

## THE USE OF CHEMICAL WARFARE AGENTS IN THE ARMED AGGRESSION OF THE RUSSIAN FEDERATION AGAINST UKRAINE: CHEMICAL WEAPONS AS AN UNCONVENTIONAL MEANS OF WARFARE

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**Introduction.** The risks of the chemical warfare agents use are currently very acute as a result of the ongoing armed aggression of the Russian Federation against Ukraine. Chemical warfare agents were first used during the First World War. In September 1914, the German army, neglecting the agreements of the Hague Conferences of 1899 and 1907, involved artillery chemical shells with irritating toxic substances in hostilities.

**The purpose** of the study was to analyze the frequency of use of chemical warfare agents by the Russian Federation against servicemen of the Armed Forces of Ukraine and to determine trends in the use of chemical weapons during full-scale aggression.

**Materials and methods.** In the course of the study, we resorted to general scientific theoretical methods, such as the bibliographic method, methods of system analysis, information synthesis and generalization. The study used open (Internet) materials of the General Staff of the Armed Forces of Ukraine etc on the cases of chemical warfare agents used by the enemy. We also built trends, calculated equations and values of reliability of the approximation of the obtained trends in the frequency of use of chemical warfare agents by the army of the Russian Federation against servicemen of the Armed Forces of Ukraine by months since December 2023 to December 2024 inclusive.

**Results.** Since December 2023 to May 2024 inclusive, there was a tendency to increase the number of uses of the above-mentioned weapons by the Russian army against servicemen of the Armed Forces of Ukraine – from 81 registered cases in December 2023 to 715 recorded cases in May 2024, which was 8.83 times more than in December 2023. This trend is reliable, since the value of the reliability of the approximation of the obtained trend is  $R^2 = 0.9227$  and is in the range of 0.8 to 1.0, which indicates a high degree of reliability of the constructed trend line and its equation.

**Conclusions.** Damage to the servicemen of the Armed Forces of Ukraine by combat poisonous irritating substances, in most cases, was of mild and moderate severity. Medical care was provided to the victims mainly on the spot, as a rule, they did not need to be evacuated to the next stages of medical evacuation.

**Key words:** chemical weapons, medical care, evacuation.

## ЗАСТОСУВАННЯ БОЙОВИХ ОТРУЙНИХ РЕЧОВИН У ЗБРОЙНІЙ АГРЕСІЇ російської федерації ПРОТИ УКРАЇНИ: ХІМІЧНА ЗБРОЯ ЯК НЕТРАДИЦІЙНИЙ ЗАСІБ ВЕДЕННЯ ВІЙНИ

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**Вступ.** Ризики застосування бойових отруйних речовин наразі постають дуже гостро внаслідок тривалої збройної агресії російської федерації проти України. Бойові отруйні речовини були вперше застосовані під час Першої світової війни. Німецька армія у вересні 1914 р., знехтувавши угодами Гаазьких конференцій 1899 та 1907 рр., залучила до бойових дій артилерійські хімічні снаряди із подразнювальними отруйними речовинами.

**Метою дослідження** було проаналізувати частоту застосування бойових отруйних речовин російською федерацією проти військовослужбовців Збройних Сил України та визначити тенденції залучення хімічної зброї під час повномасштабної агресії.

**Матеріали та методи.** В ході проведення дослідження ми вдавалися до загальнонаукових теоретичних методів, таких як бібліографічний метод, методи системного аналізу, інформаційного синтезу та узагальнення. Також ми були побудовані тенденції, обчислені рівняння та величини достовірності апроксимації отриманих трендів частоти застосування армією російської федерації бойових отруйних речовин проти військовослужбовців Збройних Сил України за місяцями з грудня 2023 року до грудня 2024 року включно.

**Результати.** З грудня 2023 року до травня 2024 року включно спостерігалася тенденція до зростання кількості використання вищезгаданої зброї армією РФ проти військовослужбовців Збройних Сил України – від 81 зареєстрованого випадку в грудні 2023 до 715 зафіксованих випадків в травні 2024 року, що складало в 8,83 рази більше, порівняно з груднем 2023 року. Даний тренд є достовірним, оскільки величина достовірності апроксимації отриманої тенденції становить  $R^2 = 0,9227$  і перебуває в проміжку в 0,8 до 1,0, що свідчить про високий ступінь достовірності побудованої лінії тренду та його рівняння.

