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ASSESSMENT OF THE IMPACT ON THE ENVIRONMENT OF THE IMPLEMENTATION OF HEAT ACCUMULATORS BASED ON ENVIRONMENTALLY CLEAN STORAGE MATERIALS IN THE HEATING SYSTEM OF A PUBLIC

Buildings are one of the main consumers of energy resources in a number of countries of the world and in Europe in particular. Ukraine is no exception. Climatic conditions in our country are characterized by a long heating period, during which, of the total amount of energy consumed, which is about 43% of the generated thermal energy, 90% is spent precisely on covering heating needs [1]. Since most of the buildings in Ukraine belong to the mass construction structures of the 80s, during the construction of which the emphasis was placed on the cost of construction with minimal capital costs without taking into account operating costs. Therefore, 80% of the buildings constructed at that time do not meet modern energy efficiency requirements [2, 3]. The period from the 1990s to today is characterized by a constant increase in energy prices, which was caused by the global economic and energy crises in different years. The answer to these challenges in the world was the increase in requirements for the energy efficiency of buildings and their engineering systems at the national level of various countries. According to the European regulations Directive 2010/31/EU and Directive 2012/27/EU, updated in 2018 and 2019 respectively, the countries of the European Union must use national energy efficiency requirements. Over the past decade, Ukraine has raised the requirements for the minimum level of energy efficiency several times in accordance with the established methods of achieving them [4, 5]. Thus, as of September 1, 2022, new, stricter requirements for the heat transfer resistance of building enclosing structures [2] were put into effect, which is a necessary but late response to similar trends in the world.

Analysis of modern trends aimed at decentralization of heating systems showed that a low-cost measure for efficient energy use is the use of intermittent heating modes, i.e. lowering the temperature during the hours when people are not in the room, with a simultaneous increase in the heat capacity of the heating system and the inertia of the building [6, 7] . The latter can be achieved both by improving the heat-shielding properties of enclosing structures, bringing the values of heat transfer resistances to the minimum set level [2], and by introducing highly efficient energy accumulators. The authors of works [8-10] conducted an analysis of various methods of energy accumulation and the requirements for modern storage devices, compared the characteristics of heat accumulators using different storage materials. It is singled out as one of the most promising systems that accumulate energy due to the heat of phase transitions and can be widely used in electric storage devices for heating systems, especially during periods of reduced electricity tariffs and/or under the conditions of their operation in pulse mode.

Taking into account these fundamentally important criteria, carrying out an ecological and economic assessment is an important task in the design of buildings and engineering systems, and studying the impact on the environment of increasing the thermal inertia of the heating system, especially in the conditions of its operation in pulse mode, requires considerable attention during operation and thermal retrofits to increase energy levels in both low-efficiency and energy-efficient buildings.

The object of the study is the building and engineering networks of the first educational building of NUBiP of Ukraine. The description of the building and engineering networks is described in [6]. Methods [4, 5] were used to model the thermal state of buildings, and [11] were used to assess the environmental impact of the introduction of highly efficient phase transition heat accumulators. The Law of Ukraine "On Amendments to the Tax Code of Ukraine and Other Legislative Acts of Ukraine on Ensuring the Balance of Budget Revenues" dated November 30, 2021 No. 1914-IX also corrected the articles of the PKU that set ecotax rates. The norms have been in effect since January 1, 2022.

The assessment of the impact on the environment of the introduction of highly efficient heat accumulators based on organic compounds was carried out taking into account the current (increased) rates of environmental tax, namely: emissions into the atmosphere - by 5% (clauses 241.1-241.3 of the Code of Civil

Procedure), and emissions of carbon dioxide (CO_2) – 3 times (clause 243.4 of the Code of Criminal Procedure); emissions into water bodies - 2.4 times. Moreover, the step-by-step increase in eco-tax rates from 2022 to 2025 is taken into account (paragraph 37, subsection 5 of the Transitional Provisions of the PKU), namely: from 2022 to 2024, eco-tax rates will be 30%, 60% and 90% of the base level of 2025 , which is defined in clause 245.1 of the Code of Civil Procedure. As a result, the ecotax was calculated for each emission of a pollutant separately (clause 249.2 of the Code of Civil Procedure), and then the total amount was found. Formulas for calculations by types of pollutants are contained in clauses 249.3-249.8 of the Code of Civil Procedure.

Conclusions and perspectives. A study was conducted and an assessment of the impact on the environment of the feasibility of introducing a phase transition heat accumulator into the heating system of a public building was given. In particular, the following has been established:

1. The introduction of a heat accumulator based on phase-transition organic compounds allows to increase the reliability of the process of providing heat to consumers and the thermal inertia of the heating system of a public building (on average) by 10-12% and the saving of consumed thermal energy at the level of 12-15%.

2. It was established that the introduction of heat accumulators into the heating system of the building under the conditions of its operation in pulse mode allows to reduce the specific consumption of thermal energy by 5.2 kWh/m3 per year (8-9%) and reduce the specific emissions of greenhouse gases by 22.4 kg/m2 per year (6-7%), and during long-term operation - by 9.6 kWh/m3 (14-15%) and by 41.5 kg/m2 per year (11 - 12 %), respectively.

3. The specific rate of eco-tax was calculated on the example of CO_2 emissions in 2022 (30 hryvnias/ton) when heat accumulators were introduced into the heating system of a public building under the conditions of its operation in pulse mode, which made it possible to reduce specific costs by 0.67 (hryvnias /t)/m2 per year (on the national scale by UAH 294 million), and when working in a long-term mode - 1.25 (UAH/t)/m2 per year (on the national scale by UAH 546 million) in accordance.

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