UDC 504.054:628.477.42
DOI https://doi.org/10.32782/3041-2080/2025-4-3

ENVIRONMENTAL RISK OF HOUSEHOLD WASTE ACCUMULATION AT THE ZHYTOMYR CITY LANDFILL IN THE PERIOD FROM 2018–2024 YEARS

Demchuk Liudmyla Ivanivna,
PhD in Pedagogy, Associate Professor,
Associate Professor at the Department of Ecology and Environmental Technologies
State University of Zhytomyr Polytechnic
ORCID ID: 0000-0001-5698-7113

Korbut Maria Bronislavivna,
PhD in Engineering,
Doctoral Student at the Department of Ecology
Lviv Polytechnic National University
ORCID ID: 0000-0001-5698-7113

Davydova Iryna Volodymyrivna,
PhD in Agriculture, Associate Professor,
Associate Professor at the Department of Ecology and Environmental Technologies
State University of Zhytomyr Polytechnic
ORCID ID: 0000-0001-6535-3948

Alpatova Oksana Nikolaevna,
PhD in Biology, Associate Professor,
Associate Professor at the Department of Ecology and Environmental Technologies
State University of Zhytomyr Polytechnic
ORCID ID: 0000-0003-0803-9850

Kalenska Vitalina Petrivna,
PhD in Economics, Associate Professor,
Associate Professor at the Department of Tourism and Hotel and Restaurant Business
State University of Zhytomyr Polytechnic
ORCID ID: 0000-0003-0995-1489

Rusetska Nataliia Mykolaivna,
Teacher of Natural Sciences
Zhytomyr Agricultural College
ORCID ID: 0000-0002-5568-4708

The study examines key aspects of the negative impact of the landfill on the environment and public health caused by its operation. It is established that leachate is formed as a result of waste decomposition and seeps into the soil, contaminating it with heavy metals, organic compounds and other toxic substances. This, in turn, leads to the contamination of underground aquifers, which are a source of drinking water for the surrounding areas. It has been proven that the decomposition of organic waste is accompanied by the release of biogas (methane, carbon dioxide, hydrogen sulfide), which is a greenhouse gas and contributes to climate change. In addition, spontaneous combustion often occurs at the landfill, which leads to emissions of harmful combustion products, including dioxins and furans, which are extremely toxic. It is analyzed that the accumulation of waste, landscape changes, and pollution of adjacent territories negatively affect natural ecosystems, leading to a reduction in plant and animal populations and changes in their species composition. It has been proven that residents of settlements located near the landfill have an increased risk of developing respiratory diseases, allergic reactions, cancer, and other health problems caused by inhaling polluted air and drinking contaminated water. The main sources and factors of environmental hazards caused by the landfill, including leachate formation, biogas emissions, and soil contamination with heavy metals, were identified. According to the results of the study.

Keywords: *waste, pollution, landfill, environmental risk, crisis situations, environmental sustainability.*

Демчук Людмила, Корбут Марія, Давидова Ірина, Алпатова Оксана, Каленська Віталіна, Русецька Наталя. Екологічний ризик накопичення побутових відходів на території Житомирського міського полігона в період з 2018 р. по 2024 р.

У дослідженні розглядаються ключові аспекти негативного впливу звалища на навколишнє середовище та здоров'я населення, спричиненого його експлуатацією. Встановлено, що в результаті розкладання відходів утворюється фільтрат, який просочується в ґрунт, забруднюючи його важкими металами, органічними сполуками та іншими токсичними речовинами. Це своєю чергою призводить до забруднення підземних водоносних горизонтів, які є джерелом питної води для навколишніх територій. Доведено, що розкладання органічних відходів супроводжується виділенням біогазу (метану, вуглекислого газу, сірководню), який є парниковим газом і сприяє зміні клімату. Крім того, на звалищі часто відбувається самозаймання, що призводить до викидів шкідливих продуктів горіння, включаючи діоксини та фурани, які є надзвичайно токсичними. Проаналізовано, що накопичення відходів, зміни ландшафту та забруднення прилеглих територій негативно впливають на природні екосистеми, що призводить до скорочення популяцій рослин і тварин та зміни їх видового складу. Доведено, що мешканці населених пунктів, розташованих поблизу сміттєзвалища, мають підвищений ризик розвитку респіраторних захворювань, алергічних реакцій, раку та інших проблем зі здоров'ям, спричинених вдиханням забрудненого повітря і вживанням забрудненої води. За результатами дослідження визначено основні джерела та фактори екологічної небезпеки, спричиненої звалищем, включаючи утворення фільтрату, викиди біогазу та забруднення ґрунту важкими металами.