**Висновки.** Ураження військовослужбовців ЗС України бойовими отруйними речовинами подразнюючої дії, у більшості випадків, відносились до легких і середніх ступенів тяжкості. Медична допомога ураженим надавалась переважно на місці, як правило, вони не потребували евакуації на наступні етапи медичної евакуації.

**Ключові слова:** хімічна зброя, медична допомога, евакуація.

**Introduction.** The risks of the chemical warfare agents use are currently very acute as a result of the ongoing armed aggression of the Russian Federation against Ukraine.

Chemical warfare agents were first used during the First World War. In September 1914, the German army, neglecting the agreements of the Hague Conferences of 1899 and 1907, involved artillery chemical shells with irritating toxic substances in hostilities. During the First World War, the industry of all states participating in the conflict produced about 180 thousand tons of chemical warfare agents, and 125 thousand tons were used on the battlefield. In total, about 1 million 300 thousand people were hit by chemical weapons [1]. The components of chemical weapons include chemical warfare agents and means of delivering them to the target. Chemical warfare agents include toxic substances and toxins that have a damaging effect on the human and animal body, as well as phytotoxins that can be used for military purposes to damage plants of various species. In the event of a response to a chemical attack or release of chemical warfare agents on any terrain, it is classified into danger level zones for immediate neutralization and localization of the affected area. The assessment of the chemical situation that affects the life of the population and the environment depends on the rate of neutralization of the affected area.

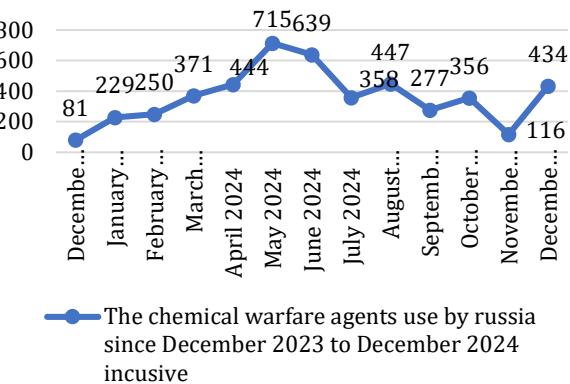
**The purpose** of the study was to analyze the frequency of use of chemical warfare agents by the Russian Federation against servicemen of the Armed Forces of Ukraine and to determine trends in the use of chemical weapons during full-scale aggression.

**Materials and methods of research.** In the course of the study, we resorted to general scientific theoretical methods, such as the bibliographic method, methods of system analysis, information synthesis and generalization. The study used open (Internet) materials of the General Staff of the Armed Forces of Ukraine etc on the cases of chemical warfare agents used by the enemy. We also built trends, calculated equations and values of reliability of the approximation of the obtained trends in the frequency of use of chemical warfare agents by the army of the Russian Federation against servicemen of the Armed Forces of Ukraine by months since December 2023 to December 2024 inclusive.

**Results and their discussion.** During the Russian-Ukrainian war, as of January 2025, 5389 cases of the use of chemical warfare agents (CWA) by the

Russian Federation against servicemen of the Armed Forces of Ukraine who are in the combat zone since February 24, 2022 have been registered. The above-mentioned phenomenon began to be particularly systematic since February 2023, since the aggressor has increasingly used prohibited means of warfare, such as: as chemical weapons, the involvement of which contradicts the international "Convention on the Prohibition of the Development, Production, Stockpiling, Use of Chemical Weapons and on Their Destruction". This international treaty was signed within the framework of the United Nations on January 13, 1993, the parties to which are, in particular, both Ukraine and the Russian Federation.

According to the results of the analysis of the number of cases of the use of CWA by the Russian army against the personnel of the Armed Forces of Ukraine from open sources, only for the period since December 2023 (when the relevant data were first published) to December 2024 inclusive, 4717 involvements of chemical compounds of various origins related to chemical weapons were recorded (Figure 1).



**Figure 1.** The number of registered cases of the chemical warfare agents use by the Russian Federation against servicemen of the Armed Forces of Ukraine since December 2023 to December 2024 inclusive

In December 2023, 81 cases of the Russian army resorting to chemical warfare agents against servicemen of the Armed Forces of Ukraine were registered [2].

