American Journal of Medicine and Medical Sciences 2026, 16(5): 2341-2347
DOI: 10.5923/j.ajmms.20261605.23

Epidemiological and Hygienic Safety Evaluation Techniques for Municipal Solid Waste Landfills

Aziz Iskandarov[1], Mirzoxid Safarov[2,*]

[1]Central Asian Medical University, Professor of the Department of Hygiene and Medical Modeling, Uzbekistan
[2]Department of Communal Hygiene and Occupational Health, Tashkent State Medical University, Tashkent, Republic of Uzbekistan

Abstract Municipal solid waste landfills represent a significant public health concern due to their potential impact on human well-being and the spread of infectious diseases. This article examines epidemiological and hygienic safety evaluation techniques used to assess health risks associated with municipal solid waste landfills. The study focuses on identifying biological, chemical, and physical hazards that may arise from improper waste management practices, including the spread of pathogenic microorganisms, air and water contamination, and vector-borne diseases. The research explores modern methodological approaches used in sanitary and epidemiological monitoring, such as environmental sampling, microbiological analysis, risk assessment models, and health surveillance systems. Particular attention is given to the role of hygiene standards, waste decomposition processes, and landfill site management in reducing public health risks. The findings indicate that effective evaluation techniques play a crucial role in early detection of health hazards and prevention of disease outbreaks in populations living near landfill sites. The study also highlights the importance of integrated public health strategies, regular monitoring, and compliance with sanitary regulations to ensure the safety of municipal solid waste disposal systems. Overall, the application of epidemiological and hygienic assessment methods contributes to improving public health protection, minimizing exposure risks, and supporting sustainable waste management practices.

Keywords Landfills, Environmental monitoring, Inspection methods, Drone technology, Ground-penetrating radar, Sensor systems, Waste management, Laboratory analysis, Environmental protection, Automated control

1. Introduction

In the second half of the 20th century, humanity faced global environmental problems, one of which was the massive generation of production and consumer waste, which led to an increase in hazardous landfills. This problem is especially evident on the example of the Moscow region, where 20% of the waste of the entire country is buried, including a large part of the waste - 7.92 million tons of waste, this amount corresponds to the amount of waste that will settle from the city of Moscow, and 3.8 million tons will be allocated from the region itself [1,2,3,4,5].

According to the non-comforting statistics provided by the Ministry of natural resources of the Russian Federation: 400 kg of different waste per person of the country's population corresponds. However, foreign experience shows that waste can be successfully converted into income. It is for this reason that many foreign countries have chosen the separate collection and recycling of waste as a priority in the system for the implementation of waste-related work. Obviously, during the recycling process, the levels of water and air pollution decrease, and the volume of waste sent to landfills decreases significantly [6,7,8,9,10].

In general, due to secondary processing, valuable natural resources are saved, which is impossible when burning waste. In some countries (Denmark, Japan, Sweden, Belgium, Austria, etc.), the volume of recycling reaches 50 or more percent and is constantly growing. Germany is the leader in household waste recycling in Europe, where 66% of waste is recycled [11,12,13,14,15].

The goal is to know the composition of the solid waste landfill for the development of pollution control technology. Such information should include information about the morphological composition of waste, the chemical and biological composition of wastewater, emissions that fall into the composition of atmospheric air. To obtain this data, the exhaust and filtrate were analyzed, the sampling points are shown in the figure.

The research used a systematic approach of study, including mathematical modeling and sanitary and microbiological analysis. The research was carried out at the Tashkent municipal solid waste landfill. Studies of the morphological composition of solid waste are usually based on the selection of several representative samples, manual sorting by components, followed by weighting and calculating the percentage of

* Corresponding author:
mirzohidsafarov729@gmail.com (Mirzoxid Safarov)
Received: Apr. 20, 2026; Accepted: May 9, 2026; Published: May 12, 2026
Published online at http://journal.sapub.org/ajmms

each component in the total mass of waste. When conducting studies of the morphological composition of solid waste before the start of field work, the list of components, the accuracy and error of measurements, the sampling location, the stratification of waste sources, time indicators, the minimum mass of the sample, the total number of samples, the requirements for devices and methods for obtaining and processing primary data are determined.

2. Materials and Methods

Basic material statement. 1. Sampling. For further research, waste samples were carried out in a classical method. 1000 g of waste was examined to determine the morphological composition of the waste. The average annual results of the study of the fractional composition of waste are presented in Table 1.

