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N.M. Fialko, V.H.Prokopov, S.A. Alyosha, Y. Sherenkovskyy,
N.A Meranova, N.P Polozenko, A.E Malecki
Institute of Engineering Thermophysics, NAS of Ukraine, Kyiv

PERFORMANCE ANALYSIS OF COOLING STABILIZING BURNERS FOR DIFFERENT STRESS BOILER UNIT

The numerical research data of the jet–stabilization burners cooling system of with different baffles are presented of the jet airflow of inside end surface by flat and round jets with different width pylon is presented. The analysis of the load influence on the boiler efficiency cooling system is carried out.

Key words: jet stabilization burners, cooling system, impact jet, boiler load, computer simulation.

Наведено дані числових досліджень систем охолодження струменево-стабілізаторних пальникових пристроїв за схемою із струменевим обдувом внутрішньої торцевої поверхні плоскими та круглими струменями при різній ширині пілона. Виконано аналіз впливу навантаження котлоагрегату на ефективність системи охолодження.

Ключові слова: струменево-стабілізаторні пальникові пристрої, система охолодження, імпактна струмина, навантаження котлоагрегату, комп'ютерне моделювання.

Introduction

For decentralized Energy of Ukraine urgent problem is to increase durability burners, which is one of the most important elements of boilers. Research on various aspects of workflow burners used in the art energy management, subject of many papers [1,2].

Analysis of the operation of various types of burner indicates that the main factors reducing their resource is inadequate cooling systems.

This work aims to address the increasing longevity stabilizatornyh burners through the use of new technical solutions for their cooling and provide acceptable temperature level of the most loaded in the heat against the elements. The essence of the proposed technical solution is cooling the most heat-intense areas of pylon by natural gas, which is specially fed into the inner cavity of the pylon and then, after executing the cooling agent enters the gas-suapply holes and used as fuel. That is, in these schemes there is no special cooling agent and his role is natural gas, which is subject to further burning. Given this scheme of its kind in a sense, can be classified as a scheme "self-cooling" burners.

Formulation of the problem and methods of research

Subject to review the proposed cooling system stabilizing burners with spray blowing inner end surface flat and round jets with different width pylon $B_{ст}$ (fig.1). Particular attention is given to the study influence of the load on the boiler unit features cooling burners. This range of variation in the relative pressure boiler N ($N = Q_к / Q_н \cdot 100\%$, where $Q_к$, $Q_н$ – current and nominal load was within 20% – 100%. For each of these options on the basis of mathematical modeling of the features of the flow, heat transfer from the walls of the pylon, pylon temperature characteristics are determined by the level of hydraulic losses in the cooling path, even heating of gas in the system and so on. It compared the effectiveness of the proposed schemes cooling.