Starting since January 2024, the trend of the use of chemical warfare agents began to go upwards, 229 cases of the use of chemical weapons against the personnel of the Armed Forces of Ukraine by the Russian Federation have already been recorded [3]. Subsequently, the number of detected cases of the use of chemical

weapons continued to gradually increase, in February 2024, 250 cases of the use of chemical warfare agents by the Russian army against servicemen of the Armed Forces of Ukraine were detected, including 244 cases of the use of explosive ordnance VOH (translated from the Russian as "fragmentation grenade launcher shot"), 1 case of gas use, and 5 cases of the use of other chemical munitions [4].

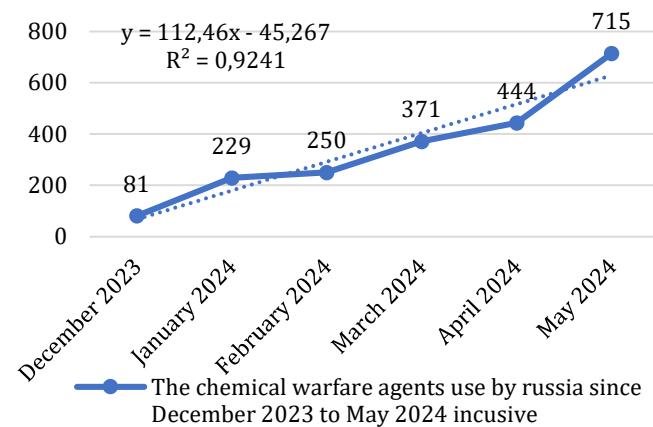
In March 2024 alone, the Security and Defense Forces of Ukraine recorded 371 cases of the aggressor's use of ammunition containing hazardous chemicals (90 cases more than in the previous period) [5].

In April 2024, 444 cases of the use of ammunition containing hazardous chemicals by Russian troops were registered, which is 71 cases more than in the previous period [6]. Instead, the following month, the largest number of cases of the use of CWA for the entire period of the Russian-Ukrainian war (as of January 2025) was detected. Thus, in May 2024, the Armed Forces of Ukraine recorded 715 cases when the enemy resorted to the use of chemical weapons, which was 271 cases more than in April. For the most part, the Russian army dropped chemicals with K-51 and RG-VO grenades from unmanned aerial vehicles. The aggressor mainly used CS (2-Chlorobenzalmalonitrile), a tear gas irritant that can be used by the police against violators during demonstrations. Its use during hostilities is unacceptable in accordance with paragraph 5 of Article II of the Convention on the Prohibition of the Development, Production, Stockpiling, Use and Destruction of Chemical Weapons. [7].

Since December 2023 to May 2024 inclusive, there was an upward trend in the number of uses of the above-mentioned weapons by the Russian army against servicemen of the Armed Forces of Ukraine – from 81 registered cases in December 2023 to 715 recorded cases in May 2024, which was 8.83 times more than in December 2023. This trend is reliable, since the value of the reliability of the approximation of the obtained trend is  $R^2 = 0.9227$  and is in the range of 0.8 to 1.0, which indicates a high degree of reliability of the constructed trend line and its equation (Figure 2).

In June 2024, the frequency of the use of chemical warfare agents by the Russian army slightly decreased and amounted to 639 cases, the share of gas grenades of the K-51 and RG-VO types was 31% of the total number of CWA used by Russia in the above month. As of June 2024, a total of 1945 cases of appeals by servicemen of the Armed Forces of Ukraine to health care institutions with symptoms of chemical damage of varying severity were recorded. The competent authorities of Ukraine also recorded deaths from acute poisoning with an unknown chemical

substance. Most of the ammunition (82%) that was used was K-51 and RG-VO hand grenades (31% in June 2024) [8].



