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QUANTITATIVE INDICATORS OF NITROGEN OXIDES WHEN USED AT DIFFERENT ENERGY INSTALLATIONS

КІЛЬКІСНІ ПОКАЗНИКИ ЗАКИСІВ АЗОТУ ПРИ ВИКОРИСТАННІ НА РІЗНИХ ЕНЕРГЕТИЧНИХ УСТАНОВКАХ

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Abstract. *The article deals with the harmful effects of nitrogen oxides on the environment. The list of primary (technological) measures aimed at reducing the formation of nitrogen oxides in the furnace or combustion chamber of the boiler: low-toxic burners, step air supply, tertiary air supply, flue gas recirculation and three-stage air and fuel supply. The NOx emission indicators for the combustion of different fuels are calculated by using these primary measures. It has been found that the most effective in reducing nitrogen oxides is a three-stage supply of air and fuel. Combinations of the above primary measures for better effect were also considered. It has been found that the use of primary measures such as low-toxic burners, stepped air supply and tertiary air supply reduces the content of nitrogen oxides in the exhaust gases by almost half compared to the results obtained with the use of three-stage air and fuel supply.*

Keywords*: nitrogen oxides, emission index, primary measures, low-toxic burners, step air supply, tertiary air supply, flue gas recirculation, three stage air flow and fuel, ecological status.*

Formulation of the problem Energy consumption is closely linked to all human activities, such as: home heating, cooking, vehicle traffic, agricultural production, etc. Solid fuels (eg coal, wood, crop residues, etc.) play an important role in energy for everyday human life and production. Although solid fuels are being replaced by other energy sources (such as natural gas and oil), over the last century, approximately 3 billion people worldwide still rely on solid fuels burned in traditional furnaces or on open fires for cooking or heating. This traditional incineration equipment emits large amounts of pollutants, leading to 4 million premature deaths worldwide each year and serious regional air pollution.

Main Text Widely known primary (regime-technological) measures aimed at reducing the formation of nitrogen oxides in the furnace or combustion chamber of the boiler. These measures include: use low-toxic burners, stepwise supply of air and fuel, recirculation flue gases, etc. [7]. The purpose of this work is the calculation definition the most effective primary measure, individual and their combinations.

Harmful effects of nitrogen oxides on the environment and in the final the total per person is large. Long-lasting effect even of relatively small ones concentrations of NOx in the air increases the number of acute and chronic respiratory diseases, and also has a negative effect on plant and animal life the world [1]. Therefore, reducing their content in gas emissions of thermal power facilities is one of the most important tasks of scientists and engineers in the energy industry.

If earlier we were talking about concentrations of NOx in product emissions combustion in hundreds of milligrams per cubic meter, then environmental safety today dictates the need to reduce the content of these pollutants to tens or even units of milligrams per cubic meter.

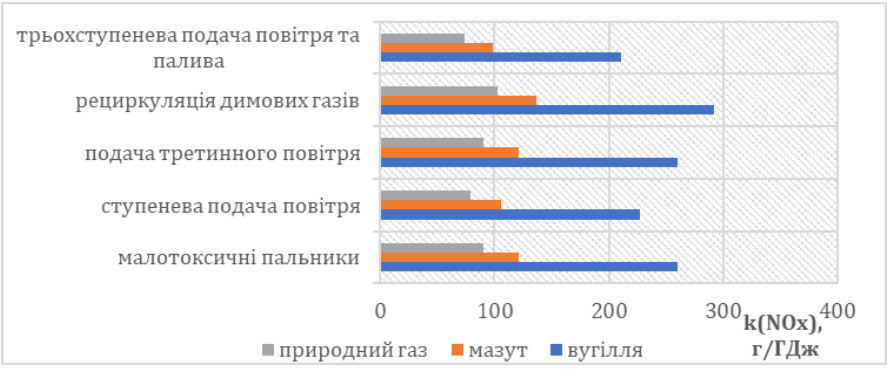
At large energy facilities, various methods are used for reducing the harmful effects of nitrogen oxides on the environment. The flue gas recirculation method is widely used in boiler technology. Usually flue gases with a temperature of 300–400°C are taken before with an air heater and a special recirculation fume hood are supplied to furnace chamber. As a result, the maximum temperature in the furnace decreases by 120–130 °C and, in addition, the oxygen concentration in the combustion zone decreases, which also reduces the formation of fuel NOx. At the same degree of recirculation, for example, when burning gas, in the first in the first case, the output of NOx decreases by 45.4%, and in the second - by 22.7% [3, 9]. The method of staged combustion of fuel is the suppression of formation of nitrogen oxides, which consists in the fact that the primary combustion zone is fed air is less than theoretically necessary (α = 0.70–0.95), the rest of the air, required for complete fuel combustion, is served further on one or several levels along the length of the torch, as a result of which they decrease maximum temperature in the combustion zone, oxygen content in the core of the torch decreases.

The calculations were performed in accordance with [11] by the formula:

$$k_{NOx} = (k_{NOx})_0 f_H (1-\eta_I)(1-\eta_{II}\beta), \text{ g / GJ} \quad (1)$$

where $(k_{NOx})_0$ – emission index of nitrogen oxides without taking into account emission reduction measures, g / GJ; $f_н$ – the degree of reduction of NOx emissions when working at low load; η_I – the effectiveness of primary (regime-technological) measures to reduce emissions; η_{II} – efficiency of secondary measures (nitrogen treatment plant); β – the efficiency of the nitrogen treatment plant.

According to the calculations obtained the following data, which are listed in Fig.1.



Source: author's development

Fig. 1. Indicators of emissions of nitrogen oxides with the use of primary NOx reduction measures.

Conclusions. The following primary mitigation measures were considered indicators of nitrogen oxide emissions: low-toxicity burners, staged supply air, supply of tertiary air, recirculation of flue gases and three-stage air and fuel supply. It is established that the most effective in reducing emissions of nitrogen oxides is a three-stage supply air and fuel.

Combinations of the above-mentioned primary ones are also considered measures aimed at increasing the effectiveness of regime-technological work methods of reducing the NOx emission rate. Calculations showed that use of a combination of "low-toxicity burners, staged air supply and supply of tertiary air" helps to reduce the content of nitrogen oxides in waste gases by 37-49%.

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