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About opportunities of the sharing of city infrastructure centralized warmly - and water supply

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Abstract. It is shown that joint use of engineering infrastructure of centralized heat and water supply of consumers will be the cost-efficient decision for municipal services of the city. The new technology for regulated heating of drinking water in the condenser of steam turbines of combined heat and power plant is offered. Calculation of energy efficiency from application of new technology is executed.

Any large city of the Russian Federation is characterized by existence of the developed engineering infrastructure providing the centralized heat supply, water supply and water disposal of consumers. Feature of functioning of the listed life support systems is their isolation and independence from each other. As a rule, these systems belong to different owners.

However economically effective decision in scales of the city is sharing of engineering infrastructure of the centralized heat and water supply of consumers. One of options of such sharing of engineering infrastructure is application of city combined heat and power plants in the scheme of preparation of drinking water of system of the centralized cold water supply [1].

The offered technology is carried out by inclusion of the built-in bunch of the condenser of the steam turbine on the cooling Wednesday in the pipeline of drinking water of system of the centralized cold water supply before giving to consumers and assumes adjustable heating of this water to 20°C (fig. 1). And adjustable heating of drinking water of system of the centralized cold water supply (CWS) in the condenser of the steam turbine before giving to consumers is made during the whole year when using artesian sources of cold water supply and during cold season – at a water intake from superficial reservoirs.

The main result of adjustable heating of the drinking water directed to consumers is decrease in an expense of warmth on heating of water of hot water supply (HWS) both the open, and closed systems of heat supply. In the closed systems of heat supply decrease in an expense of warmth is reached due to use at consumers for preparation of hot water of warmer initial drinking water, and also at mixture in water folding devices. Increase in profitability of open systems of heat supply is reached only due to reduction of amount of the hot water used by consumers at her mixture in water folding devices with warmer water of system of cold water supply.
The carried-out analysis has shown that adjustable heating of drinking water allows to provide up to 30% of the general thermal loading of HWS at the expense of fulfilled pair of heating turbines. For an assessment of applicability of technology of adjustable heating of drinking water we will consider the scheme of pipelines of drinking water of the operating combined heat and power plant (fig. 2).

As a rule, at combined heat and power plant drinking water arrives on two independent pipelines: to the main and reserve that allows to involve one of them for the organization of heating of drinking water in the turbine condenser before giving to consumers. In fig. 2 the dashed line has shown the scheme of reconstruction of pipelines of drinking water. The offered technology is implemented as follows.

Drinking water for ensuring technological process (preparation of make-up water of a heating system), and also adjustable heating on the offered technology arrives at combined heat and power plant on the main pipeline through open latches of S-1 and IVS-1. The reserve pipeline of drinking water is used for supply of the water heated to 20 °C after the built-in bunch of the allocated turbine to consumers of CWS. For this purpose the latch of IIIBC-1 is closed and the pump No. 3 turns on. Considering that the reserve pipeline is hydraulically connected with an extensive network of pipelines of the centralized CWS system, turning on of the pump allows to pump water to consumers of cold water. Along with turning on of the pump No. 3 at combined heat and power plant pumps at the pump station of the second raising of water treatment constructions have to be switched-off.

Figure 1. Use of the condenser of the existing combined heat and power plant for heating of water of system of the centralized cold water supply: 1 - water treatment constructions of the city; 2 - control devices; 3 – CHPP; 4 - boiler; 5 - steam turbine; 6 condenser; 7 – consumer
Figure 2. The scheme of the pipeline of drinking water of the operating combined heat and power plant

It should be noted that a negative consequence of adjustable heating of drinking water is development of the biological processes leading to deterioration in its properties on organoleptic, microbiological and chemical indicators. For an exception of development of biological processes use of installation of disinfecting of the drinking water included at combined heat and power plant in the pipeline before giving to consumers of CWS is offered.