Ключові слова: *відходи, забруднення, звалища, екологічні ризики, кризові ситуації, екологічна стійкість.*

Introduction. The issue of garbage or municipal solid waste (MSW) is relevant in any city on our planet, and needs to be resolved as soon as possible. The price of this solution is measured not only in terms of cost, which amounts to billions of dollars, but also in terms of environmental cleanliness and human health. But as life shows, municipal officials who are supposed to solve this problem on a daily basis turn their noses up at it, both figuratively and literally. Today, municipal solid waste is a mixture of all kinds of trash. But a more thorough analysis shows that it consists of: food waste, paper, cardboard, wood, ferrous and non-ferrous scrap metal, bones, leather, rubber, textiles, glass, and polymeric materials. But at the same time, this mixture can contain mercury salts from batteries, phosphor carbonates from fluorescent lamps, toxic chemicals contained in paint and solvent residues, varnishes and aerosols, batteries, etc.

Its amount depends on: the time of year, human household and food needs, the development of the consumer goods industry, packaging, and other factors. For example, in autumn, the amount of solid waste increases due to fallen leaves from trees and fruit and vegetable waste. The growth in the amount of solid waste is facilitated by disposable goods; consumer goods with a short service life, which we buy, consume and throw away regardless of their residual value.

Research methods and techniques. In the vast majority of cases, studies of the kinetics and structure of waste accumulation are based on general ecological methods. The main method in the process of performing the work is the method of structural functions, which is used to solve the main task of the work.

Using analysis, deduction, synthesis, deduction and analogy, the current state of solid waste management policy in Ukraine, Zhytomyr region and EU member states is analyzed. Using comparative, systematic, and general methods, it is possible to compare and systematize the management methods of European countries in the field of waste management. The methods of analysis, synthesis, forecasting, and correlation analysis were used to develop practical recommendations for improving the regional policy in the field of solid waste management and to formulate the conclusions of the study.

The main information base of the study is the legislative and regulatory acts of Ukraine, regulatory documents of regional and local organizations, scientific works on waste management by domestic and foreign scientists, waste analysis materials, information resources of the Internet and other reference literature.

The material for the article was based on statistical materials collected during the visit to the waste processing plant, regional reports for the period 2018–2024 for Zhytomyr region, as well as statistical data that are publicly available on the Internet. The methods of analysis, forecasting, and correlation were most often used.

Results and discussions. Generalized data on waste generation in the region, as well as on waste management operations, are presented in Tables 1 and 2. according to the Main Department of Statistics in Zhytomyr region.

During 2020, about 397.2 thousand tons of waste were generated in Zhytomyr region. Compared to 2018, the volume of waste generation decreased by 54 %. The majority of it is waste of hazard class IV (99.8 %). The volume of waste processing is from 8.5 % in 2020. Waste generation by type of economic activity according to 2023 data has the following distribution:

Table 1

Waste generation and management in Zhytomyr region 2018–2024, thousand tons [23]

Years	Generated	Utilized	Incinerated	Disposed to designated locations or facilities	Total volume of waste accumulated during operation in designated locations or facilities (waste disposal sites)
2018	671,9	92,3	25,3	208,2	5,999,7
2019	518,3	79,6	22,4	187,4	4,658,8
2020	550,4	76,5	42,2	140,9	5,049,7
2021	550,3	82,8	37,1	169,9	5,154,0
2022	486,2	48,9	44,1	199,5	5,318,5
2023	474,5	53,3	57,2	205,4	5,427,8
2024	397,2	33,4	30,1	224,3	5,637,6

– agriculture, forestry and fisheries – 57,342.6 tons (14.4 %);

– mining and quarrying – 96,182.0 tons (24.21 %);

– processing industry – 139,818.9 tons (35.2 %);

– electricity, gas, steam and air conditioning supply – 1,095.7 tons (0.276 %);

– water supply; sewage, waste management – 6,817.3 tons (1.716 %);

– other types of economic activity – 7,548.0 tons (1.9 %).

The Head of the Zhytomyr Regional State Administration gave an instruction to district state administrations and local self-government bodies dated October 21, 2023 No. 6684/2-19/42 to conduct a comprehensive inventory of storage locations of chemical plant protection products unsuitable for use in 2023.

Based on the results of the inventory and updated data as of 31.03.2022, it was found that there are 458,084 tons of unusable plant protection chemicals in the region that are subject to disposal. According to the License Register (Hazardous Waste Management), as of 2022, four business entities are engaged in hazardous waste management in the region.

For the purpose of proper maintenance and operation of the municipal landfill for non-hazardous waste in Zhytomyr, based on the decision of the Executive Committee of the Zhytomyr City Council dated 27.07.2023 on the determination of the contractor for the provision of household waste management services in the city of Zhytomyr, the legal entity Green Bean Ukraine LLC was recognized as the winner of the tender for the right to remove household waste. The first stage of the waste sorting line of the waste treatment plant

Table 2

Generation and management of waste of hazard classes I–IV by material category in 2023, (tons)

