

## Література

1. World Health Organization. Air Quality Guidelines for Particulate Matter, Ozone, Nitrogen Dioxide and Sulfur Dioxide: Global Update 2005. Geneva: WHO, 2006. 22 с. URL: <https://iris.who.int/bitstream/handle/10665/107823/9789289021920-eng.pdf?sequence=1> (дата звернення: 02.02.2025).

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### **DESIGNING AND DEVELOPING OF PORTABLE DISMOUNTABLE TEST BENCH FOR EXPERIMENTAL RESEARCH OF THE WORKING CHARACTERISTICS OF EXECUTIVE ELEMENTS OF ENVIRONMENTAL PROTECTION TECHNOLOGIES AGAINST THE INFLUENCE OF POWER PLANTS WITH RECIPROCATING ICE**

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The relevance of this research lies in the development of the portable dismountable test bench (PDTB), which enables experimental studies of the performance indicators of power plants (PP) with reciprocating internal combustion engines (RICE), as well as the efficiency of various actuators in environmental protection technologies (EPT) aimed at protecting the environment from technogenic impacts. These PP units with RICE may include firefighting and emergency rescue vehicles (FERV) used by the State Emergency Service of Ukraine (SES of Ukraine), especially in remote areas and frontline zones. This is crucial both during armed aggression and for post-war reconstruction of critical infrastructure.

The proposed PDTB design includes the following measurement devices:

- 5-component gas analyzer to measure concentrations of unburned hydrocarbons (C<sub>n</sub>H<sub>m</sub>), CO, NO<sub>x</sub>, CO<sub>2</sub>, and O<sub>2</sub> in exhaust gases (EG);
- opacity meter for EG opacity;

- differential U-tube manometers for EG pressure drop measurements at the EPT actuator inlet and within the executive element of EPT;
- temperature measurement system for EG, the working medium, and solid EPT components at 6–10 points;
- sound level meter for noise pollution from the RICE and EPT executive element of EPT;
- environmental sensors, including a barometer-aneroid, mercury thermometer, anemometer, and hygrometer.

Additionally, there is a foldable table for a mobile computer that processes signals from the stand's instruments using criterion-based mathematical analysis and a power supply with protection features.

The appearance (a) and the layout and of the PDTB (b) are shown in Fig. 1.

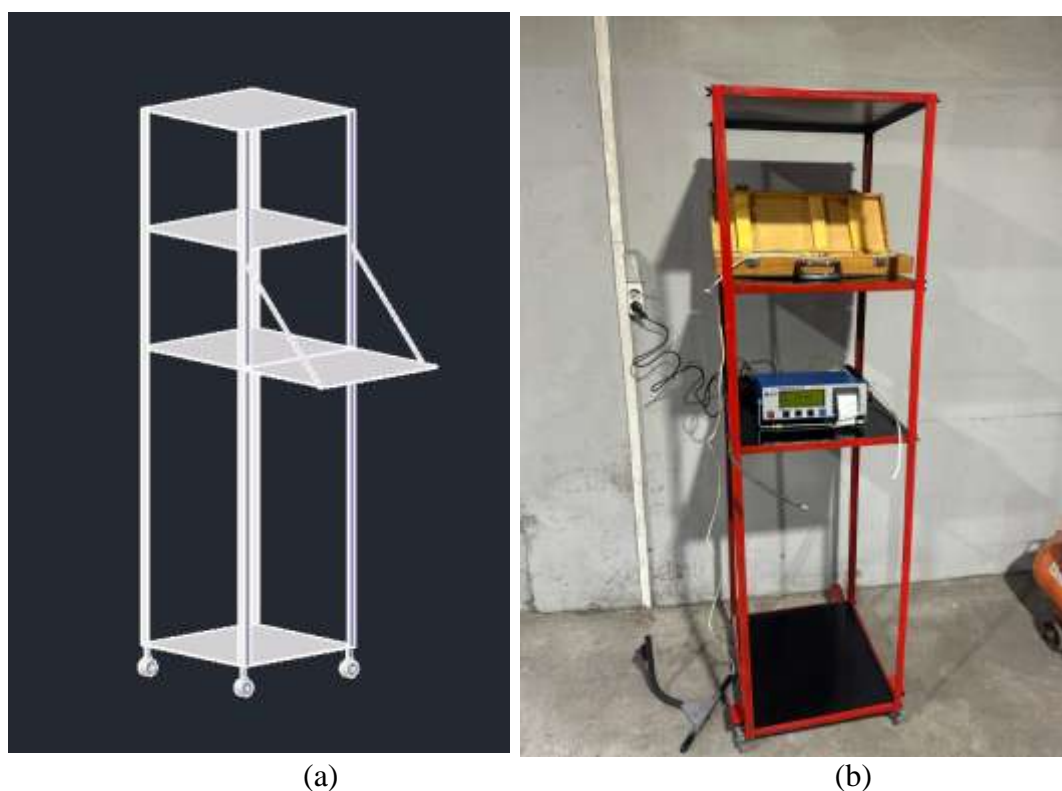


Figure 1 – Diagram (a) and appearance (b) of the designed and developed portable dismantlable test bench

In Fig. 2 presented opacimeter META-01 for the PDTB (a) and its instrument verification document (b). In Fig. 3 presented 4-component gas analyzer Autotest 02.02 for the PDTB (a) and its instrument verification document (b).

The purpose of the study is to improve the environmental safety (ES) indicators of power PP with RICE, particularly for FERV, by developing the portable dismantlable test bench for experimental studying the environmental characteristics of such PP with RICE and the efficiency of FERV.



