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IMPROVING THE PERFORMANCE
OF A LOW-TEMPERATURE WATER HEATING

Наведено результати теоретичних досліджень поля температури, швидкості і тиску в запропонованій конструкції теморегулятора. Показано, що у цьому разі спостерігається практично лінійний режим регулювання витрати теплоносія, що дає можливість працювати системі водяного опалення в постійному гідравлічному режимі зі зміною кількісної та якісної характеристик теплоносія тільки в нагрівальних приладах.

Запропоновано систему водяного опалення з низькотемпературним теплоносієм на основі використання гідравлічно змінюваного режиму в нагрівальних приладах із збереженням постійного в решті частини системи і збільшення діапазону ефективної роботи терморегуляторів, що дає змогу знизити необхідний тиск у системі опалення і капітальні витрати за рахунок зменшення кількості необхідних балансувальних клапанів у системі опалення.

Ключові слова: нагрівальний пристрій, терморегулятор, система опалення.

The paper presents the results of theoretical studies of the temperature field, velocity and pressure in the proposed design temoregulyatora. It is shown that in this case there is an almost linear regime on the coolant flow rate, which gives the opportunity to work in the hot water heating system with a constant hydraulic regime change in the quantitative and qualitative characteristics of the coolant only heating devices.

The system of water heating with low-temperature coolant through the use of hydraulically variable mode heating devices while maintaining a constant in the rest of the system and increase the range of effective operation of thermostats, allowing to reduce the required pressure in the heating system and capital costs by reducing the number of required balancing valves in the heating system

Key words: heater, thermostat, heating system.

Problem formulation

In Ukraine, the heat demand in the housing sector is about 60 % of the total thermal energy produced at the same time, equip the individual heating appliances with automatic controls of heat flow (thermostats) allows, depending on the type of controls and their operating conditions to reduce the consumption of thermal energy for heating 10–20 % mainly due to the decrease in overhead heat [1, 3, 5–7].

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The main drawback of the control systems is narrow heating region linear action thermostats (from 0,3 to 0,7 of valve travel), moreover, unlike traditional counterparts, such systems are characterized by increased time capital investments with increasing working pressure in the system (3–4 times) compared to the unregulated system that has a negative impact on operating costs [8–12]. Also, it should be noted that, despite the well-developed theory of the hydraulic control of heating systems currently available thermal models of such systems. Especially negative situation for a small thermal head in a heating device, which is typical for renewable energy.

The aim is to improve systems of water heating with low-temperature heat transfer through the use of hydraulically variable mode in heating devices to maintain a constant in the rest of the heating system.

The primary research material

To achieve this goal has been proposed a method of controlling the heating system by installing a heating device for each ejector associated with a thermostat that allows you to change the heat flux due to quantitative regulation in the heating unit and the rest of the heating system is in constant hydraulic mode. However, existing methods of selecting control equipment for water heating systems do not account for the resulting heat flow through the heater. Therefore, to simulate the effect of a local change in temperature and flow rate in the heating unit was used software package CosmosFloWork based software SolidWork. This program is used for the calculation of hydro, wind and heat and mass transfer processes using the continuity equation of the Navier-Stokes equations for viscous perfect gas [2].

On the axis of symmetry of the conditions of the ejector and solved the equations of energy and movement for the z-component of the velocity. Solution of the problem begins with the initial conditions and parameters of the problem. Within the region defined homogeneous initial conditions for the components of the velocity and temperature. Based on these theoretical data for the study was created a computer model of a local heating device with an ejector (Fig. 1).

Fig. 1. General view of the model of local control of heat flow from the heater

The following parameters were varied:
– Flow rate through the supply line;
– The diameter of the nozzle of the ejector;
– Heating water flow ejected;
– The temperature and pressure at the inlet and outlet of the model.

