

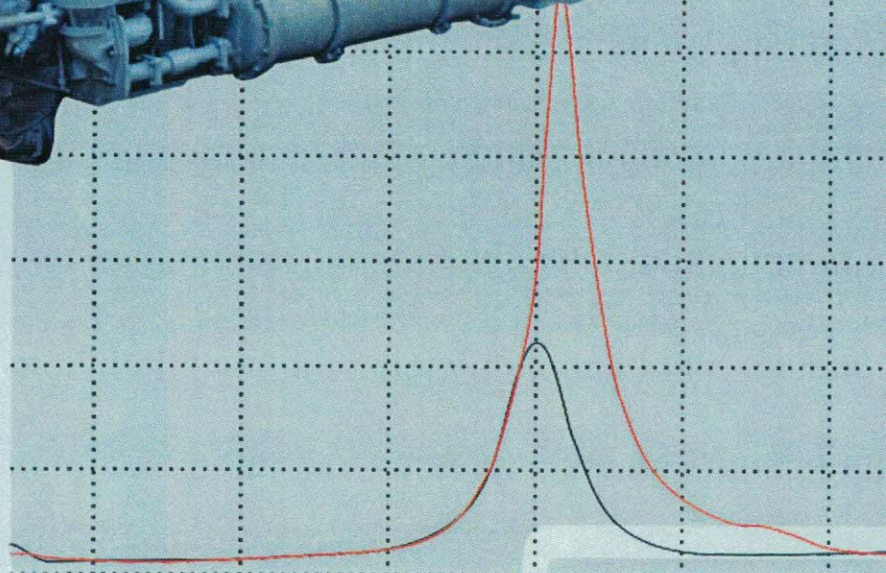
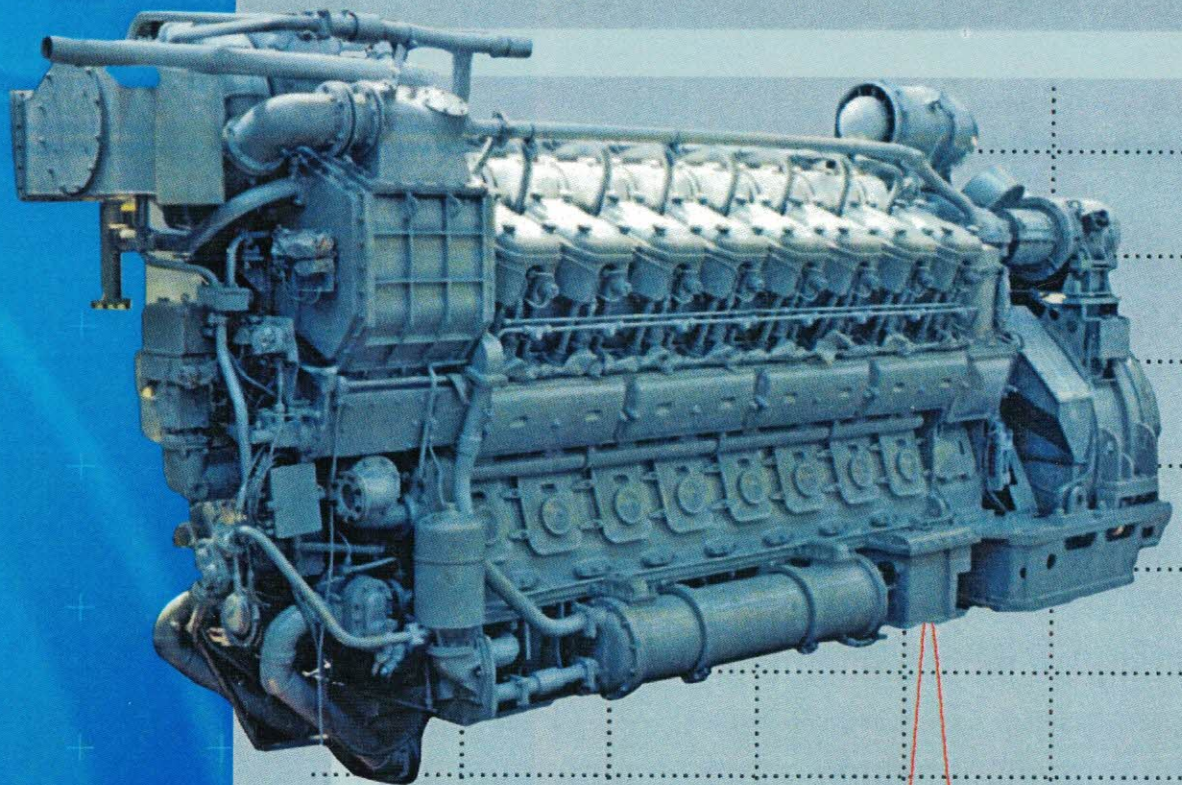
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ДВИГУНИ ВНУТРІШНЬОГО ЗГОРЯННЯ