	Generated	Disposed	Burned	Including for the of purpose		Removed to specially designated places or facilities
				obtaining energy	thermal treatment	
That's all	397,239,1	33,406,9	30,062,9	14,253,8	15,809,1	224,260,1
Used solvents	101,0	–	–	–	–	–
Waste acids, alkalis or salts	315,0	308,0	–	–	–	–
Used oils	100,5	24,3	1,3	1,3	–	–
Chemical waste	5,0	–	–	–	–	–
Industrial sewage sludge	10944,6	–	–	–	–	357,0
Sludge and liquid waste treatment plants	126,2	409,5	–	–	–	106,2
Medical and biological waste	5,3	–	19,4	19,4	–	–
Glass waste	380,1	–	–	–	–	–
Paper and cardboard waste	1,861,7	–	–	–	–	–
Plastic waste	380,0	110,1	–	–	–	–
Wood waste	80,762,3	13,984,1	29,585,2	14,171,7	15,413,5	84,3
Textile waste	221,5	–	7,3	–	7,3	0,1
Animal waste and mixed food waste	5,853,1	–	–	–	–	–
Waste of vegetable origin	32,026,4	331,6	448,3	53,5	394,8	222,8
Household and similar waste	114,261,6	–	0,7	–	0,7	216,738,5

was put into operation at the landfill. The company sorts waste and delivers plastic, glass and other materials for processing. The sorting line has a capacity of 30 thousand tons per year. Today, about 60 % of household waste is sorted.

Municipal Enterprise "Motor Transport Enterprise 0628" of the Zhytomyr City Council informed by letter No. 313 dated July 27, 2021, that the following amount of landfill gas (biogas) was extracted and processed by LNK LLC at the municipal landfill for non-hazardous waste in Zhytomyr.

In May 2021, the construction of a waste treatment plant in Zhytomyr began. The total projected cost of the plant construction is nine million euros.

The technology involves processing rather than incineration of waste. The plant's current capacity is 510 thousand cubic meters per year. The plant will produce recycled materials, compost, and RDF, a fuel that will be an alternative to heat energy for both industrial and domestic needs. According to the Zhytomyr City Council, the construction of a waste treatment plant in Zhytomyr is already nearing completion and is currently in commissioning mode. The project to build a plant with a capacity of about 75 thousand tons of waste per year will use the latest technology for treating household waste. The technology does not emit emissions into the environment and has its own wastewater and sewage treatment system. The processing depth will reach 85–95 %, and the resulting secondary raw materials will be used as an alternative RDF fuel for cement plants or thermal power plants and compost of 11 organic fractions.

All the products will be sold for reuse, which is fully consistent with the concept of a circular economy. The technology ensures sustainable waste management without the formation of landfills and landfills, economic independence of plants, waste management without environmental pollution, the use of existing logistics for collection and transportation, compactness of the plant and a small area for its location. A closed semi-automatic waste management system is envisaged. This includes a facility for processing mixed and pre-sorted municipal waste technology for the production, grinding and packaging of RDF fuel a facility for processing biodegradable waste and producing eco-compost sites for storage of oversized waste.

The first stage of construction will involve waste sorting with the removal and transportation of recyclable materials (paper, cardboard, metal, glass, polymeric materials) to specialized enterprises. Unsorted household waste of organic origin will be shredded and piled in a composting shop, followed by treatment with a special bacterial solution (according to composting technology) to accelerate the composting process. The sorting and compost production shops are designed in one building, which is divided into two parts. The workshops include storage, auxiliary and technical facilities.

Mixed municipal waste is delivered to the plant by truck. To account for the amount of waste, vehicles are weighed on truck scales. The delivered waste is unloaded into a special bunker (receiving chamber). During unloading, the presence of radioactive elements and the content of hazardous gases are monitored. A crane separates non-standard waste (construction, large industrial, tires), which is sent to special boxes for temporary storage.

At the beginning of the sorting line, there is a device for opening bags, boxes, and containers with liquids, where a strong stream of air cleans the waste from dust. Dust and small particles of dirt enter the filtration station, and possible liquids are collected by a pump and pumped to the wastewater treatment system. Further, the partially cleaned and dried waste is transported by conveyor to the roto-sieve device to separate the organic part of the waste. The organic part of the waste enters a container before being crushed by a screw chopper, and the container with the crushed biomass is transported to the compost production facility. The organic-free and dried waste is then manually sorted in a special cabin. A conveyor belt runs in the cabin, and 30 m^3 receiving boxes are placed under the sorting cabin. The sorting cabin is connected to the receiving boxes by means of outlet pipes.

The sorted materials: paper, PET containers, film, cardboard are fed to the chain conveyor system using an automatic feeder, and then, using a lifting conveyor, they are fed to the press, where they are baled into bales suitable for transportation. Glass and glass containers are collected separately, and ferromagnetic metals are separated using a magnetic separator.

The rest of the unsorted waste: shoes, rags, rubber products, leather goods, tetrapak, etc. are treated as fuel. Such residues are sent for shredding and pressing. The resulting bales are RDF fuel. Bales of recyclable materials and RDF fuel are transferred to a warehouse for temporary storage using a forklift. The shredded organic part of the waste separated on the rotary screen is transferred to the composting shop, where it is formed into longitudinal ridges (piles) 2.8 m wide and 1.4 m high on the shop floor. A special machine carries out the process of turning, adding

oxygen and moisture. Additionally, biodegraders such as Trofoyl and Econadin or their analogues are applied to accelerate the stabilization process. It is also possible to use a biodegrader preparation of the “Complexim” type, which is based on bacterial strains of the B. Subtilis species and is approved for use in Ukraine (conclusion of the state sanitary and epidemiological examination No. 05.03.02-04/99106 of 10.10.12).