The results of modeling of thermal and hydraulic processes in quantitative and qualitative regulation of heat carrier in the heating devices are shown in Fig. 2, 3.
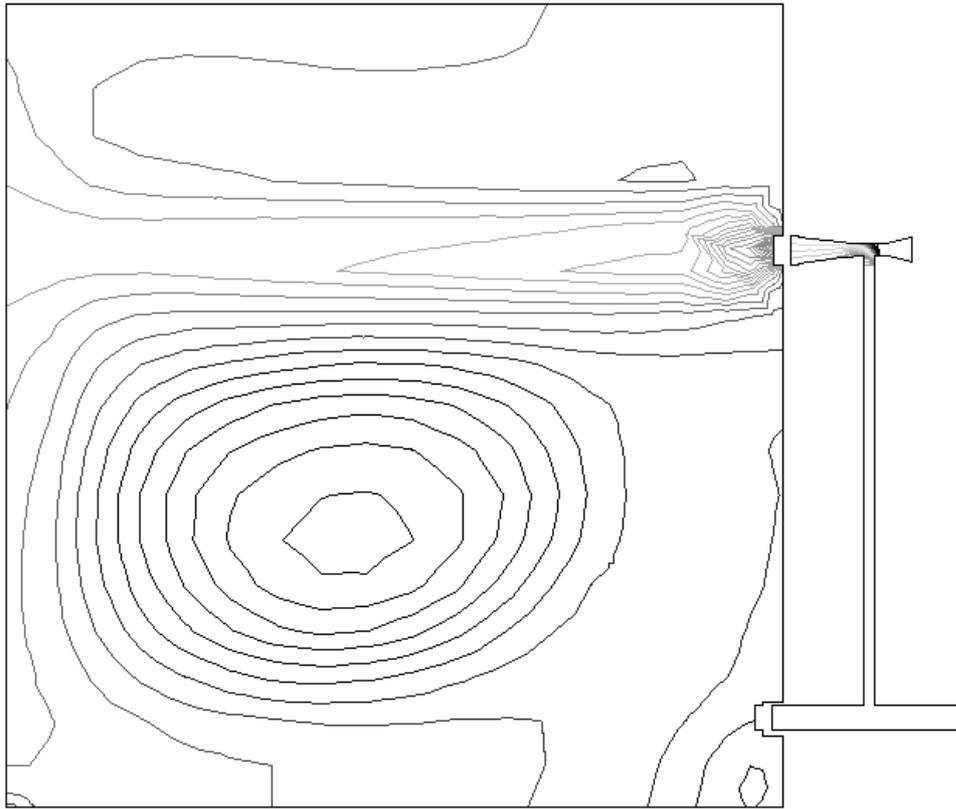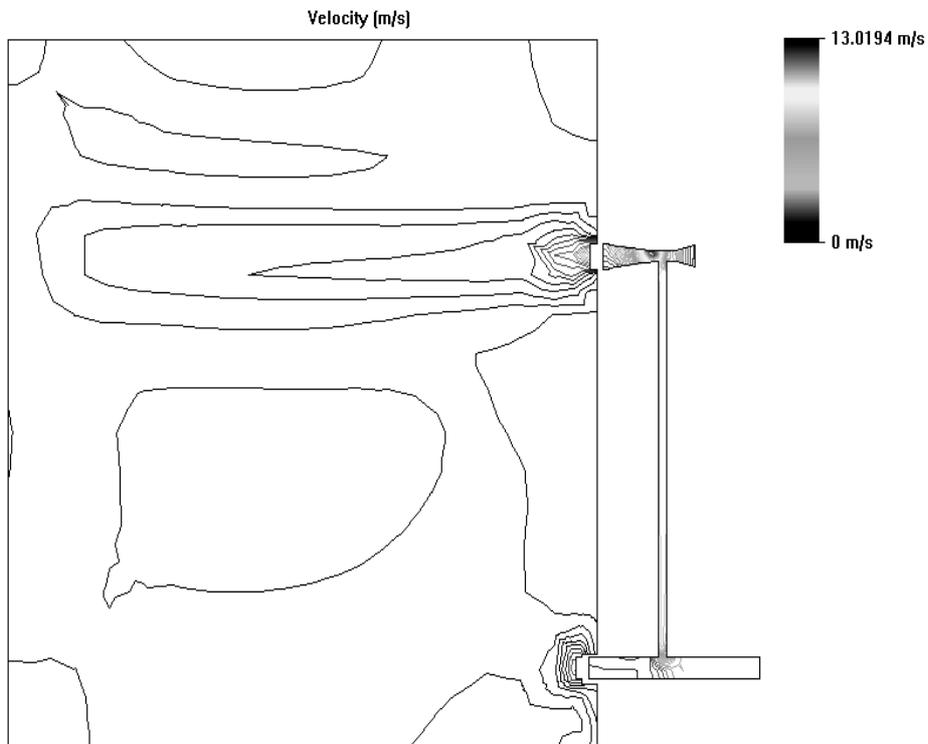
*Fig. 2. Distribution of the coolant in the heating device and the device
is ejected when mixing ratio of 1,5*

Velocity (m/s)

13.0194 m/s

0 m/s

Min=0 m/s   Max=13.0194 m/s
Iteration = 174

*Fig. 3. Distribution of the coolant in the heating device and the device
is ejected when mixing ratio of 2,2*

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Discussion of the results

The analysis of the graphs (Fig. 2, 3) on the distribution of coolant pressure and speed at various mixing ratios showed that a change in the pressure difference between the liquid and the ejected ejected by increasing the resistance in the bridge between the supply and return pipe from 0 to 1,5 kPa at a constant rate of fluid in the flow and return pipes (1,5 m / s) allows you to change the temperature entering the heater from T1 to T2, which corresponds to the zero pressure drop – and no ejection heater provides maximum heat flux with temperature Makimalno pressure. And at a pressure drop of 1,5 kPa occurs locking ejector and coolant enters the heater to a temperature T2, which is equal to zero heat flow and thus a lack of heating facilities. However, while maintaining the constancy of the hydraulic regime the rest of the heating system, which allows not to install balancing valves on every 6–8 heaters. Analysis of the data by the temperature coefficient of turbulence of Pr and heat flow in the heating appliance and the ejector while moving coolant have shown that the basic pulsation of temperature, turbulence and change the coefficient of heat flow occurs over a narrow segment – in the ejector and at the entrance of the heating device , which confirms the hypothesis of the applicability of the proposed local control heat flow in the water heating system.

Conclusions

1. A system of water heating with low-temperature heat transfer through the use of hydraulically variable mode in heating devices to maintain a constant in the rest of the system and increase the range of effective work thermostats can reduce the required pressure in the heating system and capital costs by reducing the number of required balancing valves heating system.

2. The theoretical data on the thermal and hydraulic processes in the proposed design temoregulyatora revealed almost linear mode control water flow and proven ability to work the system of water heating in continuous mode with the hydraulic change qualitative and quantitative characteristics of the coolant only heating devices.

3. Clarify the methods of hydraulic calculation for hot water heating systems with low temperature heat carrier through the use of hydraulically variable mode in heating devices to maintain a constant in the rest of the system.

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