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Fialko Nataliia

Doctor of Technical Sciences, Professor, Department Head,

Corresponding Member of NAS of Ukraine,

Honored Worker of Science and Technology of Ukraine

The Department of Thermophysics of Energy Efficient Heat Technologies

Institute of Engineering Thermophysics of

National Academy of Sciences of Ukraine

Navrodska Raisa

Candidate of Technical Sciences (PhD),

Senior Scientific Researcher, Leading Researcher

The Department of Thermophysics of Energy Efficient Heat Technologies

Institute of Engineering Thermophysics of

National Academy of Sciences of Ukraine

Gnedash Georgii

Candidate of Technical Sciences (PhD), Senior Researcher

The Department of Thermophysics of Energy Efficient Heat Technologies

Institute of Engineering Thermophysics of

National Academy of Sciences of Ukraine

Shevchuk Svitlana

Candidate of Technical Sciences (PhD), Senior Researcher

The Department of Thermophysics of Energy Efficient Heat Technologies

Institute of Engineering Thermophysics of

National Academy of Sciences of Ukraine

Sbrodova Galina

Candidate of Physical and Mathematical Sciences (PhD), Senior Researcher

The Department of Thermophysics of Energy Efficient Heat Technologies

Institute of Engineering Thermophysics of

National Academy of Sciences of Ukraine

IMPROVEMENT OF COMPLEX HEAT-RECOVERY SYSTEMS FOR GAS-FIRED BOILER UNITS

УСОВЕРШЕНСТВОВАНИЕ КОМПЛЕКСНЫХ ТЕПЛОУТИЛИЗАЦИОННЫХ СИСТЕМ ДЛЯ ГАЗОПОТРЕБЛЯЮЩИХ КОТЛОАГРЕГАТОВ

Summary. *The calculation and analysis of the complex heat-recovery system for heating by warmth of exhaust-gases from a boiler unit several heat-transfer agents for the needs of the boiler house, namely, return heat-network water, combustion air and raw water for chemical water-purification system have been carried out. Results of researches have confirmed high efficiency of the offered technical solution.*

Key words: *exhaust-gases, condensation formation, chemical water-purification system, increase of efficiency.*

Аннотация. *Проведены расчетные исследования и выполнен анализ работы комплексной теплоутилизационной системы для подогрева теплотой дымовых газов от котлоагрегата нескольких теплоносителей для нужд котельной, а именно обратной теплосетевой воды, дутьевого воздуха и сырой воды для системы химводоочистки. Результаты исследований подтвердили высокую эффективность предложенного технического решения.*

Ключевые слова: *дымовые газы, конденсатообразование, химводоочистка, повышение КПД.*

Improving the efficiency of fuel use in gas-fired units is one of the priority areas for the strategic development of the energy complex of Ukraine. One of the largest consumers of natural gas in this complex is the heating boilers of municipal heat-power engineering. Such boilers, at calculating by the low heat value, are characterized, as a rule, by the efficiency factor in the range of 92 ÷ 94 % (or 83.5 ÷ 84.5 % at determined by the high heat value). At the same time, the temperature of their flue gases is approximately 150 ÷ 190 °C. For the beneficial use of the heat of the exhaust-gases and a corresponding increase in the efficiency of the boiler unit, it is necessary to introduce additional equipment – heat-recovery exchangers. Traditionally, during heat recovery measures, boiler equipped with a heat-recovery exchanger for heating return heat-network water [1-6], which, depending on the mode of operation during the heating period, can increase the boiler efficiency by 3 ÷ 6 %. At the same time, high efficiency values are achieved when the temperature in the return line of the boiler tsp is less than 50 °C (at relatively high environment temperatures), that is, below the dew point of the water vapor contained in the exhaust-gases of the boilers, that is part of the water vapor condenses from the exhaust-gas and the use of its heat of condensation. Thus, in order to achieve a greater increase in efficiency, it is necessary to provide a condensation mode throughout the heating period. For this, it is necessary to use complex heat-recovery systems with the use of several heat exchangers for heating various heat-transfer agents cooler than return heat-network water. The main heat-transfer agents that meet this requirement include combustion air entering the burner and cold raw water entering the chemical water-purification system (CWPS). In recent years, complex heat-recovery systems with heating return heat-network water and combustion air have often been investigated. Under certain conditions, such systems make it possible to increase the average annual boiler efficiency by 6.8 ÷ 10.6 % [7-11] due to deeper cooling of its exhaust-gases compared to using only one water heat exchanger.

