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EFFECTIVENESS OF THE AIR METHOD PROTECTION OF GAS EXHAUST CHANNELS OF BOILER PLANTS WITH COMPLEX RECOVERY OF THE WASTE GASES HEAT

Summary. *The study of the effectiveness of using the air method of preventing condensate formation in the gas exhaust tracts of boiler units with complex heat-recovery systems was carried out. An analysis of the heat-*

moisture state into the mouth of chimneys of brick types was carried out at using only the air method in these systems and in combination with the method of heating cooled waste gases in the gas heaters.

Key words: *waste gases, dew point temperature, condensation formation, complex heat recovery systems, combustion air, gas-heater.*

One of the effective ways to increase the safety of the operation of the chimneys of boiler plants is the use of thermal protection systems of gas exhaust tracts against condensate formation, which causes the corrosive destruction of these tracts and is therefore considered an inhibiting factor for the wide implementation of heat-recovery technologies with deep cooling of boiler waste gases in boiler units [1-8].

Thermal methods of preventing condensate formation are used to protect the gas exhaust tracts of boiler plants [9-15]. These are the methods of partial bypassing of boiler waste gases past the heat-recovery equipment, drying of the waste gases cooled in this equipment in an additional heat exchanger – gas-heater, and the air method, which consists in mixing dry and heated air with the cooled waste gases. The first two of these methods are most widely used, and the use of the third method is very limited. This is due to the fact that the implementation of this method is carried out by increasing the temperature of flue gases and lowering their dew point when adding to the cooled gases a part of σ heated in an air-heater external to the boiler installation. That is, the limitation of the application of this method is associated with the absence of air-heaters in boiler houses with small and medium power boilers. In modern developments of heat-recovery systems, own air heaters-heat recovery systems are used, in which the air is heated due to the use of recovered heat [3, 6].

This work presents the results of studies of the effectiveness of using the air method for the protection of gas exhaust tracts with a brick chimney. The scheme of the corresponding heat-recovery plant is shown in Fig. 1. The scheme

provides for the use of part σ of the air heated in the heat-recovery system itself for drying the cooled waste gases, and if additional drying of the waste gases is necessary, the use of a gas-heater. The gas-heater serves to heat the flue gases by the value Δt and thus reduce their relative moisture content before entering the chimney. The levels of σ and Δt are determined by the conditions of gas cooling in the gas outlet tracts.