Constant monitoring and maintenance of the required humidity and temperature ensures optimal aerobic bacteria activity and high compost quality. Technical water is obtained from the wastewater recycling and treatment system. The finished compost is additionally dried and sieved, and then packaged accordingly.

The plant operates 313 days a year, 12 hours a day, in two shifts. The daily volume of household waste treatment is 640 m^3. Approximate morphological composition of household waste (according to the Customer):

wood – 2 %; 2. ferrous metals – 4 %; non-ferrous metals – 0.2 %; bones – 2 %; leather, rubber – 2 %; textiles – 3.8 %; glass breakage – 6 %; polymer – 5 %; PET bottles – 7 %; inert materials – 2 %; fractions smaller than 16 mm – 9 %; other materials – 3 %.

Green Bean Ukraine LLC specializes in the collection of hazardous waste. The company’s production capacity is 599.85 tons of waste per year [11]. Thermal destruction is carried out at the UT 500-D thermal incinerator. Thermal destruction production activities are carried out in non-residential premises with an area of 35,908 m^2, located in the industrial zone of Zhytomyr at 35 Slobidska Street. The operation of the incinerator is automated and controlled by a control panel. The incinerator provides for thermal destruction of the following types of waste:

– bioorganic (animal and bird carcasses, veterinary waste, military waste and veterinary confiscations);

– medical (disposable syringes, expired medicines, including anticancer drugs, pathological and anatomical waste, forensic waste);

– products of oil and oil sludge treatment, industrial and household waste (oily rags, fuel and oil filters, paints, solvents);

– Waste packaging materials and containers, polymeric and wooden structural elements contaminated with unknown or hazardous chemicals for the environment and human health);

– Waste consisting of or containing chemicals that do not meet the specification or are expired;

– synthetic lubricants containing polychlorinated biphenyls (PCBs) [11].

The institutional structure of waste management includes the distribution of competencies, powers, responsibilities and functions of the participants of the waste management system, the principles of their interaction, including information exchange.

The subjects of the waste management system are:

– waste generators (population, organizations, enterprises, institutions, territorial communities);

– entities providing services in the field of waste management;

– state and local authorities that make management decisions and perform control/ supervision functions in the field of waste management;

– other stakeholders, including the public (as a consumer of environmental benefits).

The specifics of the institutional structure for managing specific types of waste are determined by the specifics of the current regulatory framework that defines the competencies, powers, rights and obligations of the system participants at the national, regional and local levels.

At the national level, the competent authorities involved in waste management activities, decision-making and control functions are:

– The Cabinet of Ministers

– Ministry of Environmental Protection and Natural Resources

– Ministry of Community, Territorial and Infrastructure Development of Ukraine

– Ministry of Agrarian Policy of Ukraine.

At the regional level, the competent authorities involved in waste management activities, decision-making and control functions are:

– Zhytomyr Oblast Military Administration;

– State Ecological Inspectorate of Polissia District;

– Main Department of the State Service of Ukraine for Food Safety and Consumer Protection in Zhytomyr Oblast;

– Main Department of the State Emergency Service of Ukraine in Zhytomyr Oblast. Local level:

– Waste management is the responsibility of local governments and territorial communities;

– Local governments;

– The functions of household waste generators (primary) are defined by law.

In particular, owners or lessees, users, including tenants, of sources of household waste generation and land plots shall conclude a contract for the removal of household waste in accordance with the procedure established by law and ensure separate collection of household waste. At the same time, bulky, repair and hazardous waste as part of household waste

should be collected separately from other types of household waste.

Business entities, among other things, are obliged to:

– prevent the generation and reduce the volume of waste generation;

– determine the composition and properties of the generated waste, as well as the degree of hazard of waste to the environment and human health;

– keep primary current records of the amount, type and composition of waste generated, collected, transported, stored, treated, utilized, neutralized and disposed of, and submit statistical reports on them in accordance with the established procedure;

– ensure complete collection, proper storage and prevention of destruction and deterioration of waste, for the treatment of which there is an appropriate technology in Ukraine that meets the requirements of environmental safety;

– prevent mixing of waste, if it is not provided for by the existing technology and complicates waste management or it is not proved that such action meets the requirements for improving environmental safety (Law of Ukraine “On Waste Management”, Articles 17, 29).

In general, household waste management methods in Zhytomyr have the following components:

– mostly landfill disposal of waste, its placement in landfills, most of which do not meet environmental safety requirements;

– low level of technological support;

– inefficient approaches to management decision-making and limited financial resources;

– a small share of implementation of the latest methods and technologies.

