EVALUATION OF ENERGY-ECOLOGICAL EFFICIENCY OF INNOVATIVE TECHNOLOGIES IN CITY BOILER ROOMS

Iryna Moniuk**, Phd student, supervisor Prof. Dr. **Valeriy Kolesnik

(Dnipro University of Technology, Dnipro, Ukraine; **imov87@gmail.com)**

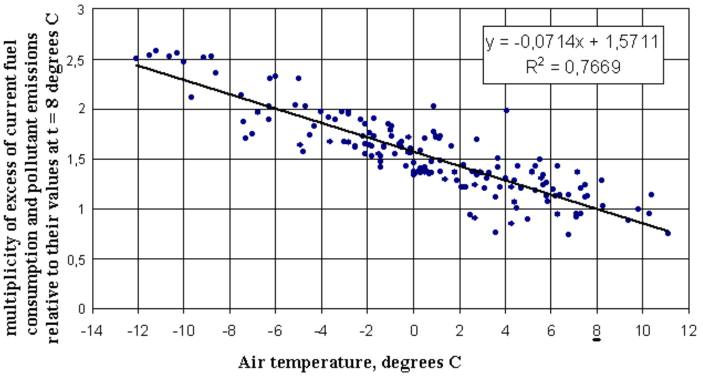
Formulation of the problem. Gross emissions of environmentally hazardous substances from pipes of power plants (including city boilers) are calculated on the basis of current regulatory methods. However, resource saving and ecological safety of boiler houses are influenced by not only natural changes, but also changes occurring as a result of the introduction of innovative technologies in the boiler house and among heat consumers. Therefore, the work included the scientific task of assessing the energy-ecological efficiency of the introduction of innovative technologies for resource-saving based on the assessment of pollutant emissions due to the fuel consumption of boiler units and the storage volumes of the generated heat.

General methodology for solving the problem. The problem was solved on the basis of generalization of methods:

- operative estimated determination of pollutant emissions based on the use of the energy-ecological index introduced with the participation of the author, which simultaneously characterizes the multiplicity of excess of both current fuel consumption and current pollutant emissions by the boiler house.

- determination of energy-ecological efficiency of introduction of technology of preservation of the thermal energy made by a city boiler room due to warming of external walls of houses by layers of polyfoam on the basis of experimental researches of temperature of not warmed and warmed surfaces by a radiation pyrometer.

Main results. The basis of these assessment methods was the regulatory formula for determining emission indicators *j-th* pollutant E_j power plants: $E_j = \sum_i E_{ji} = 10^{-6} \sum_i k_{ji} B_i \left(Q_i^r\right)_i$,



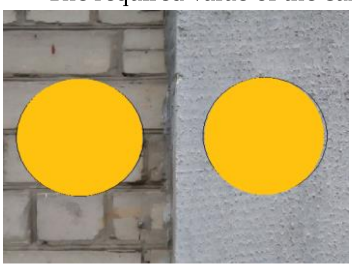
where k_{ji} – emission index of the *j-th* substance for the *i-th* fuel, g/GJ; B_i– consumption of the *i-th* fuel for a period of time *T*; Q_i– heat of combustion of the *i-th* fuel, MJ/kg.

The analysis showed that the fuel consumption index – *Bi*, practically determines the gross emission - *Ej*, and the value of *Bi* clearly depends on the seasonal changes in air temperature. This dependence is normalized relative to the values of fuel consumption - B_{8C}, determined at the beginning of the heating season at a temperature of 8^oC. As a result, a universal dependence in the form of multiplicity (*y* = *K*) of exceeding the current fuel consumption and at the same time the corresponding current emissions of pollutants by the boiler house relative to certain emission reference values – *Ej8C*, determined at a temperature of 8^oC (fig. 1)

Fig.1. Normalized dependence of atmospheric air temperature (*x* = *t*) on the values of *K*

Standardization allowed to introduce the energy-ecological index *K*, the current values of which are determined for each individual boiler house by the ratio: $K_{i.} = B_i/B_{8C} = E_j/E_{j8C}$, (24), if we consider $K_{i.} = B_i/B_{8C}$, we have the energy efficiency index of the boiler house, and if $K_i = E_j/E_{j8C}$ – the index that determines the degree of environmental hazard of its emissions.