In order to increase the efficiency of using natural gas in gas-fired boilers, IET NAS of Ukraine, an improved complex heat-recovery system is proposed, in which, after the water and combustion air heat-recovery exchangers installed another heat-recovery exchanger; it's designed to heat cold water supplied to chemical water-purification system.

The boiler plant schematic circuit with the proposed heat-recovery system is shown in Fig. 1.

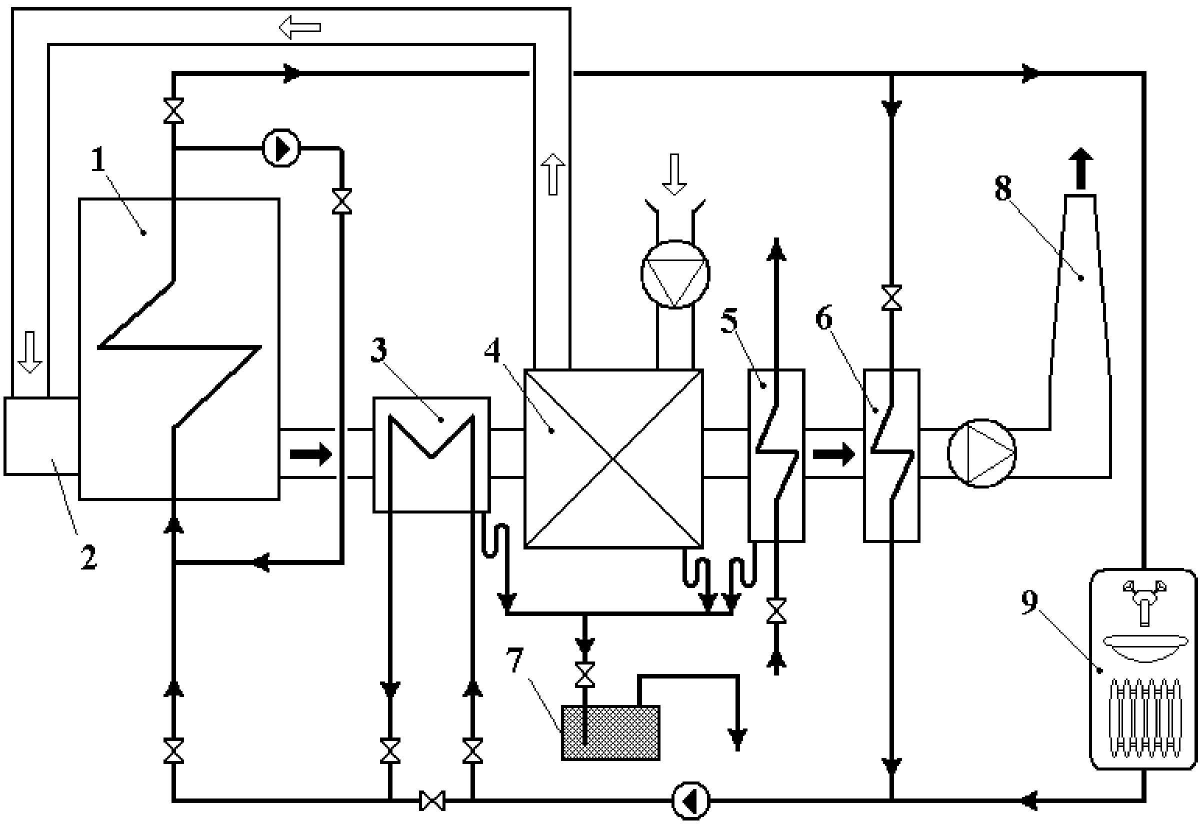

Fig. 1. The boiler plant schematic circuit with the proposed heat-recovery system: 1 – gas-fired water-heating boiler; 2 – gas-fired burner; 3 – heater of return heat-network water; 4 – heater of combustion air; 5 – water heater of CWPS; 6 – exhaust-gas heater; 7 – neutralization tank of condensate; 8 – chimney; 9 – heat energy consumer

When conducting design studies, the source data for performing thermal calculations were the operational characteristics of the TVG-8 boiler and the heating system in accordance with the temperature chart of boiler plant.