Figure 1

Table 1. Image-sampling points in landfills, waste yard and drainage tanks. Fractional composition of waste

№	Fraction name	Quantity, %
1	Food waste	40
2	Paper	30
3	Wood	5
4	Metal	2
5	Plastic	7
6	Textile	10
7	Glass	6

For chemical and biological research, large items were selected from crushed solid household waste, including paper, rags, and bones without signs of fecal contamination. Samples of 200 g were taken for research from the remaining waste mass from the mixture. A sample of untreated solid household waste was placed in a cuvette with 1.5 liter of water. Rough surface and extremely polluted objects were washed with a brush in this water, which were also discarded. Poured into a 3-liter jar with a wide throat and a smoothed stopper. Jars with washing water were shaken for 15 -20 minutes and left for 1 hour to infuse. Then the top layer of liquid was poured out, and in this everything that came up against the surface of the water was removed. The liquid residue was poured into large centrifuge test tubes. The test tubes were rotated in a centrifuge at 600 RPM for 5 minutes; the water in the test tubes was drained, and the solid residues were treated like soil to detect helminthes eggs. Point samples of sand were sampled from the soil layer around the landfill in the envelope and diagonal methods. To do this, a total of 200 grams – 1 kg of samples were taken in the envelope method on a test site consisting of one or more layers or horizons and sent to the laboratory with an observation letter. Point samples were taken with a spatula. The combined sample was made by mixing point samples from a single test site.

The combined sample for chemical analysis was formed from ten-point samples from a single test site. The mass of the combined sample is 1 kg. In order to control the contamination of sand with substances that spread on the surface (petroleum products, heavy metals, etc.), point sand samples with a mass of 200 g each were taken for each layer from a depth of 5 and 20 cm. When obtaining point samples and composing a combined sample, the possibility of their secondary contamination was excluded. Point sand samples intended for the detection of heavy metals were obtained with a non-metallic instrument in the composition. The wall of the excavated site was cleaned with a knife before point samples were taken. Point sand samples designed to detect volatile chemicals were immediately placed in glass containers with stoppers and, filled to top of the stopper.

For bacteriological and helminthological analysis, 10 combined samples were taken from one test site. Each combined sample consisted of a three-point sample with a mass of 200 g each from a depth of 5 and 20 cm taken layer by layer. Sand samples intended for bacteriological analysis were taken in compliance with the conditions of asepsis in order to prevent their secondary contamination. Water sampling the rules of civil engineering 2.04.02-2019 "Water supply. External networks and facilities" were implemented in accordance with the requirements. Containers intended for sampling and storage were washed with a 1:1 solution of hydrochloric acid, and then with distilled water. In the water sample, the auxiliary bathometer is immersed to a depth of 1-2 m, and the auxiliary one is immersed to a depth of 0.3-0.5 m.

Samples of water from the well were poured into glass jars with stoppers. The total volume of the water sample was 6 liters. Part of the sample with a volume of 2 liters, designed to perform a general chemical analysis, was taken without preservatives. The rest of the resulting sample was poured into five containers, each of which was pre-preserved. For the preservation of iron, a buffer solution of sodium acetate and acetic acid was used, sodium hydroxide for phenols, a solution of carbon tetrachloride for petroleum products, and a solution of cadmium acetate for hydrogen sulfide. The volume of the container with the hydrogen sulfide preservative was 250 ml, and the volume of the container with the preservatives of the other components indicated was 500 ml. Samples for microbiological analysis were taken according to the method, which has sterile containers, tightly closing plugs and a protective cap made of thick paper.

The containers were previously sterilized using dry heat or an autoclave.

Sterile containers were opened directly before sampling, the stopper was removed along with the sterile lid, in which the stopper was not allowed to touch the edges of the container. After filling, the container was closed with a sterile stopper and a sterile lid. When filling the containers, a gap was left between the stopper and the water surface so that the stopper did not get wet during the transportation of samples. Water samples were taken from a depth of 10-15 cm from the surface of the water. Subsoil samples were taken at a distance of 30-50 cm from the bottom. Samples were taken using inflatable floats. Samples from the surface layer of water were taken with a bathometer with a sterile container fastening device. Depth samples were taken with a special bathometer designed for these purposes. After each sample was taken, the bathometer was sterilized by flaming. From one point, first microbiological and then helminthological samples were taken. The total volume of samples was-1.5 liters.

2. Biological analysis. Total number of microbes. The total number of microorganisms includes hemophilic aerobes and facultative anaerobes, which can form visible colonies on thin Agar at 37 ℃ for 24 hours and at 22 ℃ for 72 hours when enlarged by 2 times. To determine the total number of microbes, the samples obtained were carefully mixed and diluted with distilled water in a ratio of 1:10.1:100, 1:1000. Then 1 ml of each diluted water was dripped into petri dishes with the meat peptone agar and incubated in a thermostat at 37 ℃ for 24 hours. The number of colonies grown in meat-peptone Agar was increased to the water dilution factor. The results of determining the total microbe number of the filtrate are shown in Table 2. The composition of the bacteria of the intestinal rod-shaped bacteria was studied according to the method of membrane filtration. Water samples were planted in a glucosapentonic environment. The plantings were incubated at 43 ℃ for 24 hours. The specimens were then replanted into an Endo environment. The planting material was taken with such an account and incubated at a temperature of 37 ℃ for 24 hours. When metallic shiny purplish colonies were grown in the Endo environment, it was confirmed that they belonged to intestinal rod-shaped bacteria. The Gram method is done by micros coping the stained samples and performing an oxidase test.

