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Increasing heat efficiency by changing the section area of the heat transfer pipelines

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Abstract. On the territory of our republic, individual boilers are widely used for heating many social facilities in the winter season. The efficiency (efficiency) of these heating boilers is only 70-75%. Sustainable and efficient use of fossil fuels is now becoming a problem not only in Uzbekistan, but throughout the world. In recent years, the results of expert research on the use of solid, liquid and gaseous fuels in heating boilers show that in many countries there is a shortage of fuel and problems with the supply of natural resources to these countries. Of course, given the fact that the process of burning fossil fuels depends on the cross-sectional area of heating boilers, it is necessary to develop recommendations for creating more energy-efficient use of methods to reduce fuel consumption or resource conservation. In our republic, a number of scientific works are consistently carried out to create resource-saving capacities for heat transfer pipelines. In particular, the main content of the dissertation is the development of the introduction of the latest modern scientific methods to increase the efficiency of heating boilers by improving the method of calculating resource-saving heat transfer pipelines. The article presents methods for determining the heat transfer parameters of heat exchangers in laboratory conditions, as well as methods for analyzing the results.

1. Introduction

In our republic, the supply of thermal energy to consumers requires the consistent implementation of measures to ensure its quality and continuity, updating and modernization of the main assets of the energy supply system based on the introduction of modern energy-saving technologies, efficient and rational use of fuel and energy resources. At present, our republic has sufficient energy resources for the production of electric and thermal energy, as well as for use in all areas of agriculture and the economy and social life [1]. The volume of production of energy resources exceeds 15-20% of domestic demand. As a result, this rapid development of the fuel and energy complex has become a priority area of state policy. At present, the peculiarity of such centralized heat supply systems, which consumes insignificant funds for the installation of boiler plants, but at the same time requires significant maintenance costs, is expressed in the short-term maintenance of internal heating systems and pipelines of heating networks, and the high cost of operating costs of production, transportation and consumption of heat, excess of the established norms of expenses for water and heat supply through networks. [7,10,17].Today, due to excessive obsolete boiler equipment and networks [14], it is not possible to optimally use heat sources from the existing heat supply system, which negatively affects the activities of heat supply enterprises, and the quality of heat and hot water supply to consumers. The development of heat-producing enterprises in the Republic of Uzbekistan is one of the main sectors of the economy, which has certain production and scientific and technical resources and has a significant impact on its development. Over the past decade, the balance of total energy consumption in Uzbekistan has been 84–87 percent for natural gas, 11–8 percent for fuel oil, and 3.5–4.4 percent for coal. It is obvious that fuel does not optimally meet energy safety requirements in the form of an energy balance. It is known that oil and gas reserves in Uzbekistan [2,9,17], as well as in other countries, are declining, which may last for several decades, while coal reserves may last for more than 250 years. In conclusion, given the low role of today's coal in the energy sector of Uzbekistan, it is necessary to conduct research to increase it.

2. Method and analyses

Local boiler houses located on the territory of the Namangan region intended for buildings of pre-school education institutions, school facilities and health care. The object of the study is the local boiler rooms, and the subject is the change in the cross-sectional surfaces of the heat transfer pipes and the determination of the optimal sizes.

Scientists conducted scientific research to study the heat transfer processes of local boilers and create their energy efficiency. As a result of these studies, a number of measures are still being taken to reduce fuel consumption and maintain its heat production, of course, taking into account technical, economic and effective levels. In most cases, the indicators of effective and rational use of local boiler houses are reduced due to the lack of modifications to parts of existing traditional local boiler houses. The main reason for this is that local boiler houses do not fully investigate the dynamics of the flow of coolant in the structural elements, the change in the hydraulic and thermal conditions of the pipes. The following experimental equipment was created for the efficient use of existing boiler equipment. The experimental device was prepared in the laboratory room of the department "Construction and installation of utilities." [2,3,5,9,16,17].