Internal Combustion Engines

2/2025



Всеукраїнський
науково-технічний журнал

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Всеукраїнський науково-технічний журнал з питань теорії і практики, моделювання та експериментальних досліджень робочих процесів, конструкцій, інноваційних технологій, виготовлення і експлуатації двигунів внутрішнього згоряння. Матеріали статей були рекомендовані Програмним комітетом XXX Міжнародного конгресу двигунобудівників до відкритої публікації в журналі і прийняті редакційною колегією.

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METHOD FOR COMPATIBLE CONSIDERATION OF MOTOR FUEL VAPOR AND THERMAL ENERGY EMISSIONS DURING CRITERIA-BASED ASSESSMENT OF THE ECOLOGICAL SAFETY LEVEL OF EXPLOITATION OF RECIPROCATING ICE OF FIRE-FIGHTING AND EMERGENCY-RESCUE EQUIPMENT IN CONDITIONS OF ARMED AGGRESSION

The study is aimed at improving the method for compatible consideration of motor fuel vapor and thermal energy emissions during complex criteria-based assessment of the ecological safety level of exploitation of power plants with reciprocating ICE, namely firefighting and emergency-rescue vehicles units, taking into account the realities of the functioning of the divisions and institutions of the SES of Ukraine in conditions of armed aggression and in the perspective of the post-war reconstruction of critical infrastructure and the economy of our country. The object of the study is the ecological safety level of the exploitation process of power plants with reciprocating ICE, in particular firefighting and emergency-rescue vehicles units of the institutions and divisions of the SES of Ukraine, considering the negative technogenic impact of compatible thermal energy of motor fuel vapor and thermal energy emissions into environment. The subject of the study is contribution to the numerical values of the indicators of the object of the study of the compatible thermal energy motor fuel vapor and thermal energy emissions into the environment. The scientific novelty of the research results is that the method for compatible consideration of the emission of thermal energy and motor fuel vapor emissions from fuel tank into the environment from power plants with reciprocating ICE, in particular firefighting and emergency-rescue vehicles units, in a complex criteria-based assessment of the indicators of the ecological safety level during their exploitation has been further developed. The practical significance of the research results consists in providing a quantitative and qualitative assessment of the studied effects and developing technical solutions and organizational measures on this basis to reduce or eliminate them by developing an appropriate environment protection technology with executive devices on the methodological basis of the ecological safety management system.

Keywords: environmental protection technologies, ecological safety, power plants, firefighting and emergency-rescue vehicles, reciprocating internal combustion engines, fuel vapors, thermal pollution, complex criteria-based assessment, armed aggression, post-war reconstruction.

Relevance of the study

The relevance of the research presented in this article is driven by several important considerations. To provide a comprehensive assessment of the ecological safety (ES) level during the exploitation of power plants (PP) equipped with reciprocating internal combustion engines (RICE) [1], which include fuel tanks, it is appropriate to use the mathematical apparatus of the complex fuel-ecological criterion (K_{fe}) developed by Prof. Parsadanov (NTU «KhPI», Kharkiv, Ukraine), as outlined in [2] and further improved in [3].

A hierarchically structured classifier of ES factors [3], where the source is the RICE within the PP, namely units of firefighting and emergency-rescue vehicles (FERV) of divisions and institutions of the State Emergency Service (SES) of Ukraine, during its exploitation, includes not only the emissions of legally regulated pollutants with exhaust gases (EG) flow but also the consumption of motor fuel as a non-renewable energy resource (a product of mineral processing), and the emission of fuel vapors caused by the phenomena of small (SBR) and large (LBR) breathing of the fuel tanks as well as the emissions of thermal energy.

However, in the structure of ES factors considered by the original K_{fe} criterion mathematical appa-

ratus, the first of these factors is only indirectly accounted (methods for evaluating the ponderability of RICE fuel consumption as the ES factor are described in [3]), and the 2nd and the 3rd ES factor is not considered at all.

