The calculation program of the total economy of fuel and energy resources in the hot water supply system when you change the parameters of regulations

P V Rotov¹, V I Sharapov¹, A A Sivukhin²

¹Ulyanovsk State Technical University, Russia, 432027 Ulyanovsk, Severny Venets str., 32
²UMUE «City Heatservice», Russia, 432001 Ulyanovsk, Karla Marcks str., 25

asivuhin@mail.ru

Abstract. To increase the speed and accuracy of calculations and also the opportunity of use of different source data for calculating of efficiency regulation indicators within the possible range of calculation of working parameters of the HWS, we developed the software application "The calculation of the total economy of fuel and energy resources in the hot water supply system when you change the parameters of regulations", which allows on the basis of multivariate calculations analyses of their results, to choose the optimum mode of operation heat supply system and to assess the effectiveness of load regulation in the hot water supply system.

In contrast with the European heat supply systems initially constructed on a footing of the local quantity governing, national heat supply systems were designed and constructed taking into consideration the heat conductor fixed-rate flow under the central ratio governing. The efficiency of the hot-water supply system (HWS) depends solely on the consumer and is characterized by the groundbreaking daily irregularity. The more open water hydrants, the more heat it is necessary. It is impossible to control this process centrally at the heating source.

It is possible to improve the efficiency of the HWS system via the automatic water flow control in the circulation line taking into consideration the irregularity of the hot water use conditions. One of such technologies developed in the scientific research laboratory «Heat and power systems and plants» (SRL HPSP) of the Ulyanovsk state technical university has been implemented since 2014 at the central heat supply station (CHSS) of the Ulyanovsk municipal unitary enterprise «City Heatservice».

During non-heating seasons 2014–2016 there was an engineering experiment carried out. As follows from the results of this experiment the data gathering and central heat supply station work mode analysis were carried out with different settings of the temperature regulator installed at the circulation line of the HWS system [1–3]. In Figure 1 you can see a functional metering scheme and process monitoring in HWS system.
To estimate the investment attractiveness there is a feasibility study of the implemented load governing regulation technology in the HWS system. Calculation of economic efficiency of the hot-water supply system when load governing of the HWS system by VIS (Vladimir Ivanovich Sharapov) developed and tested in the SRL HPSP [4] was carried out using the results of the abovementioned engineering experiment [1–3]. We determined analytical dependence for the discovery of key indicators of the energy efficiency when changing of regulation parameters [3].

To increase the speed and accuracy of calculations and also the opportunity of use of different source data for calculating of efficiency regulation indicators within the possible range of calculation of working parameters of the HWS, we developed the software application «The calculation of the total economy of fuel and energy resources in the HWS system when you change of the parameters of regulations». This application refers to the scope of the heat-power engineering and can be applied for the calculation of total saving of fuel and power resources in the heat supply system when changing consumption regulation parameters in the circulation line of the hot-water supply system to analyze and improve work modes of the heat supply system, to assess the energy-saving potential when implementing parameter regulation technology in the HWS system.

Application is developed using Visual Studio 2015 and the programming language C#. Application provides the fulfillment of the following functions:

- identification of parameters of the HWS system;
- identification of the regulating duration of the HWS system;
- identification of the range for the water temperature decrease in the circulation line of the HWS system and the possible changing of the water consumption in the HWS system;
- identification of parameters of the energy efficiency for the load governing in the HWS system;
- calculation of total saving due to the improvement of the work mode in the heat supply system;
- construction of the dependency graph for total saving from the temperature changing and water consumption in the circulation line of the HWS system.
In Figure 2 a window of the application interface is presented. To perform calculations with new basic data it is necessary to fill-in cells with the characteristic of the heat supply system and press the button «Calculate».

![Figure 2. Window of the application interface «The calculation of the total economy of fuel and energy resources in the HWS system when you change the parameters of regulations» with the field for entering basic data.](image1)

To enter a new range of data within the possible decrease of the water temperature in the circulation line and possible changing of the water consumption in the HWS system it is necessary to press the button «Close» and enter new values in the window of the application interface. In Figure 3 a window of the application with results of the calculation is presented.

![Figure 3. Window with results of the calculation of energy efficiency indicators of load governing in the hot-water supply system.](image2)
Results of calculation can be displayed in the form of the table or graph by pressing the relevant buttons «Table» and «Graph» and also save results of calculation in the file Microsoft Office Excel by pressing the button «In excel» (Figure 4).

![Figure 4. Window with results of the calculation in the file Microsoft Office Excel.](image)

Number of calculations in the application расчетов is unlimited. This gives an opportunity to compare work modes of the heat supply system under different working conditions of the hot-water supply system. Application gives an opportunity to perform multiple-option calculations and save results of calculations in the file Microsoft Office Excel at the design stage of the hot-water supply system when energy inspection and determination of the implementation practicability of the examined technology of the load governing in the HWS system.

References

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