European Journal of Agricultural and Rural Education (EJARE)
Available Online at: https://www.scholarzest.com
Vol. 2 No. 12, December 2021,
ISSN: 2660-5643

IMPROVEMENT OF HYDRAULIC PARAMETERS OF HEAT SUPPLY DEVICES

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Article history:

Received: 17th October 2021
Accepted: 14th November 2021
Published: 18th December 2021

Abstract:

The useful working coefficient of water heating boiler devices, which are in use today, is 70-75%. This article presents an analysis of research on the creation of heating boilers by improving the hydraulic parameters of boilers and the use of efficient structural elements to increase the energy efficiency of water heating boilers. As a result of research and calculations, a 15-20% increase in the thermal efficiency of the water heating boiler was achieved. This will increase the efficiency of water heating boilers used in social facilities and save resources used as fuel.

Keywords:

INTRODUCTION.

Consistent implementation of measures to improve the quality and uninterrupted supply of thermal energy to consumers in the world today, renewal and modernization of fixed assets of the heat supply system based on the introduction of resource-saving technologies, efficient and rational use of fuel and energy resources. At the same time, the current stage of socio-economic development of the Republic requires a comprehensive modernization of the heat supply system and raising its technical level on the basis of modern energy-saving technologies [1,2]. The effective implementation of these tasks is a topical issue today, taking into account the latest achievements of science in the use of perfect and modernized heating systems for heating social facilities [5].

METHODS AND ANALYZES.

According to the analysis of research, the provision of individual boilers for heating social facilities, including preschools, schools, family clinics and other public buildings in the winter shows an increase in thermal efficiency [2,3,4,5]. The efficiency of currently used boilers is 70-75% [2,3,4,5]. Therefore, as a result of improving the hydraulic parameters of heating boilers, the creation of improved heating boilers through the use of precise and efficient structural elements, the rational and economical use of fuel resources remains one of the most pressing issues.

The heat transfer system in the boilers currently in production is shown in Figure 1.

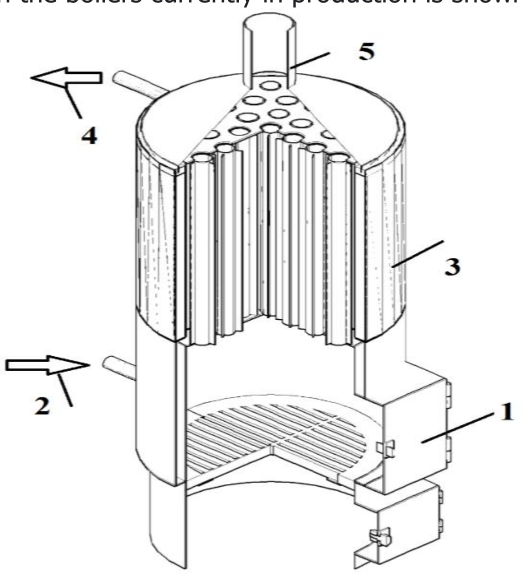

Figure 1. Appearance of the heating boiler (UVK-150)

1-Fuel furnace; 2-Rotating heat carrier (reverse heat exchanger); 3-Boiler body; 4-Heat transfer to the heating system; 5-Dudburon.

In order to increase the efficiency of this heating boiler, changes were made to its construction. It is known that heat transfer is related to the surface of the heat source and the modes of motion of the flow [2,3,4,5]. Steel pipe (diameter 50 mm) is a material that conducts heat well according to its physical properties. The design novelty of the improved heat transfer boiler is that a shell is placed on the outside of the steel pipe and the heat transfer surface is increased. As a result, the burned gas transfers more heat to the heat transfer medium (Figure 2).

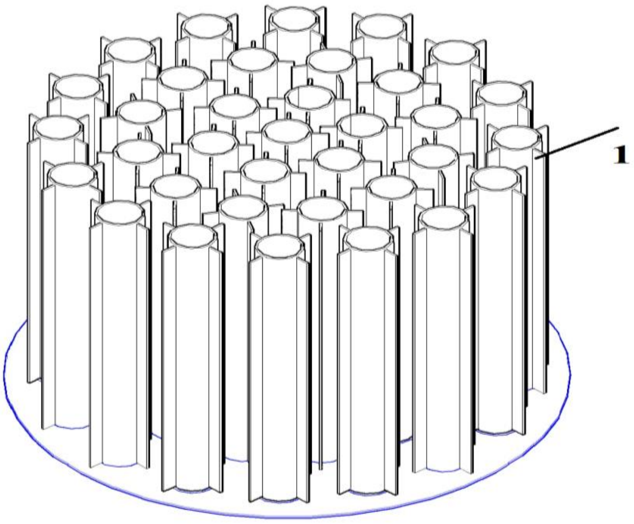

Figure 2. Improved water heating boiler section
1-steel pipe shell

RESULTS.

When estimating flow motion in heating devices, it is necessary to evaluate the two surfaces based on the geometric measurement D / d and the Reynolds criterion of complex size. The geometrical dimensions of the known device are characteristic of the D-pipe material (roughness); the linear dimension (diameter) of the d-pipe does not change significantly under the influence of temperature. The process that occurs in a stream under the influence of temperature is reflected in the Reynolds criterion.

$$R_e = \frac{\vartheta d}{\nu}; \qquad \text{or} \qquad R_e = \frac{\rho \vartheta d}{\mu}; \qquad (1)$$

where: ϑ-average speed; d-pipe characteristic diameter; ν-kinematic adhesion coefficient; ρ-fluid density; μ-dynamic viscosity coefficient.