Incorporating these additional ES factors alongside the existing ones fully aligns with the concept of improving the K_{fe} criterion mathematical apparatus as presented in [4], supports the goals of sustainable development set by the Presidential Decree of Ukraine № 722/2019 (dated 30.09.2019) [5], and corresponds to the provisions of the Regulation on Environmental Support within the State Emergency Service of Ukraine, approved by SES Order № 618 dated 20.09.2013 [6].

Fuel consumption by RICE leads to cumulative pollution of all environmental components – atmosphere, hydrosphere, and lithosphere – as well as a technogenic impact on the biosphere in general and humans in particular. The primary effect arises from thermal energy produced by exothermic redox reactions in the RICE combustion chamber. This energy is partially transferred to the environment via heat exchange with RICE parts and EG flow, partially lost to dissipative forces within the RICE, and the remainder

dissipates throughout the PP system during its exploitation. Accounting for such impacts as an ES factor in a criterion-based complex assessment of PP with RICE is an equally important scientific and technical challenge.

It should also be noted that RICEs are significant sources of environmental pollution through factors of various physical natures. This represents the qualitative dimension of the study's relevance. In peacetime, such systems generate up to 75 % [2] of mechanical and electrical energy in the country, and during the armed conflict and anticipated post-war reconstruction, this share rises to 85–90 % [6,7]. This represents the quantitative aspect of the study's relevance.

There FERV powered by RICE, used by divisions and institutions of the SES of Ukraine, both during armed conflict and throughout the post-war restoration of the country's economy and infrastructure, further emphasizing the importance of this study.

The purpose of the study. Improving the method for compatible consideration motor fuel vapor and thermal energy emissions during complex criteria-based assessment of the ES level of exploitation of PP with RICE, namely FERV units, taking into account the realities of the functioning of the divisions and institutions of the SES of Ukraine in conditions of armed aggression and in the perspective of the post-war reconstruction of critical infrastructure and the economy of our country.

Problem of the study. The imperfection of existing methods for complex criteria-based assessment of the ES level of the exploitation of the PP with RICE, especially considering the realities of the functioning of the institutions and divisions of the SES of Ukraine and their FERV units in conditions of armed aggression and in the perspective of the post-war reconstruction of the critical infrastructure and economic of our country.

Idea of the study. Improving the methodology for determining the values of the K_{fe} criterion by expanding the ES factors taken into account by its mathematical apparatus, in particular, compatible consideration of thermal energy motor fuel vapor and thermal energy emissions into environment.

Main task of the study. Determination of quantitative and qualitative aspects of the effect of compatible consideration of the thermal energy motor fuel vapor and thermal energy emission into the environment during a complex criteria-based assessment of the ES level of the exploitation process of PP with RICE, namely FERV units of the institutions and divisions of the SES of Ukraine, using the steady standardized ESC test cycle (in accordance with UNECE Regulations № 49 [9]) based on the improved mathematical apparatus

of the complex fuel-ecological criterion K_{fe} .

Object of the study. ES level of the exploitation process of PP with RICE, in particular FERV units of the institutions and divisions of the SES of Ukraine, taking into account the negative technogenic impact of compatible thermal energy motor fuel vapor and thermal energy emissions into environment.

Subject of the study. Contribution to the numerical values of the indicators of the object of the study of the compatible thermal energy motor fuel vapor and thermal energy emissions into environment.

Research methods. Analysis of specialized scientific and technical, reference, patent and regulatory literature, analysis of the results of bench engine tests using standardized steady test cycles, the position of the scientific discipline «Theory of Internal Combustion Engines» [10], improved mathematical apparatus of the complex fuel-ecological criterion of Prof. Parsadanov, the method of least squares.

The objectives of the study are as follows:

1. Development of the method for calculating the values of the complex fuel-ecological criterion with compatible consideration of the emissions of motor fuel vapors caused by the phenomena of LBR and SBR of FERV with RICE fuel tanks;
2. Development of the method for calculating the values of the complex fuel-ecological criterion with compatible consideration of the thermal energy emissions in the environment during the operation of FERV with RICE;
3. Development of the method for complex calculating the values of the complex fuel-ecological criterion with compatible consideration of the motor fuel vapor emissions and taking into account thermal energy emissions in the environment during the exploitation of FERV with RICE;
4. Obtaining the set of initial data for carrying out a calculation study for the standardized steady ESC test cycle and the 2Ch10.5/12 autotractor diesel engine.
5. Calculated assessment of the values of the complex fuel-ecological criterion with compatible consideration of the motor fuel vapor emissions caused by the phenomena of LBR and SBR of FERV with RICE fuel tanks fuel tanks and their analysis;
6. Calculated assessment of the values of the complex fuel-ecological criterion with compatible consideration of the thermal energy emissions in the environment during the exploitation of FERV with RICE;
7. Calculated assessment of the values of the complex fuel-ecological criterion with compatible consideration of the motor fuel vapor emissions and taking into account thermal energy emissions in the environment during the exploitation of FERV with RICE;