The required value of the current emissions of the *j-th* pollutant will be: $E_j = K_i \times E_{j8C}$. (3)



To determine the energy and environmental efficiency of the implementation of resource-saving technology for insulation of buildings, we present our proposed method of evaluation, based on experimental studies of temperatures of uninsulated and insulated surfaces of the house with a radiation pyrometer. The study was conducted in December-January on cloudy days in the absence of wind. This eliminated the effect of direct solar radiation on surface temperatures. The surface temperature was measured with a pyrometer in pairs, ie alternately on both sides of the insulation boundary, as shown in Fig.2.

Fig.2. The scheme of scanning of a surface of a brick wall and a heater by a pyrometer with the laser pointer

As expected, the temperature of the uninsulated wall of the house is slightly below the temperature of the atmospheric air and follows it in the temperature range (+10 to -8 ^oC). To detect the temperature difference between the insulated and uninsulated surfaces, the dependences of the temperatures of the insulated surfaces made of polyfoam with a thickness of 5 and 10 cm on the surface temperature of the uninsulated wall were constructed (Fig. 3).

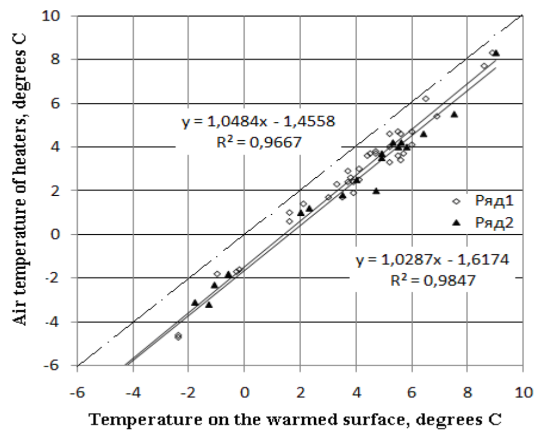


Fig.3. Dependences of temperatures of surfaces of heaters on temperature of not warmed surface of a wall defined by a pyrometer: row 1 - for a heater 5 cm thick; row 2 - for a heater - 10 cm.

It is determined that the relative heat losses from the surfaces of the insulation, compared with the radiation flux of the uninsulated wall decreased by an average of 2% with an error of 8%. It is important that such a 2% discount, which will be typical for each selected area of the insulated surface, also applies to the fuel consumption of *Bi*, pollutant emissions *Ej* and the corresponding *Ki* indices, pre-determined without insulation.

The obtained results allow to determine the resource-saving and ecological effect of the introduction of wall insulation technology. For this purpose it is necessary to determine the reference value of the energy-ecological index K_{i0} before the introduction of the technology, for example, when consuming fuel - B_{i0}, the value of which would correspond to the nominal capacity of a certain boiler house or its boiler unit. Yes, the daily value of fuel consumption. boiler 10 MW at an average atmospheric temperature t = 0°C is *Bi = 19.64 t/day*. Under such conditions, the current reference value of the energy-environmental index, according to (2) will be: $K_{i0} = 0{,}08B_{i0} = 0{,}08*19{,}64 = 1{,}5712$.

Thus, after the full-scale introduction of foam insulation in the buildings of the quarter or neighborhood of the city with a thickness of 5-10 cm, the value of the energy index will decrease by 2% to *Ki = 1.5397*, by 0.0315, which is the actual energy efficiency of the implemented technology. , Accordingly, the concentration of nitrogen oxides NO_x in the flue gases of the boiler room will decrease from *250 mg/m³ to 245 mg/m³*, and carbon monoxide CO - from *130 mg/m³ to 127.4 mg/m³*, will decrease by *5 mg/m³ and 2.6 mg/m³* (environmental efficiency). Fuel consumption - *Bi* will decrease to the level of *19,246 t/day*, will decrease by *394 kg/day* (energy efficiency of insulation technology).

General conclusion and suggestion. A method of assessing the energy and environmental efficiency of the introduction of innovative technologies for resource conservation in urban boilers by daily fuel consumption of boilers and the amount of stored heat by comparing the values of these factors and after the introduction of technology.