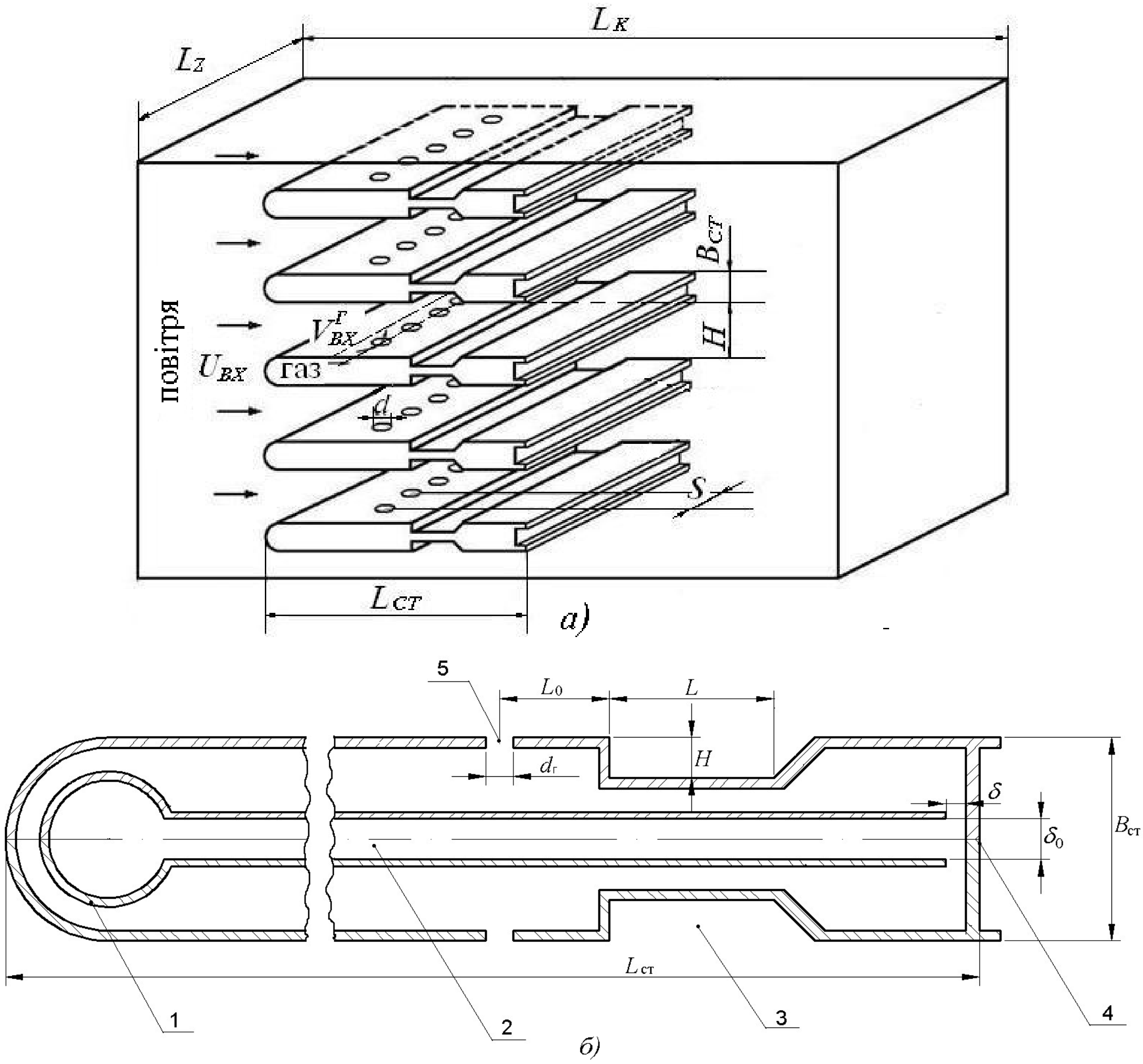

Fig. 1. Scheme of stabilizing burner type (a) and
longitudinal section of the module micro burner with air cooling (b):
1 – hazopodayuchyy collector, 2 – flat channel for gas ohlazhduyuchoho 3 – niche cavity,
4 – end wall plug, 5 – hazopodayuchi holes

Solution of problem of the transfer in question was carried out using FLUENT software system based on a phased modeling method [3].

Results and analysis

Effectiveness of the cooling gas burners type stabilizatornoho heavily determined by the load of the boiler. This fact is due to the fact that in such systems, which are called samooholodzhennya system, fuel cooling agent (natural gas) varies according to boiler load changes.

These data suggest that the decrease in the overall structure of the boiler load flow cooling agent in the oral pylon slightly different. In the situation considered at low load N, a decrease in the size of a large vortex prytortseviy zone pylon and thus increasing the cross-sectional flow wraps around this vortex. This increases the angular size of the secondary vortices. As for the nature of the flow of cooling agent at relatively large values B_{cm} ($B_{ст}$ = $50{\cdot}10^{-3}$ m), here along with the specified there is also the following feature. Vortices generated near the bottom of the niche decreases in size as far as reducing the load of the boiler with $B_{ст}$ = $50{\cdot}10^{-3}$ m.

For all the above situations the value of the maximum velocity in the oral niche $V_{\max}$ decreases with decreasing load *N*. Moreover, this dependence is much more pronounced in the case of the cooling system with round of impact jets. It should also be noted that the higher values. It should also be noted that the higher values $B_{\text{ст}}$ respond, other things being equal, larger values $V_{\max}$ for both the systems cooling. However, this difference in the case of the cooling system with a flat stream is very small for all values of load *N*. In the same situation, which corresponds to the cooling system with round jets, this difference is more significant and increases with increasing *N*.

Represents interest also consideration depending on the load of the boiler unit pressure loss in the cooling path. According to information received indicated the loss of ΔP decreases significantly with decreasing pressure boiler *N*. Thus, in the case of cooling systems with flat and round jet pressure loss ΔP falling respectively 18.9 and 21.9 times at lower load from 100% to 20% in a situation corresponding to $B_{\text{ст}} = 30 \cdot 10^{-2}$ m.

It is also important to emphasize that in the whole range of N loading pressure loss ΔP are significantly higher for systems with circular jets compared to the cooling of flat jet. Moreover, this difference is the greater, the greater the pressure of the boiler. For example, for $B_{\text{ст}} = 30 \cdot 10^{-3}$ m at $N = 20\%$ and 100% indicated difference is 209.5 Pa and 4834 Pa, respectively.

As for the impact load of the boiler on the average heat transfer coefficient $\overline{\alpha}_{BH}$, then, according to our data is characterized by reduced values $\overline{\alpha}_{BH}$ with decreasing load (see Fig. 2). Moreover, this reduction can be quite significant. Thus, the average across the surface heat transfer coefficient pylon $\overline{\alpha}_{BH}$ decreases by about 1.5 and 3.7 times while reducing the load from the nominal 60% and 20% respectively in the case of the cooling system with a flat impact stream $B_{\text{ст}} = 30 \cdot 10^{-3}$ м. As shown from a comparison of the data with increasing width of the stabilizer average heat transfer coefficients decrease at all given the load of the boiler *N*. So, at $N = 60\%$ for these variables $B_{\text{ст}} = 30 \cdot 10^{-3}$ m and $50 \cdot 10^{-3}$ m average values $\overline{\alpha}_{BH}$ equal to 118,1 and 96,5 W/(m^{2}K). That is, in this area of the heat transfer coefficient $\overline{\alpha}_{BH}$ indicated an increase in the width of the stabilizer and other fixed parameters is reduced by 1.23 times.