Tasks №№ 1, 4, 5 and №№ 2, 6 was carried out in the ghtvious parts of this study – articles [7,8]. So, in this study presented the results of the carieng out of the tasks №№ 3 and 7.

The study has been carried out on the example of a D21A1 autotrucktor diesel engine (2Ch10.5/12 according to ISO 3046-1:2002 «Reciprocating internal combustion engines. General technical conditions»), the technical description of which is given in the source [11].

The topic of this study corresponds to the content of the Resolution of the Cabinet of Ministers of Ukraine № 476 dated 30.04.2024 «On approval of the list of priority thematic areas of scientific research and scientific and technical developments for the period until December 31 of the year following the termination or abolition of martial law in Ukraine» [12], the content of the Specialty Passport 21.06.01 «Ecological Safety», approved by the Resolution of the Presidium of the Higher Attestation Commission of Ukraine № 33-07/7 dated 04.07.2001 [13]. In accordance with the Order of the SES of Ukraine № 618 dated 20.09.2013 «On Approval of the Regulations on the Organization of Ecological Support of the State Emergency Service of Ukraine» [6]. In accordance with the Decree of the President of Ukraine № 722/2019 dated 30.09.2019 «On the Sustainable Development Goals of Ukraine for the period up to 2030» [5], national security issues, in particular the security and defense sector [14], and the current trend of greening PP with RICE – decarbonization of their operation [15].

Analysis of researches and publications

In the study [16], the results of an experimental study of the effectiveness of the method for reducing harmful environmental pollution by thermal energy of a low-heat-dissipating RICE operating on the basis of a mixture of preheated linseed oil and nanoadditives are presented. In the study [17], a new trend of deep utilization of waste heat from RICE is described by using condensing economizers in waste heat boilers. In the study [18], the issue of optimizing hydrogen production and increasing system efficiency by utilizing exhaust heat in a hydrogen-consuming RICE is discussed. In the study [19], the results of an experimental evaluation of the effectiveness of a plate heat exchanger as a cold air suction system for an RICE with spark ignition using a car air conditioning system in the context of reducing thermal environmental pollution are presented. In the study [20], the issue of effective extraction of exhaust heat from an automotive RICE using thermoelectric generation technology is discussed. Source [21] is devoted to the analysis of the results of the consolidated study of the injection strategy from the point of view of gas dynamics and heat transfer in a

hydrogen diesel-ignition RICE. The waste heat recovery system for marine RICE has been optimized using the rank preference learning function built into the Bayesian optimizer as an aspect of reducing heat emissions into the atmosphere is discussed in the study [22]. The performance assessment and multi-criteria optimization of a new transcritical CO₂ Rankine cycle for the recovery of RICE waste heat is performed in the study [23]. The improvement of the heat transfer performance of air-cooled RICE fins using geometric analysis and material analysis for more efficient use of waste heat is achieved in the study [24]. The study [25] substantiates the choice of material under uncertainty for the recovery of waste heat in a diesel generator. The design and performance analysis of a methanol reforming reactor for the utilization of waste heat from the EG of a marine diesel RICE have been optimized in the study [26]. The thermodynamic study of a diesel RICE with an HCCI cycle operating on hydrogen-enriched natural gas for efficient electricity generation, heating of the consumer coolant, and cooling of the engine itself has been described in the study [27].

Study [28] shows the results of integrating cooling and adsorption technologies in improving gasoline vapor recovery in oil storage facilities. Study [29] is devoted to the use of an optimized method for assessing the efficiency of vapor recovery equipment control and estimating volatile organic compound emissions from evaporation from urban oil depots based on data from an extensive study. The results of the studies in [30–32] are an assessment of the human health effects, neurotoxicity, and subchronic inhalation toxicity of gasoline and fuel oxygenate vapors. The history, genotoxicity, and carcinogenicity of carbonaceous fuel and its emissions are described in the study [33]. The development of a new method for reducing light hydrocarbon losses at oil tank breather valves is performed in the study [34]. An analysis of the negative environmental consequences of fires in the fuel composition is provided in the study [35]. The transformation processes in primary particulate emissions to secondary organic aerosol from the EG of diesel RICE idling in China were reviewed in the study [36]. Polycyclic aromatic hydrocarbons in motor fuel vapors emissions and their effects on human health were analyzed in [37].