In the given expression μ; ρ-values are parameters that change under the influence of temperature.

The change in flow motion in heating devices is related to the heat exchange of the source. We use the theory of units of measurement to derive a model of these problems. In determining the heat transfer coefficient -α, the parameters of the flow and the size of the pipe are taken into account. Heat exchange process flow rate-ϑ; density-ρ; specific heat capacity-C; heat transfer coefficient-α_0; dynamic viscosity coefficient-μ; and is expressed in terms of the diameter-D of the pipe.

In particular, the following expression can be written for $\left(\frac{L}{D} > 50\right)$ α in the mode of turbulent motion [2,3,4,5]:

$$\alpha = 0,023\frac{\alpha_0}{D} R_e^{0,8} \Pr^{0,33} \qquad (2)$$

Here: $\frac{c\mu}{\alpha_0} = \Pr$ -Prandtl criterion:

Based on the analysis, the amount of heat can be determined on the basis of Newton's law as follows:

$$q = \alpha\left(T - T_0\right)$$

where: *q*- is the heat flux from the source;

$\left(T - T_0\right)$ - temperature difference;

T-source temperature;

In general, the amount of heat transferred for a stationary mode is determined as follows [2,3,4,5]:

$$Q = kS\square\Delta T$$

where: S-heat exchange surface;
k-heat coefficient;

$$k = \frac{\alpha_1 \square \alpha_2}{\alpha_1 + \alpha_2};$$

α_1 and α_2 are the heat transfer coefficients on the inner and outer walls.

The amount of heat transferred in the study was studied in two cases.

The first case, that is, in existing heating devices.

In this case, the given parameters are ΔT; When the α-quantity is the same, the amount of heat transferred is determined as follows for the given circuit (Fig. 1).

$$Q_1 = \alpha S_1 \Delta T$$

In the second case, the amount of heat needed for the improved design (Figure 3) is determined as follows.

$$Q_2 = \alpha S_2 \Delta T$$

Figure 3. Pipe with improved hydraulic parameters

The effectiveness of the new device was evaluated on the basis of experimental studies.

The results of the experiment were analyzed on the basis of a theoretical method. In order to clarify this, a program was developed for the smallest squares method to analyze test results for different cross-sectional surface pipes and to determine the heat transfer surface efficiency.

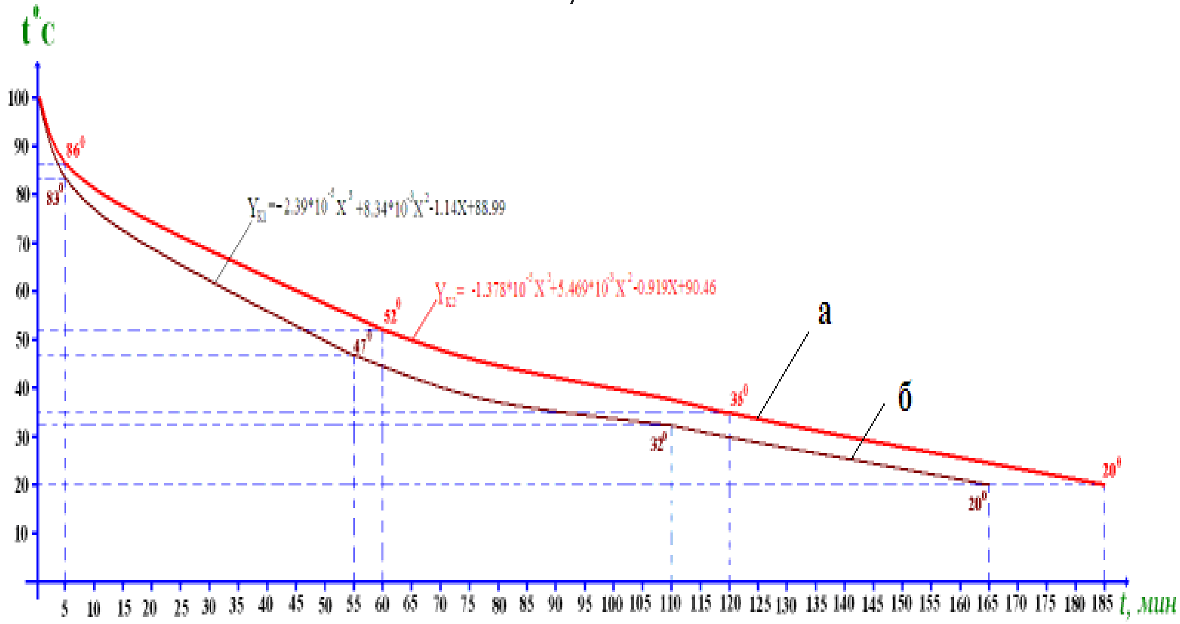

Figure 4. Graphical representation generated in conjunction with experimental trials and high-order polynomial expression [3].

a) ribbed pipe b) ribbed pipe

CONCLUSION.

As a result of the research, in order to increase the thermal efficiency of existing water heating boilers, improved design parameters of the boiler unit were developed and hydraulic calculations were performed. In particular, the cutting surfaces on which the heat flow moves are increased at the expense of additional ribs, resulting in a 15-20% increase in the thermal efficiency of the water heating boiler. This will increase the efficiency of water heating boilers used in social facilities and save resources used as fuel.

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