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STUDY OF THE EFFICIENCY OF HEAT-RECOVERY EQUIPMENT IN OPERATING MODE TO PREVENTIVE THE FORMATION OF CONDENSATE ON THE INTERNAL SURFACES OF BOILER PLANT EXHAUST DUCTS

One of the problems limiting the widespread adoption of the technology the deep recovery of the heat of the exhaust gases of gas-fired boiler plants is the formation of condensate in the gas exhaust ducts of the boiler, which can lead to a significant reduction in the life of this duct, including the chimney [1-2].

Condensation occurs when the gases reach a saturation state, and decrease gas temperatures in the adjacent layer at the wall of the gas exhaust ducts is lower than the dew point of the water vapor contained in the gases. Therefore, one way to prevent the formation of condensate is to reduce the dew point temperature, the value of which is determined solely by the moisture content of the exhaust-gases in direct proportion, and increase the temperature of the gases before they enter the exhaust duct, that is, reduce the relative humidity of the gases [3, 4]. When applying modern heat-recovery technologies [5-8], a decrease the moisture content of gases is achieved in heat-recovery exchangers, and an increase in the temperature of gases is carried out in exhaust-gas heaters installed after the heat-recovery equipment.

The purpose of this study is to analyze the effectiveness of different types of the above heat-recovery equipment and determine the parameters of the heat-transfer agents used to provide the necessary thermal and humidity condition of flue gases.

The type of equipment used (heat-recovery exchanger and exhaust-gas heater) is determined primarily by the economic feasibility of heat-recovery, which depends mainly on the type of boiler and the need for thermal energy, as well as on the availability of adequate space in the boiler building and chimney construction. The heat-transfer agents that are used to cool the exhaust-gases can be return heat-network water, water entering the chemical water-purification system, and combustion air.

To analyze the effectiveness of various types of heat-recovery exchangers that provide a significant reduction in the moisture content of gases, computational studies were carried out, which consisted in determining the specific metal consumption, volume and cost of the heat-exchange part of the equipment. The performed computational studies regarded heaters of combustion air and water-heating heat-recovery equipment, which is used when there is a significant need for thermal energy in the form of hot water. In the calculation experiments, the differences between heat-recovery exchangers consisted in the use of different heating surfaces, namely: tube bundles were composed of steel finned tubes and bimetallic pipes (steel base and aluminum fins) in hot water equipment and from steel plates or smooth tubes in air heaters. As the calculation results showed, the metal consumption and dimensions of the water heat-recovery exchangers significantly depend on the heat load of the boiler and the type of heat transfer surface, and the use of bimetallic pipes are more appropriate than the use of steel pipes. At the same time the value of the coefficient of excess air in exhaust-gases less affects the values of the studied parameters. In terms of saving financial costs for the manufacture of water-heating equipment, tube bundles with bimetallic pipes are also cheaper. As for heat exchangers for heating combustion air, under the same operating conditions, plate-type heat exchangers are usually the most effective in terms of reducing their mass, size and cost.

In order to determine the effectiveness of different types of exhaust-gas heaters, similar computational studies were carried out. An analysis of the data showed that, as in heat-recovery equipment, in water-gas heat exchangers in most cases it is advisable to use bimetallic finned tubes, and in gas-gas heat exchangers – steel plates.

Conclusions. The conclusions obtained as a result of the studies should be taken into account when designing heat-recovery systems with deep cooling of exhaust-gases and designing the corresponding equipments.

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