In this case, both the emission of motor fuel vapors and the environmental thermal energy pollution can be assessed using the developed efficiency index of the environment protection technologies (EPT) executive devices, as shown in works [4, 38]. In this case, it is possible to take into account the features of the use of alternative types of motor fuel and the operation of the RICE according to the models of exploitation of a

vehicle with a hybrid drive of the propulsion and an electric generator, as illustrated in works [39,40]. The results of such an assessment can be initial data for both implementation of physical and mathematical modeling of working processes in the EPT executive devices, and verification of the results of such modeling, as described in the monograph [41], as well as modeling of the processes of pollutant formation in the working process of the RICE and their transformation in the exhaust tract, for example, using the method of digital twins [42].

Statement of the problem and its solution

The value of the K_{fe} criterion for the i -th steady regime of exploitation of the DRICE with the value of the weighting factor WF is determined by formula (1) [1–4], and the place in it of the mass hourly emissions of motor fuel vapors caused by the phenomena of LBR and SBR is suggested in this work to be determined by formula (2).

$$K_{fe} = \eta_e \cdot (1 - \beta) = \frac{3600}{H_u \cdot g_e} \cdot \left(1 - \frac{Z_e(P_f)}{Z_f(P_f) + Z_e(P_f)} \right) = \frac{3600 \cdot N_e(M_{kp}, n_{ke})}{H_u \cdot G_{fuel}} \times \frac{1}{1 + \sigma \cdot f \cdot \sum_{m=1}^h (A_k \cdot G_k) / G_{fuel}}, \quad \%, \quad (1)$$

$$\sum_{m=1}^h (A_k \cdot G_k) = A(PM) \cdot G(PM) + A(NO_x) \cdot G(NO_x) + A(C_n H_m) \cdot G(C_n H_m) + A(CO) \cdot G(CO), \quad \text{kg/h}, \quad (2)$$

where the index i denote the values for a separate representative regime of operation of the RICE on landfill in the model of its exploitation; $H_u = 42.7$ MJ/kg [2] – lower heat of combustion of motor fuel; N_e – effective power of the diesel engine, kW; G_{fuel} – mass hourly fuel consumption, kg/h; G_k – mass hourly emission of the k -th pollutant in the EG flow, kg/h; A_k – dimensionless indicator of the relative aggressiveness of the k -th pollutant in the EG flow ($A_{NO_x} = 41.1$; $A_{PM} = 200$; $A_{CnHm} = 3.16$; $A_{CO} = 1.0$ [2]); $h = 4$ [2] – total number of pollutants in the TG flow; σ – dimensionless indicator of relative pollution safety in different territories (for automobile diesel $\sigma = 1.0$, for tractor $\sigma = 0.25$ [2]); f – dimensionless coefficient that takes into account the nature of dispersion of EG in atmospheric air (when operating diesel engines of various designations on the

territory of Ukraine $f = 1.0$ [2]); $\delta = P_f$ – dimensional indicator that converts the point estimate into a cost estimate, \$/kg; WF – relative share of diesel engine operation on the i -th polygon of exploitation model (weight factor); η_e – effective efficiency of diesel engine; β – coefficient of relative operational environmental monetary costs; Z_e and Z_f – monetary costs for compensation of environmental damage and fuel, \$/(kW·h); g_e – specific effective mass hourly fuel consumption of the internal combustion engine, kg/(kW·h); M_T and n_{cs} – torque and crankshaft speed of the RICE, N·m and min^{-1} ; $P_f = 2.482$ \$/kg – price per unit weight of motor fuel (at $P_f = 57.0$ UAH/l and exchange rate 42.0 UAH/\$); U_e – cost of compensation of environmental damage, \$/kg; g_{pr} – specific induced mass emission of pollutants in the EG flow, kg/(kW·h).