Table 1. Caliper Measurement Results

Sketch view of device parts	1-result (sm)	2-result (sm)	3-result (sm)	4-result (sm)	5-result (sm)	Average result (sm)
Pipe inner diameter (cm)	5,2	5,25	5,16	5,18	5,2	5,2
Thickness of pipe ribs (plate) (cm)	0,21	0,22	0,19	0,20	0,17	0,2
Pipe ribs height (plate) (cm)	1,4	1,47	1,49	1,43	1,41	1,44
Pipe thickness (cm)	0,2	0,22	0,2	0,24	0,23	0,218
Pipe Outer Diameter (cm)	5,71	5,67	5,68	5,65	5,67	5,676

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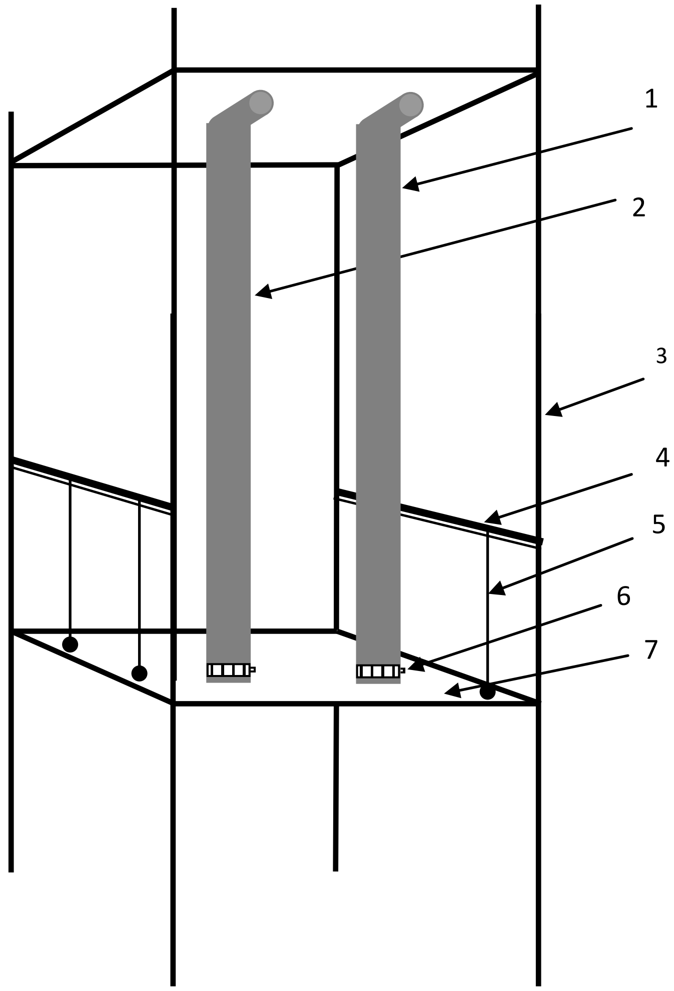

Figure 1. The structure of the experimental device.
1. Inner ribbed pipe 2. Pipe without ribs 3. Special wood frame 4. Square 5. Steel rod tractor 6. Clamp 7. Wooden lower and upper supports.

A caliper measures each of the five parts of the pipe sample: the outer and inner diameter of the pipe, the thickness of the pipe, the width and height of the pipe ribs (d1, d2, d3, d4, d5; t1, t2, t3, t4, t5; b1, b2, b3, b4, b5) and the arithmetic mean value of each side is taken as the final result [2,16].

$$d_{ýp} = \frac{d_1 + d_2 + d_3 + d_4 + d_5}{5}; \qquad (1)$$

Where, dur, tur, bur- average values size, m.

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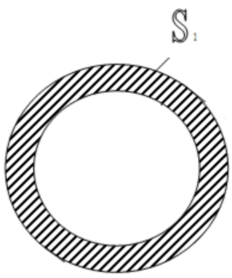

Figure 2. Determining the area of the pipe.

