OPTIMISING RESEARCHES OF THE CONSTRUCTIVE SCHEME OF THE CAMERA OF BURNING BY MEANS OF MATHEMATICAL MODELLING.

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ОПТИМИЗАЦИОННЫЕ ИССЛЕДОВАНИЯ КОНСТРУКТИВНОЙ СХЕМЫ КАМЕРЫ ГОРЕНИЯ СРЕДСТВАМИ МАТЕМАТИЧЕСКОГО МОДЕЛИРОВАНИЯ.

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Introduction

In a modern market economy and competition, a particular problem is equipment regularly update. The basic equipment of many thermal power plants operates more than half a century, so the question arises about the imminent replacement of exhausted boilers for modern energy-efficient boilers. Before the release of new competitive products, you need to spend a huge amount of work for the collection, storage and processing of information, which is not possible without the use of computer technology [1].

The use of modern automation systems engineering design allows real-time to solve a wide range of design tasks [1]. Computer simulation technology is especially effective for engineering calculations and functional aerodynamic and hydrodynamic characteristics assessment of designed boilers. That allows producing pre-operational analysis of the performance of products with lower financial costs during the design phase.

Mathematical modeling of combustion devices is one of the most important ways to obtain information about the aerodynamics, the local and the total heat transfer. This information is necessary for the design of new power plants. The results obtained by numerical experiment enables you to test the installation, to predict the behavior of the boiler at work on a variety of loads, to identify areas requiring improvement. In this paper, a numerical experiment was carried out using modern application package such as FLUENT [2], which allows you to solve a variety of tasks, such as calculating cavitations, the flow of compressible media and the heat transfer of real gases and moisture vapor. First of all for the task used turbulence models of hydrodynamics and gas dynamics of the FLUENT software package. In this paper, with using modern methods of modeling the drum boiler was designed with steam capacity of 250 tons per hour with a flame burning process of lignite and with liquid slag removal. Superheated steam pressure of 13.3MPa and temperature of superheated steam to 505 ˚C were adopted as the operating parameters. In the course of the project the thermal, aerodynamic and hydrodynamic calculations of the boiler plant were made. The calculation results do not contradict the requirements of regulatory techniques [3].Two-stage layout tail heating surfaces was selected.

Calculation results

Combustion chamber (Fig. 2) of the boiler is equipped with four 35 MW ram dust burner located tangentially in one layer. According to the calculations: Gross efficiency of the boiler is 92.4 %; fuel consumption is 11.2 kg/s. In Figure 1 distribution of the design characteristics of heating surfaces is shown. Flues were designed and resistances on the flue gas side were determined with the aerodynamic calculations. Ash collector and exhauster were selected.

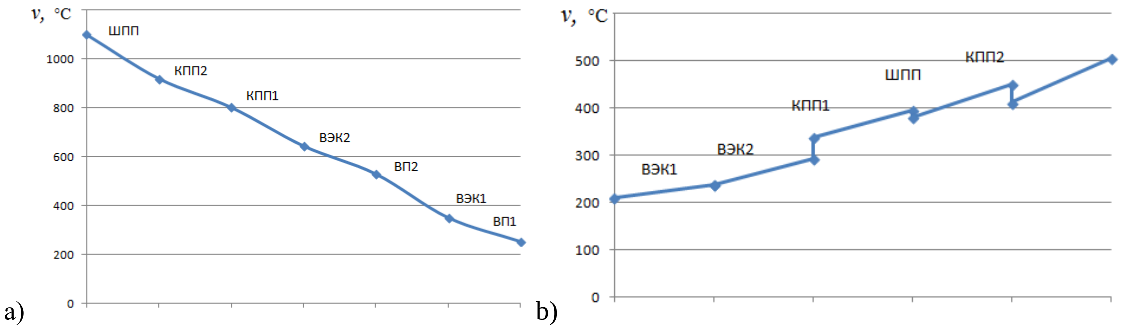

Figure 1 - Mean values of the flue gas temperature (a) and carrier (b) in the heating surface.