Installation of disinfecting (ID) can be executed on the basis of technologies of ultra-violet disinfecting (UVD). Disinfection of water by means of UV-radiation is considered one of the safest methods as ultraviolet represents the natural radiation capable to make negative impact on a human body only at rather long impact directly on the person. This way doesn't influence physical and chemical properties of water, but at the same time purifies it of the most part of harmful bacteria. If in water there are no very steady microorganisms, Ural federal district is the most optimal variant as it is more economic in comparison with other ways. Also at combined heat and power plant installation of stationary devices of an assessment of quality of drinking water after adjustable heating with transfer of indications is provided in chemical laboratory of combined heat and power plant. It is offered to control the following indicators of quality of water in real time: turbidity, chromaticity, oxidability, iron, and also temperature.

Thus, implementation of the proposed solution of adjustable heating of drinking water at combined heat and power plant before giving in the centralized CWS system demands the minimum costs of reconstruction. In relation to conditions of the operating combined heat and power plant total expenses make 15.4 million rubles without the VAT of them:
- the new Du pipeline of =600 mm 200 m long – 4.2 million rubles;
- installation of disinfecting with a productivity of 2000 m3/h – 7.6 million rubles;
- system of monitoring of quality of drinking water – 3.6 million rubles.

The technology of adjustable heating of drinking water in condensers of steam turbines is especially urgent for northern regions of our country. As a rule, in these regions thermal insulation of pipelines and laying of conduits with heat tracers is applied to an exception of freezing of a water supply system. Adjustable heating of drinking water will allow to refuse partially expensive systems for prevention of freezing of a water supply system.

The positive effect from use of the offered technology can be also gained in system of water disposal of the city.

It is known that temperature of utility fluids shouldn't fall lower than 12 ° C since it leads to decrease in overall performance of constructions of biological cleaning [2]. Now in connection with installation
of metering devices on hot water temperature of utility fluids has significantly decreased. So in Ulyanovsk the average temperature of drains has decreased to extreme value of 12 °C that significantly complicates work of the sewer treatment facilities (STF). Temperature increase of the cold water arriving to consumers will increase overall performance of STF of the city during the winter period due to increase in average temperature of sewer drains.

The technique providing use as criterion of thermal profitability of size of specific power generation on thermal consumption [3] is applied to an assessment of power efficiency of changes of the working hours of combined heat and power plant connected with introduction of adjustable heating of drinking water.

In relation to real operating conditions of the Ulyanovsk CHPP-1 economic effect of use of new technology makes more than 7400 tons of conditional fuel a year. In calculation it was considered that the offered scheme is operated within 8 months (except summer months and September), and the hourly average consumption of drinking water via the condenser of the allocated turbine makes 1800 m3/h.

Actual data on temperatures of drinking water for various months of year, and also decrease in thermal profitability because of reduction of the power of heating selections of steam turbines caused by use of warmer drinking water for HWS are considered. Taking into account the cost of conditional fuel of 3800 rub/t savings in terms of money from implementation of the proposed solution of adjustable heating of drinking water make more than 28 million rubles (without the VAT), and the payback period for the operating combined heat and power plant doesn't exceed the 1st year.

Besides achievement of essential economy of fuel at combined heat and power plant implementation of the proposed solution allows to increase reliability of systems of the centralized cold water supply. Thanks to adjustable heating of drinking water before giving to consumers condensation of water vapor on the surface of pipelines is excluded that, certainly, reduces intensity of external corrosion of pipelines of water of systems of the centralized water supply.

Thus, it is possible to draw the following conclusions:

1. Sharing of city engineering infrastructure of the centralized heat and water supply of consumers is economically effective decision for municipal services of the city.
2. Realization of the proposed technical solution on adjustable heating of drinking water in the condenser of turbines of combined heat and power plant allows to increase significantly thermal profitability of combined heat and power plant, to cut a warmth consumption on heating of water of hot water supply to 15%, to intensify processes of clarification and to reduce expenses of reagents by preparation of drinking water on water treatment constructions.
3. Economic effect of use of new technology in relation to real operating conditions of the Ulyanovsk CHPP-1 makes more than 7400 tons of conditional fuel a year. Taking into account the cost of conditional fuel of 3800 rub/t savings in terms of money from implementation of the proposed solution of adjustable heating of drinking water make more than 28 million rubles (without the VAT).

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