Development of the method for complex calculating the values of the complex fuel-ecological criterion with compatible consideration of the motor fuel vapor emissions and thermal energy emissions in the environment during the exploitation of FERV with RICE

In accordance with the previous two sections of the work, this section suggests a method for calculating the values of a complex fuel-ecological criterion with the joint account of motor fuel vapor emissions and thermal energy emissions into the environment as a common indicator of the negative impact on the components of the environment of a PP with DRICE exploitation, which is directly related to the use of motor fuel, together with the actual impact of motor fuel consumption as a non-renewable energy resource (see source [3,4,39,40]).

The suggested method is essentially a combination of the two previous methods. Accordingly, the formula (2) takes the form of a formula (3).

$$\sum_{m=1}^h (A_k \cdot G_k) = A(PM) \cdot G(PM) + A(NO_x) \cdot G(NO_x) + A(C_n H_m) \cdot G(C_n H_m) + A(RB) \cdot G(RB) + A_Q \cdot G_Q, \quad \text{kg/h}. \quad (3)$$

where $A(RB)$ – ponderability of the motor fuel vapor emission (dimensionless value); $G(RB)$ – mass hourly emission of motor fuel vapor, kg/h; A_Q – ponderability of the thermal energy emission (dimensionless value); G_Q – mass hourly emission of thermal energy, kg/h.

In the previous research [8] it was determined and justified that the value $A(RB)$ is equal to ponderability of the fuel component of the K_{fe} criterion, averaged over the field of operating regimes of the diesel engine 2Ch10.5/12, calculated in the monograph [3] when

equating the expressions for the partial derivatives of the K_{fe} criterion with the quantities G_{fuel} and G_k , that is $A(RB) = A_{fuel} = 38.4$. Also, it was shown that the value $G(RB)$ is equal to the sum of the emissions of the of motor fuel vapor at the manifestation of large breathing reservoir phenomena $G(SB)$ and the emission at the small breathing reservoir phenomena $G(IB)$.

In the previous research [7] it was determined and justified that the value A_Q is equal to multiplication result of the A_{fuel} value and the energy coefficient $k_E = 0.75$ value, so A_Q is 28.8. Also, it has been shown that the value G_Q is equal to multiplication result of the mass hourly fuel consumption G_{fuel} (in kg/h) value and the value of difference between 1 and effective efficiency coefficient η_e (dimensionless value) value.

The calculated assessment of the values of the complex fuel-ecological criterion has been carried out taking into account the emissions of motor fuel vapors caused by the phenomena of LBR and SBR on the PP with DRICE. It has been established that the individual regime value of the emission of motor fuel vapors from the tank is observed in the minimum idle regime, and the maximum – in the nominal power regime of DRICE. It has also been found that the average operational values of the K_{fe} criterion for the ESC cycle for the 2Ch10.5/12 diesel engine are almost not affected (up to 0.25 %), however, for the variant of taking into account the effect of the LBR phenomenon, such an impact is significant (up to 5.25 %) [8].

The calculation evaluation of the values of the complex fuel-ecological criterion was carried out taking into account thermal energy emissions in the environment during the exploitation of the PP with the DRICE. It has been established that the individual regime value of the motor fuel consumption as an equivalent of thermal energy emissions in the environment

during the exploitation of the PP with the DRICE is observed at the nominal power regime and is 3.3 kg/h, and the minimum – at the minimum idle regime and is 0.5 kg/h. It has also been found that for the average operational values of the K_{fe} criterion for the ESC cycle for the 2Ch10.5/12 diesel engine, taking into account thermal energy emissions in the environment during the exploitation of the PP with the DRICE for the current version of the calculation study is 12.5 %, i.e. the effect of taking into account such ES factor δK_{fe} is –80 %. For the pessimistic version of the calculation study, this effect is –89 % [7].

Calculation study variants

The study will consider the following variants: Variant A – «Reference» – without taking into account both ES factors. Variant B – «Best» – taking into account the full values of motor fuel vapor emissions according to the LBR and SBR mechanisms and the minimum values of thermal energy emissions into the environment. Variant C – «Worst» – taking into account the full values of motor fuel vapor emissions according to the LBR and SBR mechanisms and the maximum values of thermal energy emissions into the environment.

Results of the calculation study

Fig. 1 and Fig. 2 show the distribution of the values of the criterion K_{fe} and effect δK_{fe} according to ESC test cycle regimes for an autotractor diesel engine 2Ch10,5/12 for all studied variants, taking into account the values of both ES factors. Fig. 3 shows the following data for the average operational values of the criterion K_{fe} and effect δK_{fe} for all studied variants, taking into account the values of both ES factors.

