IMPROVE HEAT EXCHANGE EFFICIENCY IN CONDENSING BOILERS WITH RADIATION BURNERS

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Increasing the efficiency of heat transfer processes in furnace devices and convective heat exchangers is one of the promising tasks of modern boiler construction [1, 2]. As shown by experimental studies [3,4], the use of radiation burners with NiAl intermetallides porous nozzles is one of the ways to increase the technical and ecological characteristics of boilers.

Traditionally, the designing of heat exchangers for boilers is carried out according to empirical dependencies obtained experimentally. These dependencies consider many factors such as the height of the burner arrangement, the degree of contamination of the combustion walls, and the layout of the heating surfaces [5]. However, the main criterion for empirical calculations remains the emissivity of the mixture of gases - the combustion fuel products. The application of these calculations in the case of boilers with radiation burners is not correct, since the source of radiation in them is solid heat, in addition to gases.

The experimental setup include NaAl porouse burner, water and air supply systems. Fuel - propane / butane 50/50%. Porous burner with preliminary mixture formation by fan and gas nozzles. Combustion mode - internal. Heating surfaces - tubes filled with circulating water at a temperature of 15 °C at the inlet.

The combustion chamber consists of radiation-convection heating surfaces with a staggered order of pipelines diameter 22/20 mm. Then - convective heating surfaces also arranged in staggered order. Water inlet into the combustion chamber pipelines. The water temperature is measured at the inlet to the setup, between the combustion chamber and convective part, and at the outlet from the setup. The air temperature is measured at the inlet, the combustion products temperature measured in the outlet from the combustion chamber, and at the outlet of the setup. This arrangement of measuring apartments allows making a complete picture of the distribution of heat flows in this prototype boiler.

According to the results of the conducted experiments, with the obtained conversion coefficient of heat to radiation 44.2%, the efficiency of the unit at the highest calorific value is 89%. The gas temperature at the setup outlet is 80 °C. The heat stress of the furnace space is 5.24 MW / m^3.

In order to intensify the heat transfer in the furnace volume, it was decided to replace the pipelines of radiation-convective heating surfaces with corrugated pipes with diameters of 13/15mm. The number of pipelines along the length increases by 15%, the total water and gas volumes remain unchanged. The increase in the heat-receiving surface estimated at 20%. The gas temperature at the setup outlet decreased to 60 °C. The heat stress of the furnace space increased to 6.6 MW / m^3. Efficiency by HCV increased to 93%.

In connection with the transition of the setup to the condensation mode, was decided to return the condensate by means of a submersible pump with further spraying it on radiation-convective heating surfaces. The gas temperature at the setup outlet decreased to 45 °C. The heat stress of the furnace space increased to 8.8 MW / m^3. Efficiency by HCV increased to 96%.

The conducted experiments, with a burner power of 15 kW, showed:

1. The experimentally determined heat stress of the furnace boiler room with radiation burners reaches 8.8 MW / m^3, which is 4 times more than in the furnaces of traditional boilers.

2. The expansion of the surface of the radiation-convective packet is proportional to the increase in the efficiency of the perception of heat transmitted by radiation.

3. Spraying of the returned condensate in the radiation-convective package also allows increasing the efficiency of the setup.

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