The water consumption for the CWPS system was taken in the amount of 2 % of the water consumption for the boiler, that is correspond to the normative indicators of the heating network recharge.

During the research, the following main parameters were determined for water-heating and air-heating exchangers: heat capacity *Q* and the level of increase in the coefficient the use heat of fuel (CUHF) of boiler Δη (Fig. 2).

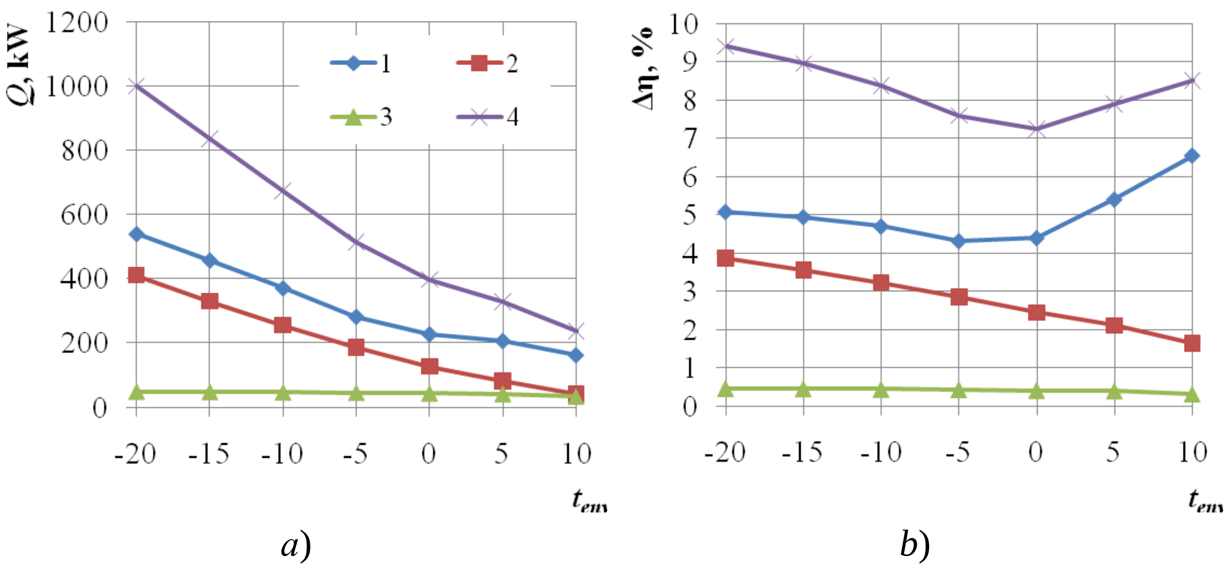

Fig. 2. The heat output (*a*) and the increase the coefficient the use heat of fuel of boiler (*b*) depending on the environment temperature: for a water heat exchanger (1), a combustion air heater (2), a water heater for the CWPS system (3), and the overall entire complex system (4)

A comparison was also made of the indicated indicators of the improved heat-recovery system with the corresponding indicators of the known system with heating only the return heating water and combustion air.

As can be seen from the above data, the application of the proposed system allows deeper cooling of the exhaust-gases of the boiler plant due to the installation of water heater of CWPS and compared to a system without such a heater, increase its heat productivity *Q* by 5.2 ÷ 14.5 %. It is shown that the improvement of the known system with an additional heat exchanger designed for preheating cold water for chemical water-purification system (CWPS) allows, through deeper cooling of the exhaust-gases of a boiler plant, increasing its CUHF by 9.4 % maximum, which is 0.5 % more compared to lack with the absence of heating of water on the CWPS.

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