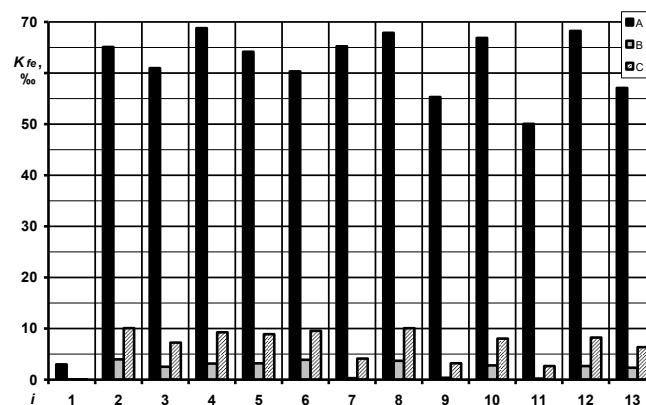


Fig. 1. Distribution of criterion values K_{fe} according to ESC test cycle variants for autotractor diesel engine 2Ch10,5/12 for all studied variants of taking into account the emission of both ES factors

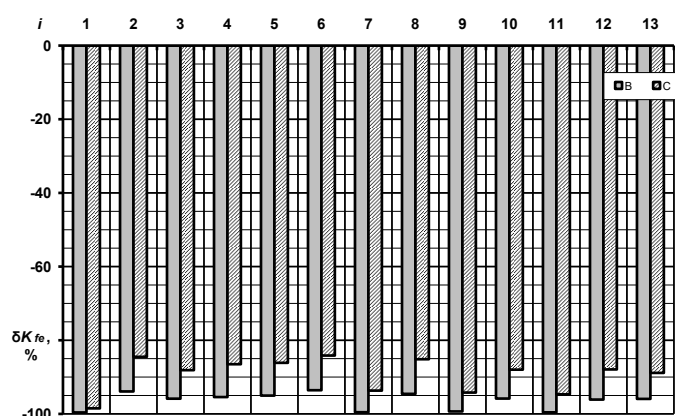


Fig. 2. Distribution of effect values δK_{fe} according to ESC test cycle regimes for autotractor diesel engine 2Ch10,5/12 for all studied variants of taking into account both ES factors

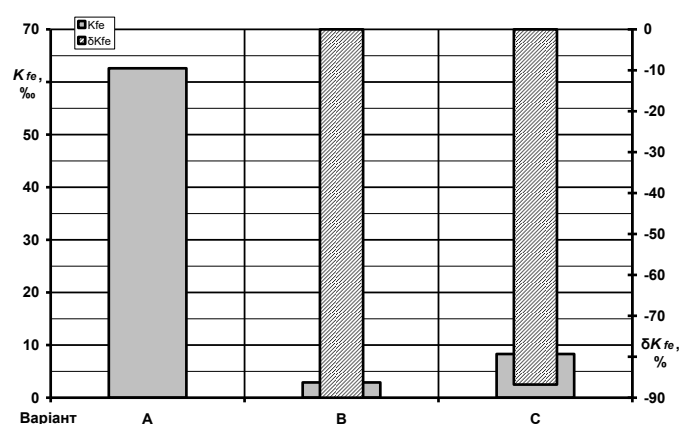


Fig. 3. Distribution of average operational values of the criterion K_{fe} and value δK_{fe} for autotractor diesel engine 2Ch10,5/12 and all studied variants for taking into account the emission of both ES factors

Conclusions

The calculated assessment of the values of the complex fuel-ecological criterion has been carried out, taking into account the total emissions of motor fuel vapors due to LBR and SBR phenomena and thermal energy emissions in the environment as a common indicator of the negative impact on the environment components of the operated PP with the DRICE, which is directly related to the use of motor fuel, together with the actual impact on the consumption of motor fuel as a non-renewable energy resource.

It has been found that for the average operational values of the K_{fe} criterion for the ESC cycle for the 2Ch10.5/12 diesel engine, taking into account the emission of both ES factors when operating the PP with the DRICE for the best variant of the calculation study is 8.3 ‰, i.e. the effect of taking into account such an ES factor δK_{fe} is –86.8 %. For the worst case variant of the computational study, this effect is –95.4 %.

Scientific novelty of the results of the study.

The method for compatible consideration of the emission of thermal energy and motor fuel vapor emissions from fuel tank into the environment from PP with

RICE, in particular FERV units, in a complex criteria-based assessment of the indicators of the ES level during their exploitation has been further developed.

