Industrial Research of Condensing Unit for Natural Gas Boiler House

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I. Introduction

Each EU member state has to reach energy and climate target in 2020 by improvement of energy efficiency and use of renewable energy [4].

One of the most important aspects of energy and ecoefficient solutions is compliance of environment protection requirements. As one of the key measures to improve energy efficiency of existing boilers is by utilization of flue gas heating.

Analysis of data of flue gas condensing unit in boiler house and results of industrial research work are carried out with the 10 MW condensing economizer, installed behind the natural gas fuelled 116 MW water heating boiler KVGM 100 in SC "Imanta".

II. Industrial Experiment Description

A condensing economizer is classic tubular heat exchanger used for heat transmission from hot heat-transfer agent (flue gas) to cool (heating network water) [2]. The economizer is installed in the boiler's KVGM-100 flue gas channel and is placed between the fan and chimney. The return water from district heating (DH) network is used as heat-exchange agent in economizer. The circulating water is heated up by absorbing physical and condensing heat energy.

The framework of industrial experiment includes number of measurements which are illustrated in Table I.

TABLE I
INDUSTRIAL RESEARCH DATA

Parameter	Measurement unit	The measuring range	Designation scheme
Temperature before the economizer	^{0}C	36,8 – 55,9	T_2
Temperature after the economizer	^{0}C	41,2 – 58,6	T_2'
Flue gas temperature before the economizer	^{0}C	68,1 – 127,0	T_3
Outdoor air temperature (the average daily)	^{0}C	(-20,3) – (+21,1)	$T_{āra}$
Economizer heat production (per month)	MWh	410 - 4400	Q_{eko}

III. Regression Analysis of Data

Regression analysis methods are used for statistical processing of industrial research data. Regression analysis designates random variable changes in precise quantitative parameters – importance of stochastic links expressed with functional correlation. In result of regression analysis is possible to obtain quantitative parameters for statistical correlation closeness of the independent and dependent random variables and determine regression coefficients [3].

One of many correlations is found between return water temperature versus outdoor temperature and it partly confirms the qualitative control of DH system. When parameters obtained in the coldest month are expressed separately, it is possible to conclude that with decreasing outdoor temperature network return water temperature increases (Figure 5).

Correlation expressed in the form of linear regression equation.

$$t_2 = -0{,}8183 t_{arg} + 39{,}485 \qquad (2)$$

where

t_2 – water temperature of the return network, °C;

t_{arg}- outdoor air temperature, °C.

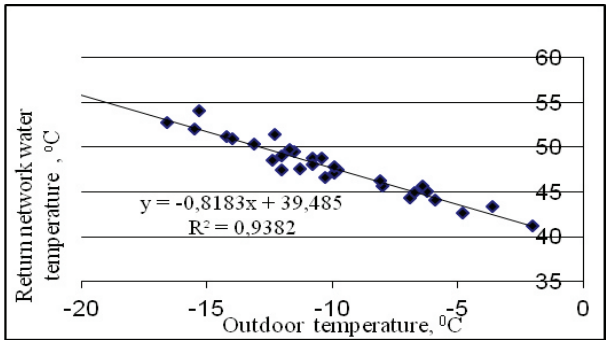

Fig. 5. Return network water temperature versus outdoor temperature in January 2010

As result of work there is graphically reflected empirical dependence obtained by regression analysis: capacity of condensing unit versus outdoor temperature. Characteristics for more effective work of condensing unit present several linear equations on the basis on these data.

IV. Conclusions

1. The considerable increase of the return network water temperature according to graphic of heat supply network temperature is the factor that restricts the latent heat output at low outdoor temperature. If return network water temperature is higher than 52 ^{0}C, economizer stops functioning in condensation mode and heat production decreases by 43%, in comparison to mode where temperature is 42 ^{0}C

2. The most efficient operating mode of economizer, as it was established during experiment, is that with the boiler load 92 MW, which is close to nominal, and economizers load accordingly 8,5 MW.

3. Use of condensing economizers allows to save 5,4 million n m^3 of fossil fuels and reduce carbon dioxide emissions by 10290 tons or 7% during the period from January 2010 to December 2011.

V. References

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