Today, the most common method of waste management is to remove it and store it in landfills. In most cases, there is no reasonable treatment, and the various compounds they introduce pollute not only landfills but also the surrounding areas.

Even at officially designated waste disposal sites, including those where passports have been obtained, violations have been identified that pose a risk to the environment and the public.

In 2023, 503 unauthorized landfills were cleared through site inspections. However, these measures alone are not enough to solve the problem on a regional scale. Therefore, the heads of the National Consumer Protection Service called on the heads of local governments to take a more active part in the development of comprehensive plans for the sanitary cleaning of designated areas in settlements with garbage facilities.

As the chart shows, since 2018, there has been a steady upward trend in the amount of household waste. The sharp increase in 2021 is due to an increase in the amount of such waste as (Fig. 1):

– Disposable personal protective equipment (gloves, masks, etc.);

– Antiseptics for hand and surface treatment;

– Increase in polyethylene and plastic due to the implementation of quarantine requirements for food safety.

Unfortunately, not all waste ends up in centralized collection and storage facilities. For

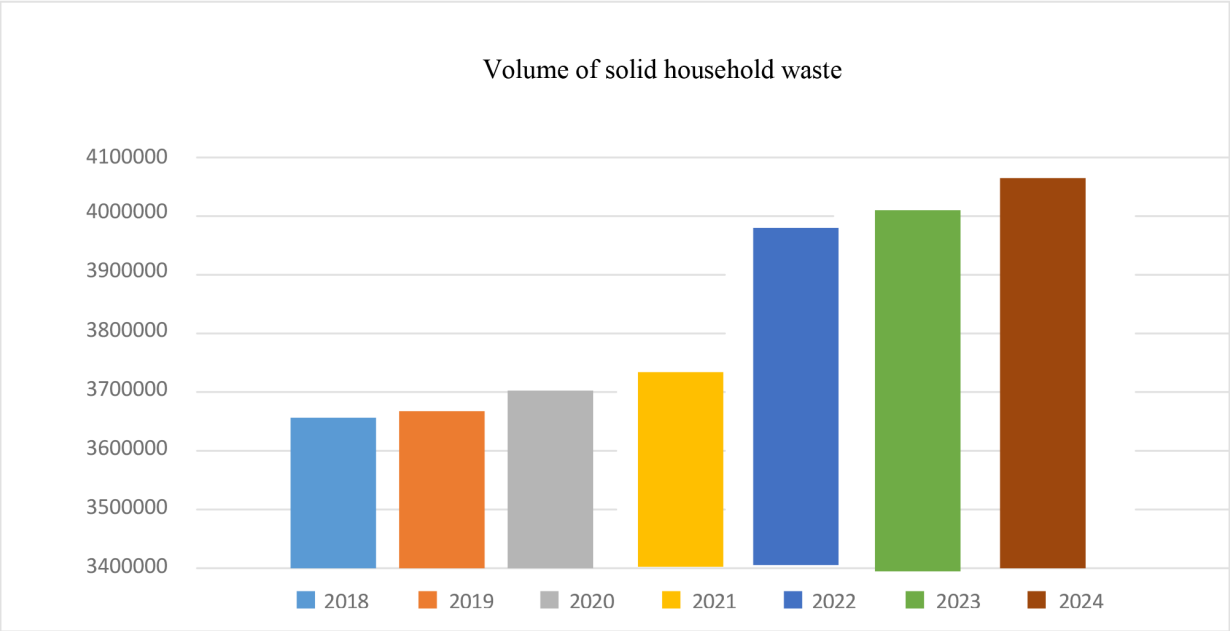

Fig. 1. Dynamics of solid waste generation in the Zhytomyr region from 2018 to 2024

example, in 2019, approximately 4 million tons of solid household waste were generated, of which only 2.8 million were disposed of in special places, and the remaining 1.2 million tons were dumped in unauthorized landfills.

The lack of waste disposal in the region is a very significant problem and requires a quick solution [3]. Thus, over the past 6 years, there has been a steady upward trend in the amount of solid waste in Zhytomyr. As follows from the diagram (Fig. 1), the composition of solid waste in Zhytomyr region is as follows: food waste – 24.8 %; paper – 5.9 %; metal – 2.5 %; plastic packaging – 14.4 %; folding packaging – 2 %; wood – 2.3 %; textiles – 9.7 %; glass – 7.4 %; leather and rubber – 7.2 %; stones – 0.7 %; bones – 0.1 %; screenings – 7.8 %; batteries, solvents – 0.6 %; construction waste – 4.9 %; polyethylene products – 9.7 % [2].

Since the composition of most solid waste contains resource-rich components such as paper, glass, plastic, metal, rubber, etc. that can be used as secondary raw materials. Thus, the largest contribution to the structure of municipal solid waste is made by the following types: food waste, plastic packaging, textiles, and polyethylene products [3]. It should be noted that plastic packaging and polyethylene products are types of waste that are difficult to decompose and can cause significant harm to the environment.