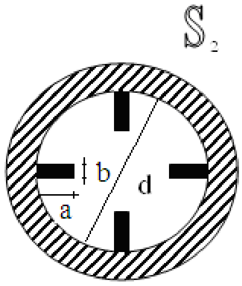

Figure 3. Determining the area of the ribbed. without ribtube

$$S_1 = \frac{\pi d^2}{4} \quad (2)$$

where, S_1 is the area of the pipe without ribs (Figure 2.), π = 3.14, d is the inner diameter of the pipe, cm; $S_1 = \frac{\pi d^2}{4} = \frac{3{,}14 \cdot 5{,}2^2}{4} = 21{,}23\text{cM}^2$ $S_2 = (S_1 - 4 \cdot ab)$ where, S_2 is the area of the ribbed pipe,
S1 - pipe area without ribs, a - pipe rib height (plate),
b- Thickness of the pipe ribs (plate), cm (Figure 3);

$$S_2 = (S_1 - 4 \cdot ab) = 21{,}23 - 4 \cdot 1{,}44 \cdot 0{,}2 = 21{,}23 - 1{,}152 = 20{,}078 \text{см}^2$$

Differentiation of water capacity of ribbed tubes and without ribs.

$$A\% = \frac{S_1 - S_2}{S_1} \cdot 100 = \frac{21{,}23 - 20{,}078}{21{,}23} \cdot 100 = 5{,}4\%$$

This shows that 5.4% a lot of water is placed on a pipe without ribs compared to a ribbed pipe.
The area of friction of the coolant in relation to the pipe.

$$F_1 = \pi d \quad (3)$$

Where, F1 is the friction area of the pipe without ribs, π = 3.14, d is the inner diameter of the pipe without ribs;

$$F_1 = \pi d = 3{,}14 \cdot 5{,}2 = 16{,}3$$

The area of friction of the coolant over a complex section.

$$F_2 = (\pi d + (2a + b) \cdot 4 - 4b)$$

Where, F2 is the friction area of the ribbed pipe, π = 3.14, d is the inner diameter of the ribbed pipe; , a- pipe rib height (plate), b- Thickness of pipe ribs (plate), cm;

$$F_2 = (\pi d + (2a + b) \cdot 4 - 4b) = (16{,}3 + (2 \cdot 1{,}44 + 0{,}2) \cdot 4 - 4 \cdot 0{,}2) = 27{,}82$$

Differences in two sections.

$$B\% = \frac{F_2 - F_1}{F_1} \cdot 100 = \frac{27{,}82 - 16{,}3}{16{,}3} \cdot 100 = 70{,}67\%$$

3. Results

The temperature inside the pipe is higher than the temperature in the room, so a gradual decrease in the temperature inside the pipe was observed. A specific unit of time for measurements was taken. Every 5 minutes, the internal temperature of the two pipes was measured with a thermometer and recorded in a log. A decrease in the internal temperature in pipes with different cross sections showed different results. The experiment lasted 3 hours. The results are presented in table 1. [2,3,9,10,16,17].

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Table 2. Laboratory test results

№	Measurement time in the interval every 5 minutes	Temperature of water in ribbed pipe in measured time	Temperature of water in pipe without ribs in measured time	№	Measurement time in the interval every 5 minutes	Temperature of water in ribbed pipe in measured time	Temperature of water in pipe without ribs in measured time
1	12:09	83 °C	86 °C	19	13:39	35 °C	41 °C
2	12:14	75 °C	82 °C	20	13:44	34 °C	39 °C
3	12:19	71°C	78 °C	21	13:49	33 °C	38 °C
4	12:24	68°C	74 °C	22	13:54	32 °C	37 °C
5	12:29	65°C	72 °C	23	13:59	31 °C	36 °C
6	12:34	61°C	68 °C	24	14:04	30 °C	35 °C
7	12:39	58°C	65 °C	25	14:09	29 °C	34 °C
8	12:44	54°C	62 °C	26	14:14	28 °C	33 °C
9	12:49	51°C	59 °C	27	14:19	27 °C	32 °C
10	12:54	49°C	56°C	28	14:24	26 °C	31 °C
11	12:59	47°C	54°C	29	14:29	25 °C	30°C
12	13:04	45°C	52 °C	30	14:34	24 °C	30 °C
13	13:09	43 °C	50°C	31	14:39	23 °C	29 °C
14	13:14	42 °C	48 °C	32	14:44	21 °C	28 °C
15	13:19	40 °C	46 °C	33	14:49	20 °C	27 °C
16	13:24	39 °C	44°C	34	14:54		25 °C
17	13:29	38 °C	43°C	35	14:59		23 °C
18	13:34	37 °C	42 °C	36	15:04		21 °C

