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STUDY OF LOCAL EXERGE LOSSES IN THE AIR HEATER OF THE HEAT RECYCLING SYSTEM OF A BOILER INSTALLATION

Summary. *The efficiency of heat recovery equipment of boiler plants is determined by the level of exergy losses in its elements. Local exergy losses associated with heat transfer and hydrodynamic resistance during the movement of coolants in the air heater of the heat recovery system of a boiler plant were studied. The patterns of influence of the heat output of the air heater and heat transfer coefficients on exergy losses in the air heater have been established. The greatest exergy losses in an air heater are associated with heat transfer from the wall to the air. The area of the main characteristics of the air heater has been determined, within which the minimum level of exergy losses is ensured.*

Key words: *exergy efficiency, heat recovery systems, air heater, transfer coefficient, exergy losses.*

Introduction. The efficiency of heat recovery equipment when using deep heat recovery technologies is determined by the level of local exergy losses in its elements, which are determined by heat transfer and movement of coolants. The effectiveness of using deep heat recovery technologies increases if complex techniques based on the exergy approach are used to analyze exergy losses. The complex methodology used in the work makes it possible to calculate these losses and analyze the influence on them of the main thermophysical parameters of the air heater, which makes it possible to increase the efficiency of heat recovery equipment of boiler plants and expand the scope of application of exergy analysis methods. In connection with the above, the research presented in the work is relevant.

Statement of the problem and research method. Approaches based on exergy analysis methods are quite effective in analyzing the exergy efficiency of power plants of various types. As an example of research based on the use of a class of exergy methods to analyze the efficiency of installations, one can cite works [1–4]. In works [5–10], complex methods based on the exergy approach

are used to analyze exergy efficiency and optimize heat recovery systems of boiler plants and glass furnaces. The use of a methodology based on the calculation of local exergy losses makes it possible to look for opportunities to increase the exergy efficiency of heat recovery systems by changing the thermophysical characteristics of their individual elements.

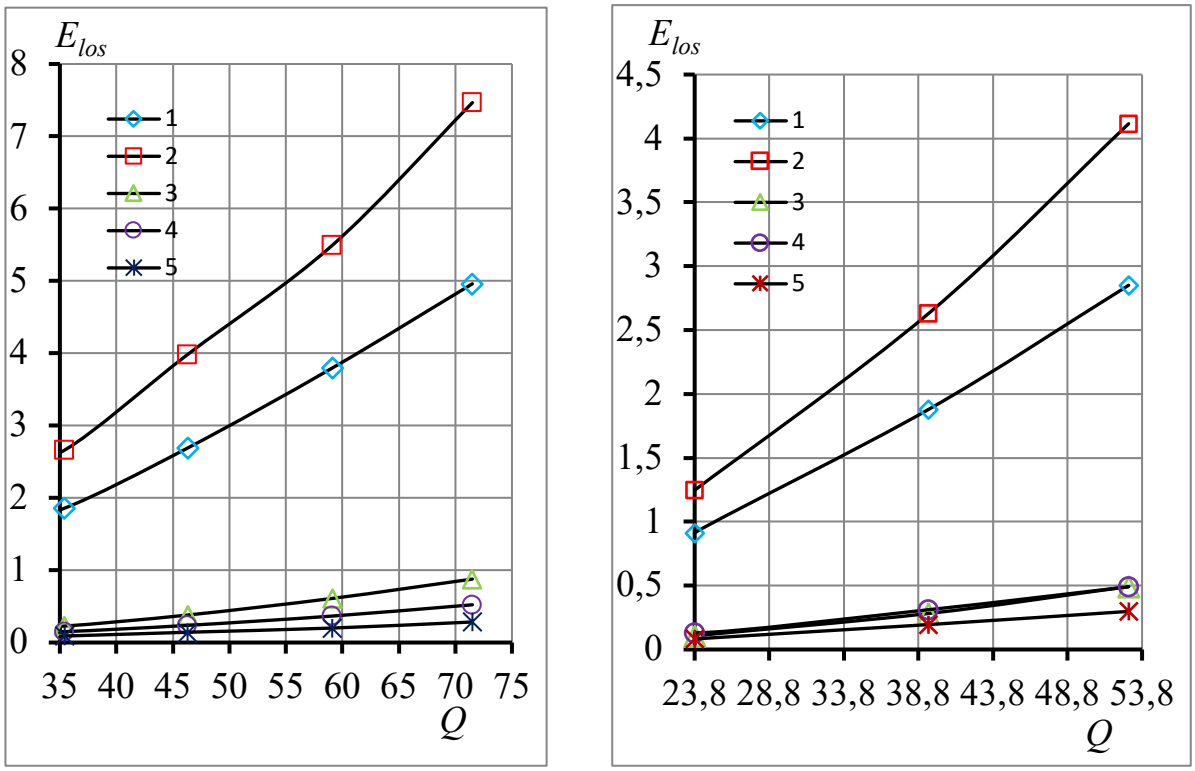
Purpose and objectives of the study. The purpose of the work is to establish the patterns of influence of the thermophysical parameters of the air heater of the heat recovery system of a boiler plant on local exergy losses in the air heater and to determine the range of changes in its parameters, within which the minimum level of losses is ensured.