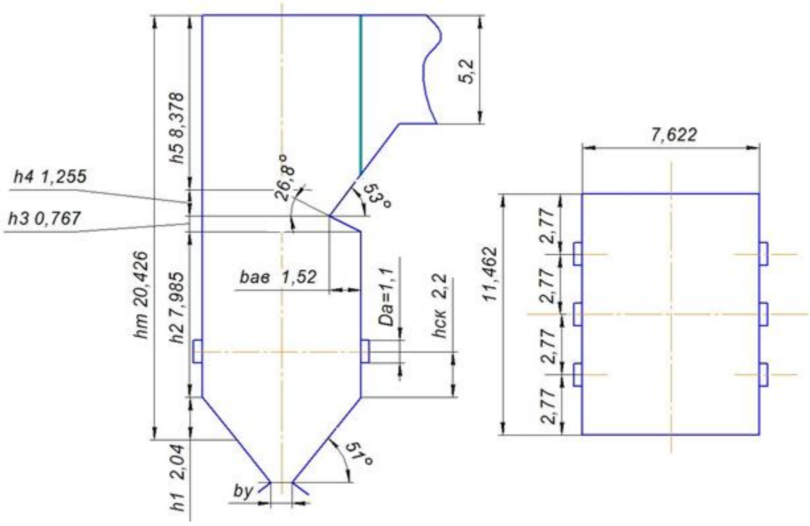

Figure 2 - The main geometrical characteristics of the combustion chamber (m)

According to the results of mathematical modeling of thermal processes in the furnace of the designed boiler, we can conclude that there is a pronounced vortex aerodynamics in the furnace. Flue gases that rise along the back wall of the firebox get a twist in the direction of the front screen. Moreover quasi-stationary eddy currents are also observed near the mouth of the funnel cold. An incandescent vortex was pumping by combustion products. Recycling particles in the furnace volume makes it possible to dramatically increase the residence time of the fuel and oxidizer near the burners, and promotes intense ignition and fuel burn up. The temperature level that is needed to release and ignition of volatile substances is achieved through recycling. Ignition of the fuel takes place with the internal generator of the burner jets due to intensive reverse current hot products of combustion based on the results of numerical modeling. Flame kernel is located in the opposing jets impact region (Fig. 3) in the center of the furnace that facilitates uniform distribution of heat fluxes of the incident radiation and is a positive factor in the hydrodynamics.

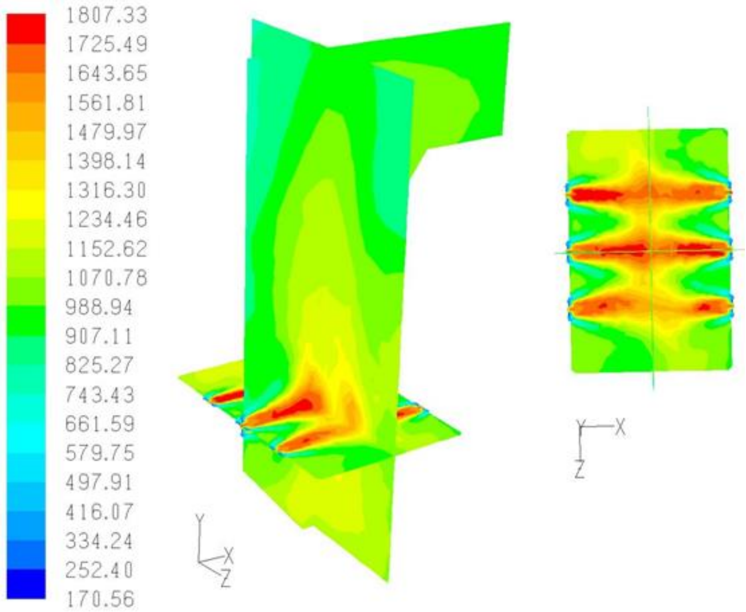

Figure 3 - The temperature distribution of the combustion medium (K).

Conclusion

In this paper, the numerical simulation of turbulent combustion of lignite in large power ramjet burner was used to study the processes occurring in the combustion chamber. Based on the results of the calculations we can conclude that,

- there is a pronounced vortex aerodynamics in the furnace, which contribute to a sharp increase in the residence time of the fuel and oxidizer near the burner, and promotes intensive ignition and fuel burn up.

-processes occurring symmetrical in the horizontal section of the combustion chamber of the boiler. Detailed analysis of the distributions of temperature and velocity of the medium in the combustion volume (Fig. 3) contributes to the evaluation of the equipment and makes it possible to predict the behavior of the boiler plant under real operating conditions.

These results confirm the effective application of modeling techniques for solving design of the boiler equipment.

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