Without recycling, the decomposition cycle of some components is very long, including: 2–10 years for paper, almost 100 years for cans, 200 years for polyethylene materials, 500 years for plastics, and about 1000 years for glass to fully decompose [13]. There are 21 rayons in Zhytomyr Oblast, which vary greatly in terms of population and the amount of solid waste accumulated on the territory. Analyzing the amount of solid waste generated and the population, a close correlation can be traced, which is – 0.94. Thus, in each of the districts, the population plays a decisive role in the accumulation of solid waste.

Accordingly, one of the most effective ways to improve the situation with the amount of solid waste in the districts and in the region as a whole will be to take measures aimed at working with the population. Based on this, it is possible to introduce such recommendations as: 1. actively promote the program of separate collection of solid waste in the city and in the region. Since food waste accounts for a large share of solid waste, it would be advisable to use the possible raw materials for agricultural needs. Conduct a broad awareness-raising policy and improve advertising activities to encourage people to refuse plastic and polyethylene products. Hazardous waste includes waste of hazard classes 1–3. Of the total amount of waste generated, only 9.3 tons were utilized, which is 0.8 %. 0.1 tons were incinerated and energy was generated (Table 3).

Table 3

Hazardous waste management in Zhytomyr

№	Waste management	Amount, tons
1.	Total waste generated	1,153,3
2.	Recycled	9,3
3.	Incinerated	0,1
4.	Energy received	0,1
5.	Removed to special places of permanent storage	–

The structure of hazardous waste is dominated by combustion waste (29.9 %), chemical waste (21.9 %), and used oil (21.2 %). Only 0.6 % of hazardous waste is utilized. These are mainly oils. In addition, 0.1 tons of textile waste is incinerated and 0.1 tons of this waste is used to generate energy.

In the field of hazardous waste management in household waste, it is necessary to ensure

– minimize the generation of hazardous waste in household waste;

– organizing a system of separate collection of hazardous waste as part of household waste for further treatment.

Prevention of hazardous waste generation in household waste is ensured by including relevant issues in the ongoing information campaign.

Targeted creation of facilities focused on the treatment of hazardous waste as part of household waste is not envisaged in the region. All collected hazardous waste will be transferred to specialized organizations for treatment at facilities located outside the region. If there are hazardous waste treatment facilities located in the region to which the collected waste can be transferred, this option may also be possible.

Options for technical solutions to organize the collection of hazardous waste as part of household waste:

– establishment of stationary hazardous waste collection points as part of household waste;

– organization of acceptance of hazardous waste as part of household waste at “mobile acceptance points”.

The National Waste Management Strategy for Ukraine until 2030 stipulates that cities with a population of more than 50,000 people should establish specialized municipal waste collection points focused on the collection of hazardous waste as part of household waste [9]. In Zhytomyr Oblast, only one city, Zhytomyr, meets this criterion.

The approximate number of municipal waste collection points for Vinnytsia is 7 units (1 point per 50 thousand residents). The final decision on the number of municipal waste collection points is made by local governments. In addition, in accordance with clause 11.2.4 of the State Building Code B.2.2-12:2019 “Planning and Development of Territories”, settlements should provide places for the installation of waste collection points for paper, plastic, glass, packaging waste, waste batteries, batteries and accumulators, electrical and electronic equipment and tires.

All responsibility for managing this waste lies with its owners, who are clearly identified. Authorities should ensure that waste owners and organizations engaged in hazardous waste management fulfill their own responsibilities and/or the terms of service contracts related to hazardous waste management.

Hazardous waste management activities of business entities consist of providing information support and organizational assistance to business entities in implementing environmental management systems in accordance with the ISO 14001 standard, “cleaner production methodologies” in the creation and operation of a regional center for the introduction of cleaner production (technologies) to minimize waste generation.

Conclusions. The accumulation of household waste at the Zhytomyr City Landfill in 2018–2024 posed a significant environmental risk that required immediate attention and comprehensive solutions. This period was characterized by an increase in waste volumes, which led to an increase in the negative impact on the environment and public health. The decomposition of organic waste was accompanied by the release of biogas (methane and carbon dioxide), which is a powerful greenhouse gas that contributes to climate change. In addition, spontaneous combustion often occurred at the landfill, leading to emissions of hazardous dioxins, furans, and other toxic substances into the air.

The accumulation of waste and its negative impact on the ecosystems around the landfill led to the degradation of natural landscapes, the destruction of animal and plant habitats, and a decrease in biodiversity.

In order to minimize these risks and improve the environmental situation in Zhytomyr and its surroundings, it was necessary to take a number of urgent measures in the period 2018–2024, and even more so now: introduction of modern waste treatment technologies; reclamation of existing landfills; reduction of waste generation; attraction of investments and cooperation with international organizations; environmental monitoring.

To summarize, the problem of household waste accumulation at Zhytomyr landfill in 2018–2024 has revealed an urgent need to implement systematic and comprehensive waste management solutions. Inaction in this regard will lead to further deterioration of the environmental situation.

