Three-dimensional modelling of heat and mass transfer during combustion of low-grade Karaganda coal

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Thermal power plants are a major source of the harmful impact on the environment. Half of the operating units of the Republic of Kazakhstan operated for over 40 years and require modernization and optimization. In this regard, remains relevant more profound study of the processes of solid fuel combustion, development and implementation of 'clean' technologies to protect the environment and ensure the efficiency of power plant equipment. It is clear that the implementation of direct experimental research directly into the combustion chamber is expensive and not effective, as the results will only make sense for a particular boiler. However, advances in computer technology and methods of numerical simulation allows to carry out computing experiments on the ignition, heat transfer and mechanisms of pulverized coal torch burnout in the boiler furnace without a full-scale experiments.

The study in this paper is focused to research using modern methods of 3D computer modeling processes of heat and mass transfer occurring in the real furnace chambers of industrial power plants during combustion of low-grade Karaganda coal. The data so obtained can be used for calculating the parameters and modes of operation of real fuel systems which helps to find more effective and cleaner ways of exploitation the energy object.

The real combustion process characteristics of low-grade Karaganda coal were determined in two boundary conditions aiming to find the more adequate scheme describing the real technological process. As a result developed the physical, chemical and mathematical models and propose numerical methods for solving the system of nonlinear equations. Also carried out computational experiments on two boundary conditions of the wall temperature (the aerodynamic, heat and mass transfer characteristics – V, T, Q, O_2, CO_2), and studied its effects on the combustion process characteristics. Verification of numerical calculation results with natural experimental data was made and the optimal boundary condition for the temperature on the walls of chamber determined.