**Figure 2.** The trend of the chemical warfare agents use by the Russian federation against servicemen of the Armed Forces of Ukraine since December 2023 to May 2024 inclusive, line, trend equation and the value of the reliability of the approximation

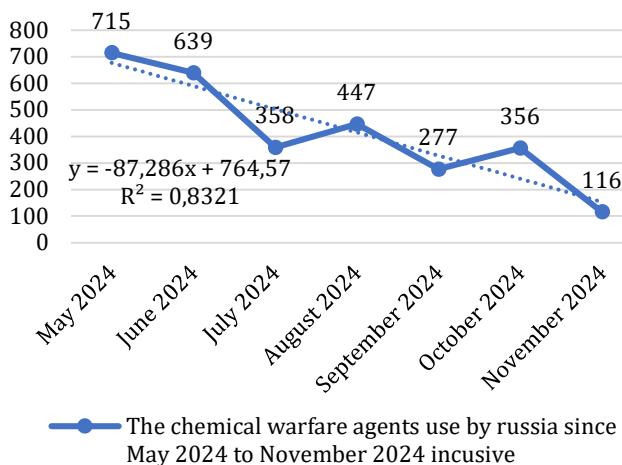
The trend of the aggressor's use of CWA on the contact line since May to November 2024 inclusive continued to decline. During July 2024 alone, 358 cases of the enemy's use of ammunition containing dangerous chemical compounds were documented [9].

In August 2024, 447 cases of the use of chemical munitions against servicemen of the Armed Forces of Ukraine were detected [10].

According to the Command of the Support Forces of the Armed Forces of Ukraine, in September 2024, the enemy used chemicals 277 times. In October 2024, 356 cases were recorded, in November 2024 – 116 cases. The use of hazardous chemicals often occurs in the areas of the front where the enemy concentrates the most forces. To hide this fact, Russian troops use dense artillery and rocket and bomb fire, which complicates the selection of evidence, samples for laboratory research for international investigations [11].

After constructing the trend line and calculating its equation, it was found that since May to November 2024 inclusive, the trend of the aggressor's army using CWA began to gradually decline (Figure 3). The value of the reliability of the approximation of the obtained trend is  $R^2 = 0.8319$ , which indicates that the trend is reliable, since the value of the reliability of the approximation is in the range from 0.8 to 1.0. Nevertheless, since December 2024, the trend of using CWA begins to move upwards again (Figure 1).

Numerous cases of the use of ammunition containing dangerous chemical compounds of an unknown type have been recorded.



**Figure 3.** The trend of the chemical warfare agents use by the russian federation against servicemen of the Armed Forces of Ukraine since May 2024 to November 2024 inclusive, line, trend equation and the value of the reliability of the approximation

Thus, in December 2024, radiation, chemical, and biological intelligence units of the Support Forces of the Armed Forces of Ukraine documented 434 cases of the use of such ammunition. In total, since February 2023, 5389 cases of the use of hazardous chemicals have been recorded. In general, cases of the use of dangerous chemicals by the russians on the battlefield have been recorded since the very beginning of the large-scale invasion. But it is since February 2023 that this phenomenon has become systemic [12].

The head of the medical service must provide the victim with immediate evacuation to the next stages of evacuation to the specialized medical care unit (mobile hospitals, hospitals). The principles of first aid and treatment of lesions with toxic substances include: termination of the access of CWA to the body; termination of further intake of CWA in the body. body (removal of the victim from the affected area, use of personal

protective equipment, partial special treatment; speedy removal of toxic substances and their poisonous metabolites from blood and tissues; use of specific antidote therapy; ensuring the normal functioning of vital organs and systems; timely provision of medical care at the site of the lesion and treatment in a specialized hospital; prevention of various complications). Among the servicemen of the Armed Forces of Ukraine, mainly damages by irritating military toxic substances were recorded, in most cases, they were mild and moderate. Medical care was provided to the victims in a timely and professional manner, in most cases, on the spot, as a rule, only isolated cases required evacuation to the next stages of medical evacuation.

### Conclusions

1. During the russian-Ukrainian war, as of January 2025, 5389 cases of the use of chemical warfare agents by the russian federation against servicemen of the Armed Forces of Ukraine were registered, and every month during 2024, more and more injuries of servicemen of the Armed Forces of Ukraine were detected (most 715 cases were registered in May 2024 compared to 444 cases in April 2024), which indicates that there is a stable upward trend towards a wider deliberate use of chemical warfare agents by units of the russian federation, the coefficient of determination of which  $R^2$  was high and amounted to 0.9227, and which continues to grow steadily.