The results of the research show that for all the considered situations highest values of temperature observed on blast edge stabilizer. The highest values $t_{\text{ст}}^{\max}$ take place at the minimum load.

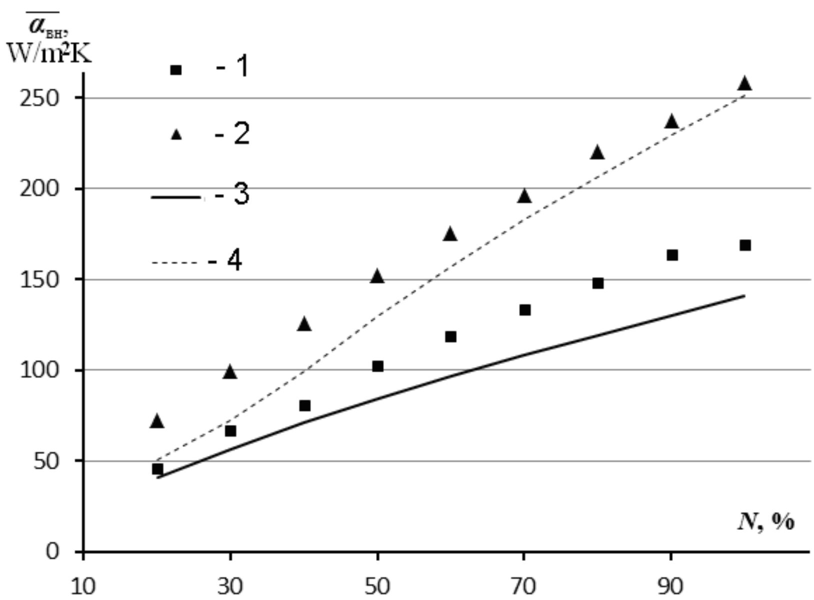

Fig. 2. The dependence of the average heat transfer coefficient $\overline{\alpha}_{BH}$ on the surface of the pylon, which is cooled by the boiler load N at z = 0 for systems of cooling airflow to the end of the pylon flat of impact jet (1), (3) and circular jets (2), (4) with different widths of pylon B_{cm}:1,2 – $B_{cm}=30 \cdot 10^{-3}$ m, 3,4 – $B_{cm}=50 \cdot 10^{-3}$ m

By increasing the last value $t_{ст}^{max}$ decreases monotonically. It should also be noted that for all values of *N* loading rate of maximum wall temperature pylon is ceteris paribus higher in the case of cooling airflow end pylon flat jet as compared to the situation that corresponds to the system of round jets. The greater width of the stabilizer Вст, the higher the value $t_{ст}^{max}$ as for cooling systems with a flat and with round jets (see Fig. 3).

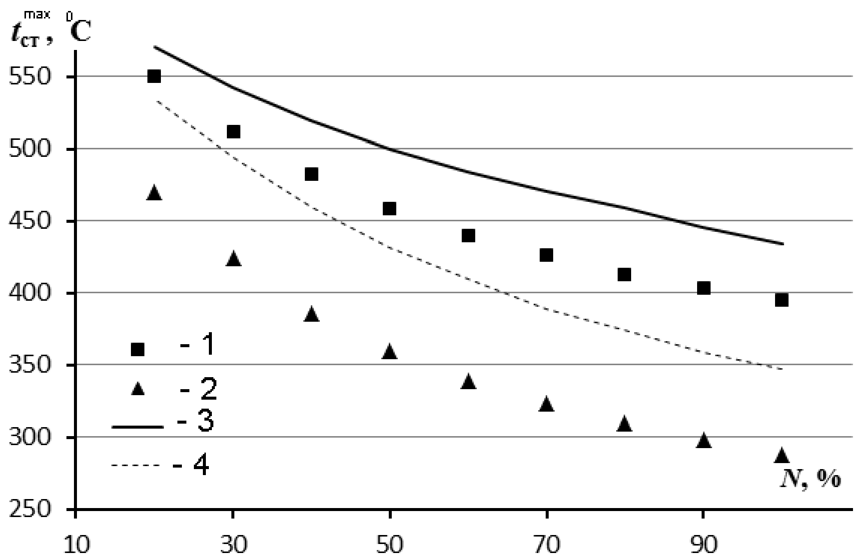

Fig. 3. The dependence of the maximum wall temperature pylon $t_{ст}^{max}$ on the load of the boiler for cooling systems with airflow to the end of the pylon flat of impact jet (1), (3) and circuit cooling system round jets (2), (4) for different values of the width of the pylon Всm=0,03m lines 1,2 і Всm=0,05m lines 3,4

Conclusions

The research to evaluate the effectiveness of the proposed self-stabilizing cooling burners in a wide range of boiler load changes. Determined the regularities of the flow and mass transfer in these systems. The data on the thermal state of the walls of the pylons burners for the conditions of use of different cooling systems

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