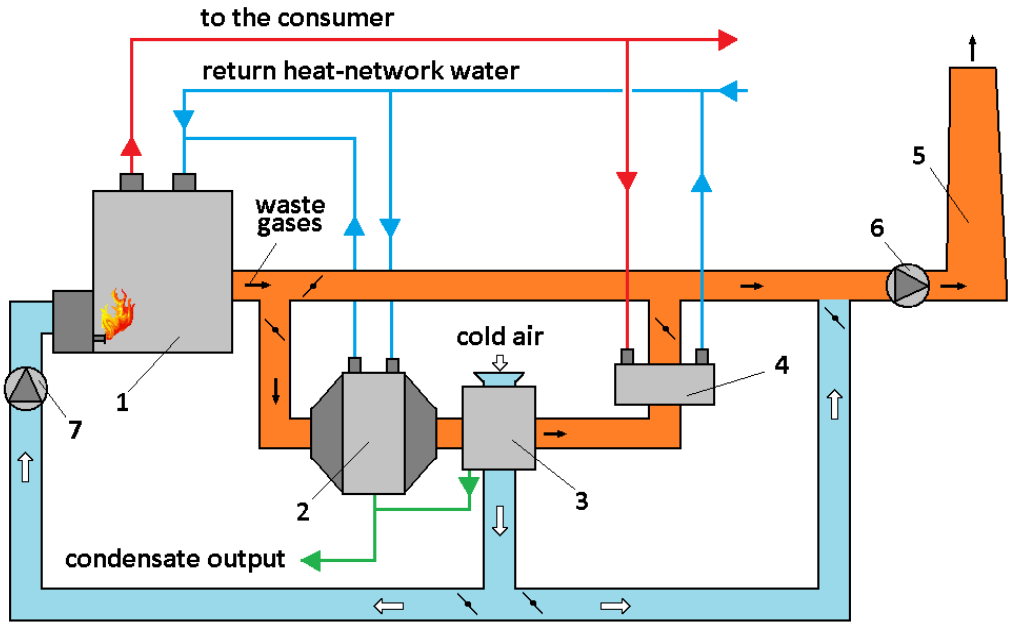

Fig. 1. Schematic circuit of the complex heat-recovery plant: 1 – boiler; 2 – water-heater; 3 – air-heater; 4 – gas-heater; 5 – chimney; 6 – exhauster; 7 – blower

At performing calculation studies (Fig. 2), the surface temperature t_s and the dew point of flue gases t_{dp} in the most vulnerable area – the mouth of the chimney were calculated depending on the ambient temperature t_a.

Research data shown in Fig. 2*a*, proved the low efficiency of the application of the single method due to the relatively low temperature (63 ÷ 96 °C) of the air heated in the heater 3. Thus, in some operating modes of the boiler, the necessary condition of the absence of condensation ($t_s > t_{dp}$) into the mouth of the chimney was not observed. Actually, due to the low efficiency of

the single air method in the complex heat-recovery system, the use of a combined of thermal methods (air and drying in a gas-heater) was proposed.

The formed water condensate can be usefully used for the boiler unit's own needs [16-20] or safely diverted in accordance with the norms of discharge to the sewage network.

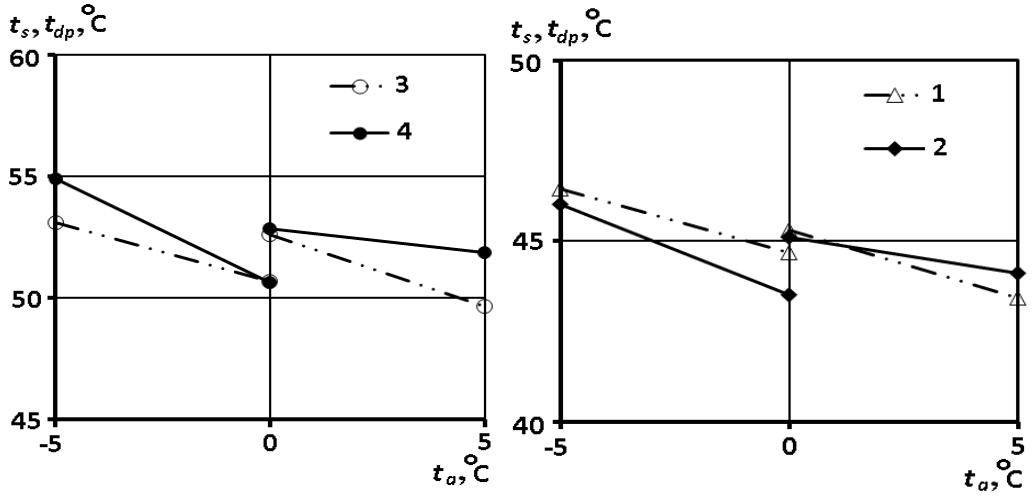

Fig. 2. Dependence of the temperature of the inner surface t_s at the mouth of the brick chimney (2, 4) and the dew point t_{dp} (1, 3) on the ambient temperature t_a at using the single air method (a) and the complex of methods (b) with the proportion of air addition σ = 5 %

Shown in Fig. 2*b* data evidence that the application of a combined of the specified methods ensures the prevention of condensate formation in the chimney at the proportion of mixed air σ from 0 to 5 % and the levels of Δt = 9 ÷ 15 °C heating of cooled gases in the gas-heater for the studied temperature range of the heating period.

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