2. Damage to the servicemen of the Armed Forces of Ukraine with chemical warfare agents of irritating action, in most cases, belonged to mild and moderate severity. Medical care was provided to the victims mainly on the spot, as a rule, they did not need to be evacuated to the next stages of medical evacuation.

**Prospects for further research.** In the future, it is planned to improve preventive measures to prevent poisoning with chemical warfare agents and expand approaches to their treatment.

### References

1. Kondratiuk, Ye. (2024). Rizyky zastosuvannia khimichnoi zbroi pid chas povnomasshtabnoho vtorhnennia. Materiały Vseukrainskoi naukovo-praktychnoi konferentsii kursantiv, studentiv, adiunktiv (aspirantiv) «Nauka pro tsvyilnyi zaklyuch yak shliakh stanovlennia molodykh vchenykh», m. Cherkasy, 16 travnia 2024 r. 44-46.
2. UNIAN redaktsiia. (2024, 1 sichnia). Strashna i zaboronena zbroia: Henshtab ZSU vpershe pokazav statystyku khimichnykh atak rf. Novyny Ukrayny - ostanni novyny Ukrayny sohodni - UNIAN. [https://www.unian.ua/multimedia/video/war/1047526\\_2-strashnoe-i-zapreshchennoe-oruzhie-genshtab-vsuvperve-pokazal-statistiku-himicheskikh-atak-rf.html](https://www.unian.ua/multimedia/video/war/1047526_2-strashnoe-i-zapreshchennoe-oruzhie-genshtab-vsuvperve-pokazal-statistiku-himicheskikh-atak-rf.html)
3. Kalnichenko, A. (2024, 10 liutoho). Ponad 800 raziv: rosiia vse chastyne vikorystovuie khimichnu zbroiu proty ukrainskykh viiskovykh, — ZSU. FOKUS. <https://focus.ua/uk/voennye-novosti/626019-ponad-800-raziv-rosiya-vse-chastyne-vikorystovuie-himichnu-zbroyu-proti-ukrayinskikh-viiskovih-zsu>
4. Vid pochatku povnomasshtabnoi viiny rosiiany 1068 raziv zastosuvaly khimichnu zbroiu. (2024, 7 bereznia). Militarnyi. <https://mil.in.ua/uk/news/vid-pochatku-povnomasshtabnoi-viiny-rosiiany-1068-raziv-zastosuvaly-himichnu-zbroyu/>
5. Perun, V. (2024, 5 kvitnia). Syly oborony zaiavliaut pro zbilshennia kilkosti vypadkiv khimichnykh atak z boku Rosii. LB.ua.

[https://lb.ua/society/2024/04/05/607094\\_sili\\_oboroni\\_z\\_ayavlyayut\\_pro.html](https://lb.ua/society/2024/04/05/607094_sili_oboroni_z_ayavlyayut_pro.html)

6. Ukrinform. (2024b, 3 travnia). rosiia za misiats ponad 440 raziv zastosuvala khimichni boieprypasy - ZSU. Ukrinform - aktualni novyny Ukrayny ta svitu. <https://www.ukrinform.ua/rubric-ato/3859758-rosia-za-misac-ponad-440-raziv-zastosuvala-himicni-boepripasi.html>

7. Kuzmenko, Yu. (2024, 24 chervnia). U travni rf 715 raziv zastosuvala khimichni rechovyny na fronti — Sily pidtrymky ZSU. Suspilne. Novyny. <https://suspilne.media/775475-u-travni-rf-715-raziv-zastosuvala-himicni-recovini-na-fronti-sili-pidtrimki-zsu/>

8. Ukrinform. (2024b, 12 lypnia). Ukraina predstavyla OZKhZ detalizovanu informatsiu pro hrubi porushennia rf polozhen Konventsii. Ukrinform - aktualni novyny Ukrayny ta svitu. <https://www.ukrinform.ua/rubric-ato/3884504-ukraina-predstavila-ozhz-detalizovanu-informaciu-pro-grubi-porusenna-rf-polozen-konvencii.html>

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*A – концепція та дизайн дослідження; B – збір даних; C – аналіз та інтерпретація даних;*

*D – написання статті; E – редактування статті; F – остаточне затвердження статті.*

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*D – writing the article; E – critical revision of the article; F – final approval of the article.*



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