To achieve this goal, the following tasks were set:

– for the air heater of the heat recovery system of the boiler plant VK-21-M2 (KSVA-2.0G), calculate local exergy losses associated with heat transfer and movement of coolants,

– to study the patterns of influence of the thermophysical parameters of the air heater on exergy losses at different values of its heat output and to determine the areas of air heater parameters within which the minimum level of exergy losses is ensured.

Research results. Studies of exergy losses in the plate air heater of the heat recovery system of the boiler installation VK-21-M2 (KSVA-2.0G) have been carried out. For the research, a complex methodology was used based on the exergetic approach, which, unlike alternatives, makes it possible to separate exergy losses in the air heater under study by reasons and areas of their localization and to calculate losses from heat transfer, thermal conductivity and movement of coolants (Fig. 1).



a) *b*)

Fig. 1. Dependence of exergy losses E_{los} (kW) during heat transfer $E_{los}\alpha_g$, $E_{los}\alpha_{air}$, thermal conductivity $E_{los\lambda}$ and movement of coolants E_{losGg}, $E_{losGair}$ on the heat output of the air heater Q (kW): *a*) modes 1-4; *b*) modes 5-7; 1 – $E_{los}\alpha_g$; 2 – $E_{los}\alpha_{air}$; 3 – $E_{los\lambda}$; 4 – E_{losGg}; 5 – $E_{losGair}$

The advantage of this approach compared to alternative ones is the possibility of increasing the efficiency of the heat recovery system of a boiler plant by reducing local exergy losses in its individual elements. Exergy losses are calculated for various boiler operating modes. The boiler operating modes were carried out in sequence from maximum to minimum boiler load during the heating period. It was taken into account that according to the regulations, if the thermal load of the boilers is 50% of the nominal, the corresponding number of boilers is transferred to the nominal mode while reducing the total number of operating boilers. As can be seen from the figures, the greatest exergy losses for all values of the heat output of the air heater are associated with heat transfer from the wall to the air from the flue gases to the wall. At the same time, exergy

losses associated with heat transfer from the wall to the air are 1.4-1.5 times higher than exergy losses associated with heat transfer from flue gases to the wall. It is advisable to reduce exergy losses precisely by changing the heat transfer coefficients, mainly the heat transfer coefficient from the wall to the air. The area of the main characteristics of the air heater has been determined, within which the minimum level of exergy power losses is ensured. The optimal range of changes in heat transfer coefficients is 0.04-0.06 kW/m^{2}K.

Conclusions.

1. Using a complex methodology developed on the basis of the exergy approach, the patterns of influence of the heat output of the air heater of the heat recovery system of the VK-21-M2 boiler plant on local exergy losses in the air heater were established.

2. It has been established that the greatest exergy losses in the air heater for all values of the heat output of the air heater are associated with heat transfer from the wall to the air and from the flue gases to the wall.

3. The area of the main characteristics of the air heater has been determined, within which the minimum level of exergy losses is ensured. The optimal range of changes in heat transfer coefficients is 0.04-0.06 kW/m^{2}K.

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