the study of a wide range of characteristics of the primary products for coal-water fuel. The experimental data were processed by combining the comparison method and the numerical solution of inverse heat conduction problem. For analysis of experimental data a mathematical model was created, which allows to calculate the distribution of temperature fields in no stationary regime. In the process of numerical solution of the boundary conditions used I, II, III and IV kind of boundary conditions.

Experiments were conducted for coal-water fuels derived from coal of different stages of metamorphism, contain high amounts of mineral impurities. As shown by experimental studies, the thermal conductivity of coal-water fuel increases dramatically as compared to coal and varies from 0.41 to 0.81 W / m · K, naturally increasing rising temperature in the studied range of 40-150 °C.

Experimental studies concerning the effect of particle size of the solid phase in the coal-water fuel for the thermal conductivity of fuel were made. During the experiment samples of coal-water fuels with coal particles size less than 200 microns, and samples of coal-water fuels coal particles with sizes of 2-3 mm were used. Studies have shown that the thermal conductivity of coal-water fuel containing coal particles of a size less than 200 microns, the average is 15-20% higher than for the coal particles size of 2-3 mm in the temperature range investigated.