BIBLIOGRAPHY:

1. Білявський О. О. Проблеми утилізації твердих відходів в Україні та шляхи їх вирішення. *Стратегія економічного розвитку України*. 2023. 52. 72–83. https://doi.org/10.33111/sedu.2023.52.072.083

2. Демчук Л., Нонік Л. Актуальність впливу хімічних речовин та відходів на довкілля. Сталий розвиток – стан та перспективи. IV Міжнародний науковий симпозіум в рамках Erasmus+ Модуль Жана Моне «Концепція екосистемних послуг: європейський досвід» («EE4CES»). Львів – Славське, 2024. С. 13–16.

3. Логістичні процеси утилізації відходів / Л. Демчук та ін. *Екологічні проблеми*. 2025. № 10(1). С. 13–19.

4. Директива N 2008/98/ЕС Європейського Парламенту та Ради від 19 листопада 2008 року про відходи та скасування деяких директив. URL: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32008L0098

5. Горностай О., Станіславчук О. Оцінка професійних ризиків працівників полігону твердих відходів. *Бюлетень Львівського державного університету безпеки життя*. 2023. № 27. С. 77–85. https://doi.org/https://doi.org/10.32447/20784643.27.2023.09

6. Кім Н.-Дж., Чун С.-К. Вплив фільтрату та впорскування органічних стічних вод на характеристики розкладання відходів на звалищі. *Журнал Корейського товариства з управління відходами*. 2012. № 29(8).С. 697–704. https://doi.org/10.9786/kswm.2012.29.8.697

7. Korbut M., Safronov T., Malovany M. Методологічні підходи до оцінки екологічних ризиків від звалищ твердих відходів. *Вісник Хмельницького національного університету. Технічні науки*. 2024. № 337(3(2)). С. 187–196. https://doi.org/10.31891/2307-5732-2024-337-3-28

8. Корбут М. Б. Забезпечення екологічної безпеки звалищ твердих побутових відходів (анотація до кандидатської дисертації). Кременчук, 2015. 5 с.

9. Корбут М. Б., Маловани М. С. Визначення забруднення атмосферного повітря в зоні впливу полігону ТПВ м. Житомир за допомогою ліхеноїндикації. *Чисте місто. Чиста річка. Чиста планета : збірник матеріалів 5-го Міжнародного екологічного форуму*. Херсон : ХТПП, 2013. С. 113–117.

10. Лунова О. В. Визначення параметрів безпечного використання твердих побутових відходів. (реферат дисертації на здобуття наукового ступеня доктора філософії). Донецьк, 2010. С. 1–5.

11. Моніторинг впливу сміттєзвалищ на атмосферне повітря з використанням методів біоіндикації на прикладі Житомирського сміттєзвалища (Україна) / М. Маловани та ін. *Журнал екологічної інженерії*. 2021. № 22(6). С. 36–49.

12. Національна стратегія управління відходами в Україні до 2030 року, затверджена Постановою Кабінету Міністрів України від 8 листопада 2017 року № 820-р. URL: htpp://zakon.rada.gov.ua/laws/show/820-2017-р

13. Рибалова О., Артем'єв С., Бригадія Е. Оцінка ризиків забруднення ґрунтів на полігонах твердих відходів. *Вісник Харківського національного університету імені В. Н. Каразіна, Серія «Геологія. Географія. Екологія»*. 2024. № 60. С. 399–413. https://doi.org/10.26565/2410-7360- 2024-60-30

14. Сталінська І. В. Особливості екологічної безпеки в системі «тверді побутові відходи – навколишнє середовище – здоров'я людини». *Науковий вісник Національного лісотехнічного університету України*. Львів, 2016. С. 238–245.

15. Сталінська І. В. Зниження екологічного ризику полігонів твердих відходів. *Науково-практичний журнал «Екологічні науки»*. 2022. С. 185–189.

REFERENCES:

1. Biliavskyi, O. O. (2023). Problemy utylizatsii tverdykh vidkhodiv v Ukraini ta shliakhy yikh vyrishennia [Problems of solid waste disposal in Ukraine and ways to solve them]. Stratehiia ekonomichnoho rozvytku Ukrainy, 52, 72–83. https://doi.org/10.33111/sedu.2023.52.072.083

2. Demchuk, L., & Nonik, L. (2024). Aktualnist vplyvu khimichnykh rechovyn i vidkhodiv na dovkillia [Relevance of the impact of chemicals and waste on the environment]. Stalyi rozvytok – stan ta perspektyvy. IV mizhnarodnyi naukovyi sympozium v ramkakh Erasmus+ Modul Zhana Mone "Kontseptsiia ekosystemnykh posluh: yevropeiskyi dosvid" ("EE4CES") [Sustainable development – state and prospects. IV International Scientific Symposium within the Erasmus+ Jean Monnet Module "Ecosystem Services Concept: European Experience" ("EE4CES")]. Lviv – Slavske, Ukraine.