Practical significance of results of the study.

The results obtained are suitable for providing a quantitative and qualitative assessment of the studied effects and developing on this basis technical solutions and organizational measures to reduce or eliminate them by developing an appropriate EPT with executive devices on the methodological basis of the ESMS.

The analysis of the results of the performed study shows that compatible consideration of the emission of thermal energy and motor fuel vapor emissions from fuel tank into the environment from PP with RICE, in particular FERV units of divisions of SES of Ukraine and other special equipment of institutions of sector of safety and defense of Ukraine, in conditions of armed aggression is an urgent task in view of the need to ensure compliance with the requirements contained in the Order of the SES of Ukraine № 618 (on the main activity) dated 20.09.2013 «On approval of the Regulations on the organization of ecological support of the State Emergency Service of Ukraine» both during armed

aggression and during the post-war reconstruction of the country's critical infrastructure and economy in the historical perspective of ensuring the goals of sustainable development, defined in the Decree of the President of Ukraine № 722/2019 dated 30.09.2019 «On the Goals of Sustainable Development of Ukraine for the period up to 2030».

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At the same time, the materials from the VCU library system were used, including electronic versions of journals and other materials, databases, interlibrary subscription as part of participation in Non-Resident Academic Associates program co-sponsored by the College of Humanities and Sciences at Virginia Commonwealth University (VCU) and the Davis Center for Eurasian Studies at Harvard University in 202–2025 academic year.

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cordance with the Higher Education Standard, approved and put into effect by Order of the Ministry of Education and Science of Ukraine № 1427 dated 12/23/2021, as well as the Professional Standard for the group of professions «Teachers of Higher Education Institutions», approved by Order of the Ministry of Economic Development, Trade and Agriculture № 610 dated March 23, 2021, namely as the part of the lecture course «Environmental monitoring methods» (3 ECTS credits).

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Науково-технічний журнал "Двигуни внутрішнього згоряння" випускається 2 рази в рік. Основна мета видання – надати можливість опублікувати результати наукових праць і статті науковим співробітникам, викладачам, аспірантам і здобувачам наукових ступенів, а також розширити можливості для обміну науково-технічною інформацією в Україні та за її межами.

До опублікування приймаються статті українською, російською, англійською, німецькою мовами за наступними науковими напрямками:

- Загальні проблеми двигунобудування;
- Конструкція ДВЗ;
- Робочі процеси ДВЗ;
- Екологізація ДВЗ;
- Випробування та експлуатація ДВЗ;
- Технологія виробництва ДВЗ;
- Гібридні силові установки;
- Історія двигунобудування, особистості, ювілеї;
- Методологія вищої освіти зі спеціальності ДВЗ.

Матеріал (стаття) подається редколегії в 2-х примірниках. До матеріалів повинен додаватися електронний варіант статті, набраної в текстовому редакторі MS Word.

ВИМОГИ ДО ОФОРМЛЕННЯ СТАТТІ можна завантажити на офіційному сайті журналу <http://dvs.khpi.edu.ua/>, а також на сайті кафедри "Двигуни та гібридні енергетичні установки" за посиланням <http://web.kpi.kharkov.ua/diesel/nauka/zhurnal-dvz/> в розділі «Наука», «Журнал ДВЗ».

СТРУКТУРА СТАТТІ:

– УДК; І.Б.Ф. Заголовок статті. Анотація мовою тексту статті. Текст статті. Список літератури. Список літератури, оформлений транслітерацією. Відомості про авторів. Анотації українською (російською), англійською мовами.

Стаття повинна мати такі необхідні елементи:

- постановка проблеми в загальному вигляді та її зв'язок з важливим науковим чи практичними задачами;
- аналіз останніх досліджень і публікацій, в яких започатковано розв'язання даної проблеми, на які спирається автор,
- виділення невирішених раніше частин загальної проблеми, котрим присвячується означена стаття;
- формулювання цілей статті (постановка завдання);
- виклад основного матеріалу дослідження з повним обґрунтуванням отриманих наукових результатів;
- висновки з даного дослідження і перспективи подальших досліджень у даному напрямку.

До статті додаються:

- рецензія,
- акт експертизи про можливість опублікування.

СТАТТІ, ОФОРМЛЕННЯ ЯКИХ НЕ ВІДПОВІДАЄ ВИМОГАМ, РЕДКОЛЕГІЄЮ НЕ РОЗГЛЯДАЮТЬСЯ

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