Figure 2 – Opacimeter META-01 for the mobile test bench (a) and its instrument verification document (b)

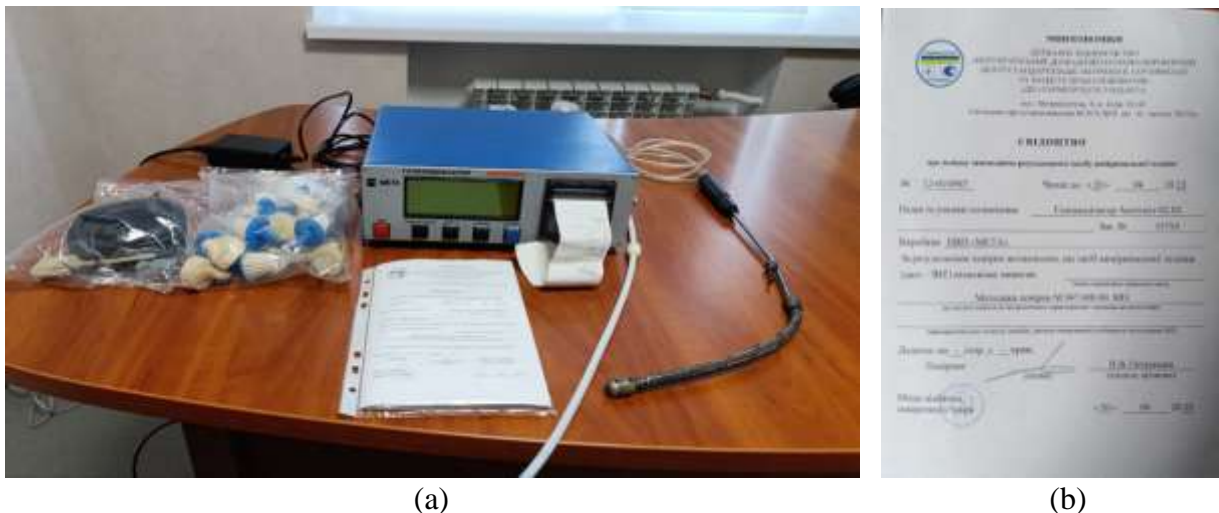


Figure 3 – 4-component gas analyzer Autotest 02.02 for the mobile test bench (a) and its instrument verification document (b)

The problem of the study lies in the absence of a mobile test bench suitable for such studies in remote and conflict-affected areas.

The concept of the study is to create a quickly deployable, universal test bench with all necessary instruments for direct and indirect measurement of RICE, ES and EPT efficiency indicators essential for complex criteria-based assessment.

The object of the study includes ES factors, executive element of EPT efficiency indicators, and factors for complex criteria-based assessment of FERV exploitation process. The subject of the study is the portable dismountable test bench for experimentally determining the physical quantities of the research object. The scientific novelty of results of the study lies in refining the concept for experimental acquisition of baseline data to assess ES during exploitation of PP with RICE, specifically adapted for FERV in remote departments affected by armed aggression.

The practical value of results of the study is in developing a portable dismountable test bench for FERV in remote departments in conflict-affected areas, ensuring compliance with the «Regulations on Environmental Safety for the State Emergency Service of Ukraine» approved by Order No. 618 on September 20, 2013.

This study was carried out as part of the scientific and research work of the Department of Environmental Protection Technologies of the Educational and Scientific Institute of Management and Population Safety of the National University of Civil Protection of Ukraine of SES of Ukraine «Development of a methodology for complex assessment of the impact of exploitation and application of special equipment on the environment in conditions of military aggression» (State Registration № 0124U000374, 01.2024–12.2026).

At the same time, 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 2024–2025 academic year.

## Conclusions

Thus, in this study the portable dismountable test bench for experimental research of the working characteristics of executive elements of complex synergetical environmental protection technologies against the influence of power plants with reciprocating internal combustion engine based on the exhaust gas filter with liquid working body was designed and developed.

## References

1. Kondratenko O.M. The place of DPF with a liquid working body in the classification of atmospheric air protection technologies from the complex negative influence of power plants with reciprocation ICE / O.M. Kondratenko, V.A. Krasnov, V.M. Semykin // Technogenic and ecological safety. – Kh.: NUCP of Ukraine, 2023. – 14(2/2023). – pp. 67–91. – DOI: 10.52363/2522-1892.2023.2.8.
2. Development and Use of the Index of Particulate Matter Filter Efficiency in Environmental Protection Technology for Diesel-Generator with Consumption of Biofuels / O. Kondratenko, V. Andronov, V. Koloskov, O. Strokov // 2021 IEEE KhPI Week on Advanced Technology: Conference Proceedings (13–17 September 2021, NTU «KhPI», Kharkiv). – Kharkiv: NTU «KhPI», 2021. – pp. 239–244. – DOI: 10.1109/KhPIWeek53812.2021.9570034.
3. Інструментальна похибка відомих формул перерахунку показників димності у показники токсичності відпрацьованих газів поршневих ДВЗ / О.М. Кондратенко, В.А. Андронов, О.П. Строков, В.М. Бабакін, В.А. Краснов // Technogenic and ecological safety. – 2022. – № 12(2/2022). – С. 3–18. – DOI: 10.52363/2522-1892.2022.2.1.
4. Krasnov V.A. Portable test bench for experimental research of the working characteristics of executive elements of environmental protection technologies against the influence of power plants with reciprocating ICE [Text] / V.A. Krasnov, O.M. Kondratenko // Екологічна безпека в умовах війни: збірник тез доповідей V Міжнародної науково-практичної конференції (21 листопада 2024 р., ЛДУБЖД, Львів). – Львів: ЛДУБЖД, 2024. – С. 45–47.