3. Demchuk, L., Patseva, I., Nonik, L., & Voinakovych, I. (2025). Lohistychni protsesy utylizatsii vidkhodiv [Logistical processes of waste disposal]. Zhurnal "Ekolohichni problem", 10(1), 13–19.

4. Dyrektyva N 2008/98/EC Yevropeiskoho Parlamentu ta Rady vid 19 lystopada 2008 roku pro vidkhody ta skasuvannia deiakykh dyrektyv [Directive N 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain Directives]. (n.d.). Retrieved from https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32008L0098

5. Hornostai, O., & Stanislavchuk, O. (2023). Otsinka profesiinykh ryzykiv pratsivnykiv polihonu tverdykh vidkhodiv [Assessment of professional risks of solid waste landfill workers]. Biulleten Lvivskoho derzhavnoho universytetu bezpeky zhyttia, 27, 77–85. https://doi.org/https://doi.org/10.32447/20784643.27.2023.09

6. Kim, N.-J., & Chun, S.-K. (2012). Vplyv filtratu ta vporoskuvannia orhanichnykh stichnykh vod na kharakterystyky rozkladannia vidkhodiv na zvalyshchi [Effect of leachate and organic wastewater injection on landfill waste decomposition characteristics]. Zhurnal Koreiskoho tovarystva z upravlinnia vidkhodamy, 29(8), 697–704. https://doi.org/10.9786/kswm.2012.29.8.697

7. Korbut, M., Safronov, T., & Malovany, M. (2024). Metodolohichni pidkhody do otsinky ekolohichnykh ryzykiv vid zvalyshch tverdykh vidkhodiv [Methodological approaches to assessing environmental risks from solid waste landfills]. Visnyk Khmelnytskoho natsionalnoho universytetu. Tekhnichni nauky, 337(3(2)), 187–196. https://doi.org/10.31891/2307-5732-2024-337-3-28

8. Korbut, M. B. (2015). Zabezpechennia ekolohichnoi bezpeky zvalyshch tverdykh pobutovykh vidkhodiv [Ensuring environmental safety of solid household waste landfills] (Ph.D. dissertation abstract). Kremenchuk, Ukraine.

9. Korbut, M. B., & Malovany, M. S. (2013). Vyznachennia zabrudnennia atmosfernoho povitria v zoni vplyvu polihonu TPV m. Zhytomyr za dopomohoiu likhenoindykatsii [Determination of atmospheric air pollution in the impact zone of the Zhytomyr solid waste landfill using lichen indication]. In Chyste misto. Chysta richka. Chysta planeta: zbirnyk materialiv 5-ho Mizhnarodnoho ekolohichnoho forumu (pp. 113–117). Kherson: KhTPP.

10. Lunova, O. V. (2010). Vyznachennia parametriv bezpechnoho vykorystannia tverdykh pobutovykh vidkhodiv [Determination of parameters for safe use of solid household waste] (Ph.D. dissertation abstract). Donetsk, Ukraine.

11. Malovany, M., Korbut, M., Davydova, I., & Tymchuk, I. (2021). Monitorynh vplyvu smittiezvalyshch na atmosferne povitria z vykorystanniam metodiv bioindykatsii na prykladi Zhytomyrskoho smittiezvalyshcha,

Ukraina [Monitoring the impact of landfills on atmospheric air using bioindication methods on the example of the Zhytomyr landfill, Ukraine]. Zhurnal ekolohichnoi inzhenerii, 22(6), 36–49.

12. Natsionalna stratehiia upravlinnia vidkhodamy v Ukraini do 2030 roku, zatverdzhena Postanovoiu Kabinetu Ministriv Ukrainy vid 8 lystopada 2017 roku № 820-r [National waste management strategy in Ukraine until 2030, approved by the Resolution of the Cabinet of Ministers of Ukraine of November 8, 2017 No. 820-r]. (n.d.). Retrieved from zakon.rada.gov.ua/laws/show/820-2017-p

13. Ribalova, O., Artemiev, S., & Bryhadia, E. (2024). Otsinka ryzykiv zabrudnennia gruntiv na polihonakh tverdykh vidkhodiv [Assessment of soil contamination risks at solid waste landfills]. Visnyk Kharkivskoho natsionalnoho universytetu imeni V.N. Karazina, Seriia “Heolohiia. Heohrafiia. Ekolohiia”, 60, 399–413. https://doi.org/10.26565/2410-7360-2024-60-30

14. Stalinska, I. V. (2016). Osoblyvosti ekolohichnoi bezpeky v systemi “tverdi pobutovi vidkhody – navkolyshnie seredovyshche – zdorovia liudyny” [Features of ecological safety in the system “solid household waste – environment – human health”]. Naukovyi visnyk Natsionalnoho lisotekhnichnoho universytetu Ukrainy. Lviv, Ukraine, 238–245.

15. Stalinska, I. V. (2022). Znyzhennia ekolohichnoho ryzyku polihoniv tverdykh vidkhodiv [Reducing the environmental risk of solid waste landfills]. Naukovo-praktychnyi zhurnal “Ekolohichni nauky”, 185–189.