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FEASIBILITY STUDY FOR THE APPLICATION OF HEAT PUMP INSTALLATION IN THE THERMAL SCHEME OF THE BOILER HOUSE OF THE PLANT OF FRUIT CONCENTRATES AND WINES

Ostapenko Olga,
Ph.D., Associate Professor
Vinnytsia National Technical University

The aim of the proposed study is to develop a feasibility study (FS) for the application of heat pump installation (HPI) in the thermal scheme of the industrial heating boiler house of the plant of fruit concentrates and wines in Vinnytsia, which was performed based on the results of our study [1].

In the study [1] the analysis of the indicators of energy efficiency of the application of heat pump installation for the thermal scheme of the steam industrial heating boiler house of the plant of fruit concentrates and wines was performed. In this work, it was proposed to install a steam-compression HPI driven by a compressor from the gas-piston engine-generator in order to increase energy and economic efficiency of the thermal scheme of the boiler house, reduce the consumption of fossil fuels by the boiler house, which was carried out using the results of our previous studies from [2 – 14].

As noted in the study [1], the industrial heating boiler house of the plant of fruit concentrates and wines is designed to provide the load of technological consumers, the needs of heating and hot water supply of the plant. In our study [1] it was proposed to reduce the generation of thermal power directly by the boiler house with the simultaneous generation of displaced thermal power on the basis of high-efficiency HPI at low temperature heat from the contact heat recovery waste gas utilization equipment. The use of a highly efficient cogeneration-heat-pump installation on the basis of a steam-compression HPI and a gas-piston engine-generator is proposed in the thermal scheme of the boiler house.

Research of indicators of energy efficiency of work of the investigated thermal scheme of a boiler house with HPI in the publication [1] is carried out with application of results of researches [2 – 7] and methodical bases from [8 – 14].

In the study [1] it is noted that the implementation of the selected variant of cogeneration heat pump installation in the thermal scheme of the industrial heating boiler house of the plant of fruit concentrates and wines, will save working fuel. According to the determined thermal and electrical loads for the selected variant of HPI application, the installation of: gas-piston engine-generator Generac SG350 and heat pump with an estimated heat output of 500 kW was selected.

The proposed investigation developed a feasibility study to determine the efficiency of cogeneration HPI in the thermal scheme of industrial heating boiler house of the plant of fruit concentrates and wines, which was performed based on previous studies and developed methodological bases for assessing energy, economic and

environmental efficiency of energy supply systems with cogeneration HPI from publications [1 – 14].

The economic effect of the use of cogeneration HPI in the thermal scheme of the industrial heating boiler house of the plant of fruit concentrates and wines is estimated in the study. It is confirmed by the economic efficiency of capital investments made in comparison with the basic variant of the heat supply source (HSS) of the plant. Comparison of indicators of economic efficiency of basic and alternative (with HPI) variants for heat supply sources of the plant of fruit concentrates and wines was performed on the basis of studies [1 – 14], the results are summarized in Table 1.

Table 1

Results of technical and economic analysis of basic and alternative variants of HSS of the plant of fruit concentrates and wines

Indicator	Unit	Variant of HSS	
		Basic variant of HSS of the plant	Alternative variant with HPI of HSS of the plant
Annual consumption of working fuel of HSS	million m ³ / year	3,17	2,82
Annual savings of working fuel of HSS	%	---	11,04
Expenditure of funds for the fuel	UAH million / year	31,602	28,106
Operational expenses	UAH million / year	35,081	32,293
Economic efficiency	UAH million / year	---	2,788
Investment in the new cogeneration HPI equipment (considering installation costs)	UAH million	---	10,499
Payback period	year	---	3,77

Conclusions

The investigation developed a feasibility study for the application of heat pump installation in the thermal scheme of the industrial heating boiler house of the plant of fruit concentrates and wines.

According to the results of the proposed technical and economic analysis of the efficiency of the application of cogeneration HPP in the thermal scheme of the boiler house of the plant, it is determined that: savings of working fuel will be provided by the boiler house in the amount of 11,04%; will reduce the operating costs (economic efficiency) of the boiler house in the amount of UAH 2,788 million / year, investment in new cogeneration HPI equipment, including installation costs, will amount to UAH

10,499 million, payback period of new cogeneration HPI equipment for the modernized heating scheme of the boiler house of the plant will be 3,77 years.

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