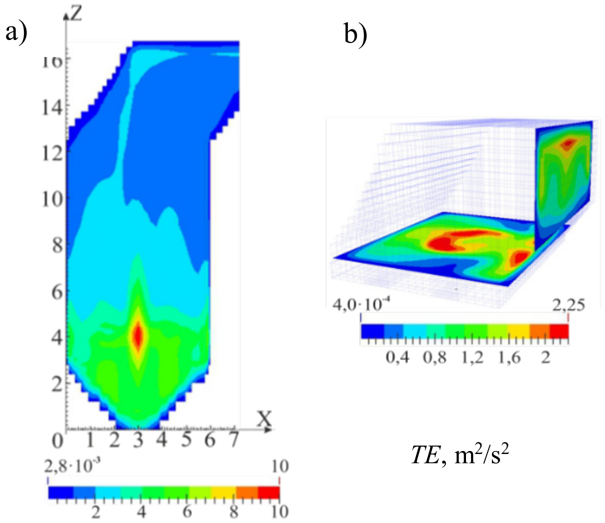

Fig. 3. Distribution of the kinetic energy of turbulence *TE* in a) longitudinal central section along the depth of the furnace (Y=3.19m); b) turning area (Z=12.65m) and at the outlet of the furnace (X=7m)

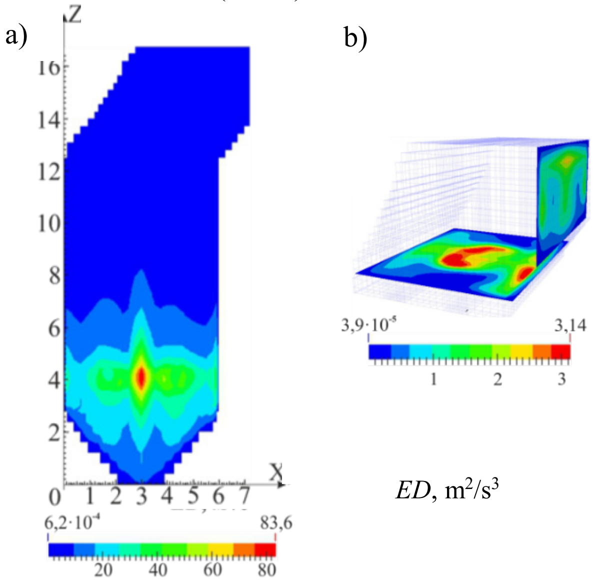

Fig. 4. Distribution of the dissipation energy *ED* in a) longitudinal central section along the depth of the furnace (Y=3.19m); b) turning area (Z=12.65m) and at the outlet of the furnace (X=7m)

Analysis of Fig. 5 of the distribution of concentrations of nitrogen oxides *NO* in the area of the location of the burner devices and at the outlet of the combustion chamber indicates the influence of flow aerodynamics on the processes of formation of concentration fields of nitrogen oxides *NO*. Intensive mixing of fuel and oxidizer, created by turbulent flows of air mixture injected from the burners, provides favorable conditions in this zone for the formation of nitrogen oxides *NO*. Thus, the concentrations of nitric oxide *NO* reach their maximum values of 5206.2 mg/Nm^3 (Fig. 5a).

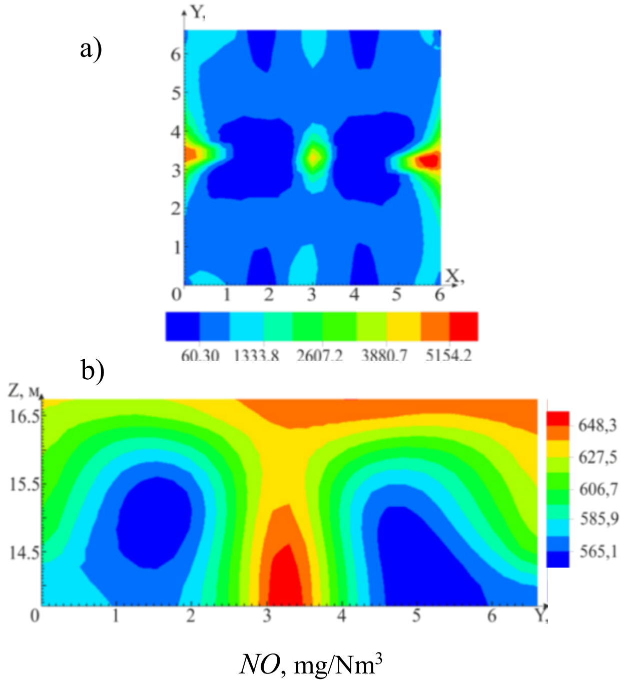

Fig. 5. Distribution of the concentration of nitrogen oxides *NO* in a) zone of the furnace burner belt (Z=3.98m); b) at the exit from the furnace (X=7.14m)

As we move towards the exit from the furnace, the chemical reactions of nitrogen oxidation decay, which is explained by afterburning and the described behavior of the aerodynamics of turbulent flows. This leads to a decrease in *NO* concentrations in the upper regions of the furnace space. The maximum concentration of nitric oxide *NO* at the outlet of the furnace (X=7.14 m) is 649.2 mg/Nm^3 (Fig. 5b). The average value of the concentration of nitric oxide *NO* at the outlet of the furnace is 613.1 mg/Nm^3, which corresponds to the MPC (640 mg/Nm^3) for coal-fired CHPPs of the Republic of Kazakhstan.

The aerodynamic characteristics obtained during the computational experiment reflect the real technological process observed in the combustion chambers. These results indicate that in the central region of the combustion chamber there is a sharp change in aerodynamic characteristics (velocity, kinetic energy of turbulent pulsations and dissipation energy) associated with the formation of a vortex flow, which weakens as the pulverized coal flow and combustion products move to the exit.

The conducted studies testify to the complexity of heat and mass transfer processes occurring during the combustion of pulverized coal fuel in the combustion chambers of industrial boiler plants. An analysis of the results obtained shows that such a detailed study of the aerodynamic pattern that takes place in the combustion chamber of the boilers of operating TPPs is possible only by numerical simulation methods and by conducting computational experiments.

CONCLUSIONS

The presence of a volumetric vortex flow in the central region of the combustion chamber has a positive effect on the combustion process of pulverized coal fuel (heat exchange and mass transfer), since, due to the turbulent nature of the flow, intensive mixing of the fuel components with the oxidizer occurs here, which means that more complete burnout of coal dust is ensured.

The justified choice of the turbulence model made it possible to obtain with sufficient accuracy the aerodynamics of the flow and the distribution of nitrogen oxides over the entire space of the combustion chamber. The results obtained will make it possible to effectively control the processes of fuel combustion in real power plants and solve urgent problems of thermal power engineering and ecology.

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