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## INDICATORS OF THE EFFICIENCY OF COGENERATION HEAT PUMP INSTALLATION IN THE THERMAL SCHEME OF HEATING BOILER HOUSE

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**Abstract.** *The study analyzes the indicators of the efficiency of cogeneration heat pump installation (CHPI) in the thermal scheme of heating boiler house. It is determined that the application of CHPI in the thermal scheme of heating boiler house will provide high values of indicators of energy efficiency performance and savings of natural gas in heating boiler house.*

**Key words:** *indicator, efficiency, cogeneration-heat pump installation.*

### **Introduction.**

As it is noted in a number of domestic and foreign publications [1 – 15], the using of high effectiveness cogeneration heat pump installation (CHPI) in the thermal schemes of heating boiler houses provide high values of indicators of energy performance efficiency, of energy-economic efficiency and environmental safety.

### **Presentation of the material.**

The aim of our research is analyze of the indicators of efficiency of CHPI in the thermal scheme of heating boiler house. Suggested CHPI is based on steam compression heat pump installation and gas piston engine-generator. As it is noted in our previous researches [1 – 8], proposed in this study CHPI for the thermal scheme of the heating boiler house can be used to replace part of the heat capacity generation of the suggested boiler house and to provide heat and electric energy to consumers.

In our study, we have analyzed of indicators of efficiency CHPI application in the thermal scheme of the heating boiler house, on the base of methodical basis and scientific results from our studies [10 – 15]. In order to increase the efficiency of the thermal scheme with CHPI of the heating boiler house, we proposed to application the CHPI on low-temperature heat from heat recycler of secondary energy resources of the boiler house.



For the investigated thermal scheme of boiler house the installation of two heat pumps with estimated heat output of 300 kW was chosen, the gas-piston engine-generator with nominal power of the electric generator of 400 kW is selected.

In our study the efficiency of CHPI in the thermal scheme of heating boiler house was estimated, based on developed methodical bases for assessing energy, economic and environmental efficiency of energy supply systems with CHPI from publications [1 – 15]. Evaluated indicators of the efficiency of CHPI application in the thermal scheme of heating boiler house are presented in Table 1.

**Table 1 - Indicators of CHPI efficiency for thermal scheme of heating boiler house**

Indicator	Value
CHPI coefficient of performance	5,41
Annual savings of working fuel of boiler house with CHPI, %	23,26
Economic efficiency, UAH million / year	2,843
Investment in the new CHPI equipment, UAH million / year	6,422
Payback period, year	2,26

*Source: author's data.*

As it is seen from Table 1, application of CHPI in thermal scheme of heating boiler house, with the use of low-temperature heat from heat recycler of secondary energy resources of the boiler house in CHPI, will provide generation of thermal and electric energy in CHPI with high energy efficiency ( $\varphi = 5,41$ ) and economy of working fuel (natural gas) in the amount of 23,26%.

### **Conclusions.**

The study analyzes the indicators of the efficiency of cogeneration heat pump installation in the thermal scheme of heating boiler house. It is determined that the application of CHPI in the thermal scheme of heating boiler house will provide high values of indicators of energy efficiency performance and savings of natural gas in heating boiler house.



According to the results of the proposed analysis of the indicators of the efficiency of the CHPI application in the thermal scheme of heating boiler house, it is determined that:

- ✓ savings of working fuel (natural gas) will be provided by the boiler house in the amount of 23,26%;
- ✓ will reduce the operating costs (economic efficiency) of the boiler house with CHPI in the amount of UAH 2,843 million / year,
- ✓ investment in new CHPI equipment will amount to UAH 6,422 million,
- ✓ payback period of new CHPI equipment for the modernized thermal scheme of the heating boiler house will be 2,26 years.

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