Ribbed

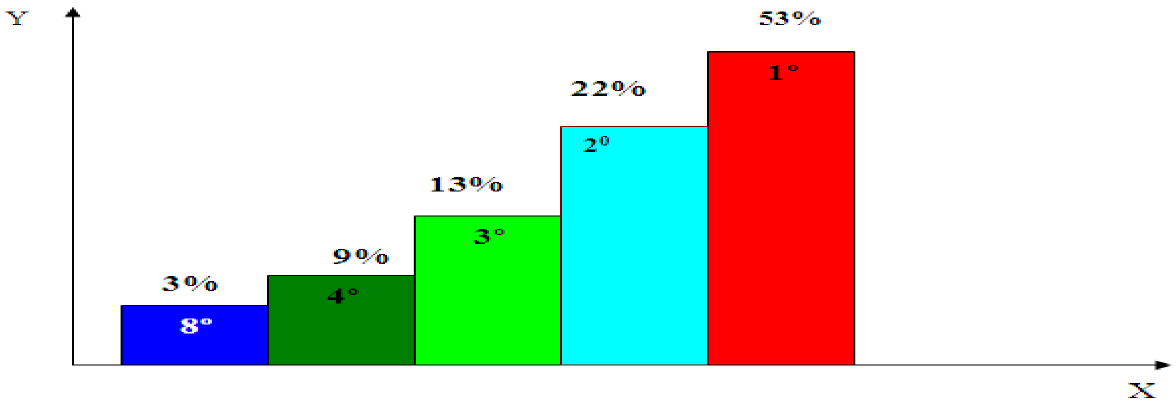

Figure 4. Temperature change of a ribbed pipe over a specific unit of time.

No ribs

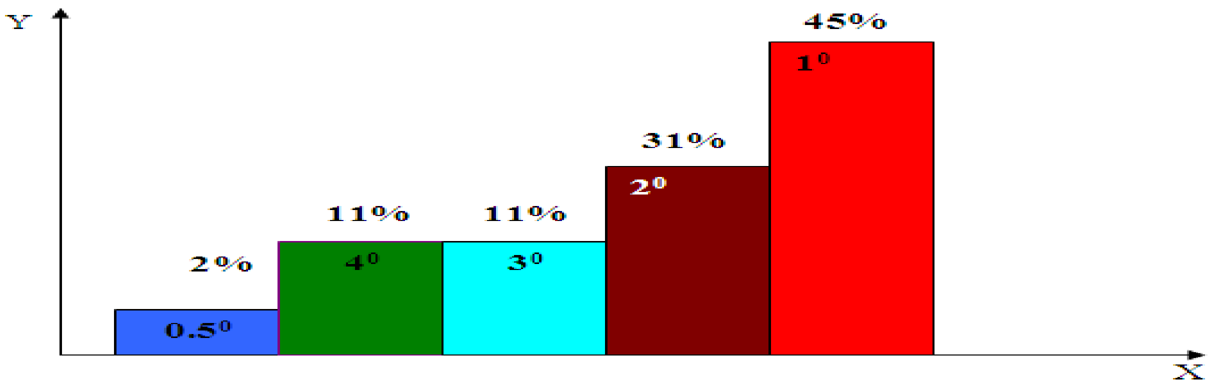

Figure 5. Change in pipe temperature without ribs for a specific unit of time

As can be seen, according to the results of scientific research, the efficiency of a ribbed pipe in relation to pipes without ribs is determined by 15%

4. Conclusoins

In conclusion, we can say that the efficiency (efficiency) of existing boiler plants is 70-75%. The full service life of individual boiler houses used in social facilities of Namangan region is 5-6 years. For this reason, the details of heating boiler rooms are improved using accurate and effective structural elements. This reflects the fact that energy is not fully used in the process of fuel combustion. The rational and economical use of fuel resources as a result of the creation of heating boilers remains one of the most pressing problems. Thanks to the introduction of minimal changes to the proposed boiler equipment, it can be effectively used in the heat supply of residential and industrial buildings in the winter season.

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