The presence of Gram-negative rods that do not form small spores in the sample and the negative oxidase test made it possible to conclude that the sample of water being analyzed contained an intestinal rod-shaped bacteria.

Table 2. Total microbial count of the filtrate

Sampling site	1	2	3	4
Indicator mark, colony / l	$5{,}2 \cdot 10^5$	$6{,}1 \cdot 10^5$	$6{,}0 \cdot 10^6$	$6{,}8 \cdot 10^4$

The oxidase fracture was performed as follows: 2-3 isolated colonies grown in an Endo environment were taken with a inoculating loop and rubbed with a bar on filter paper moistened with the corresponding reagent. In the case of a negative reaction to the oxidase test, the filter paper does not change color for 1-2 minutes after applying the bacterial mass. In an active reaction to oxidase, the filter paper will turn blue within 1-2 minutes. Determination of rod-shaped (MPN) was achieved by determining the minimum amount of water in which a single intestinal Rod is located. Microbiological indicators of waste prepared in sampling were carried out in the same way by studying the waters of the wash. Microorganism's r. Salmonella was studied by the method of identification.

To identify Salmonella, the specimen was planted in two clumping environments, the selenite broth and the Müller -Kaufman environments. For the quantitative determination of salmonella, their concentration was determined by adding appropriate samples and solutions and planting in a magnesium medium with titration in three parallel rows of 100 to 1 ml of ten-time dilutions. Plantings in gathering environments were incubated at 37 ℃ for 18-20 hours. When turbidity was detected, bismuth-sulfite Agar with bacteriological crust was planted in two bowls. Separation was carried out as one of the methods of obtaining isolated colonies.

Petri dishes were incubated at a temperature of 37 ℃ for 18-20 hours. When suspicious colonies were discovered on salmonella, colonies separated from each dish by 4-5 were taken for planting in test tubes with a combined environment to determine their biochemical characteristics confirming belonging to the Salmonella generation. p. Staphylococcus microorganisms were detected using a microscopic method. To do this, the water sample being examined was passed through 3 filters to obtain isolated colonies. The filters were placed in yellow-salt Agar and incubated for 24 hours at a temperature of 37 ℃. The shiny convex was considered colonies of white, yellowish, golden color, with a rainbow-colored, pearl-like shiny zone. To confirm the affiliation of such bacteria to Staphylococcus aureus, the suspicious colonies were replanted with yellow salt Agar planks, examined microscopically, found plasma coagulase activity.

In the presence and plasma coagulation of tiny gram-negative cocci, located in the form of shingles, their amount was divided by filters taken into account by the volume of filtered water and multiplied by 100. In water, clostridiums were identified in the context of the use of these indicators to assess the effectiveness of drinking water purification at the stages of technological processes. Spores of sulfite reducing clostridians are more resistant to the action of detoxifying agents than vegetative cells of bacteria, as well as unfavorable factors affecting microorganisms in water bodies of water. The presence of Clostridia indicates that it has been contaminated with feces for a long time.

Sulfite reducing was determined by direct sowing of spores of clostridia's according to the microscopic method. To do this, the plantings were placed in sterile test tubes and iron-sulfite agar poured high along the test wall to prevent air from entering. Immediately after filling the test tubes were lowered into a container of cold water to create anaerobic conditions in the agar layer. After hardening, the plantings were incubated at a temperature of 44 ℃, after 24 hours the results were calculated. Examination of the sand into helminthes eggs was carried out according to the method of microscopic analysis. The soil was placed in centrifuge test

tubes and a 3% solution of sodium hydroxide was poured over it. After centrifugation, a solution of sodium nitrate was added to the liquid above the precipitate. They are examined under microscope at 80 times magnification, and at 400 times magnification for their degree of development or deformation.

The helminthological examination of water was carried out according to the microscopic method. To do this, aluminum sulfate was added to each wastewater sample as a coagulant. The mixture was mixed and centrifuged, the liquid was drained and the sediment was processed according to Romanenko's method to study the soil. The method of helminthological study of wastewater sediments and bottom sediments was carried out. To do this, the washed sediment was examined in the Romanenko method to examine the soil for helminth eggs.

3. Chemical analysis. The measurement of the concentration of sodium, potassium, lithium and Strontium was carried out in an emission flame photometric method. Before making measurements, wastewater samples with a pH below 2 were filtered through a paper filter. To determine the amount of sodium and potassium, a solution of cesium salt (spectroscopic buffer) and distilled water were added to the filtered water sample. The results of determining the concentration of sodium and potassium in the filtrate are presented in table 3.

A mixture of cesium chloride and aluminum nitrate (spectroscopic buffer) was added to the sample being analyzed for lithium detection. A solution of lanthanum chloride (spectroscopic buffer) was added to the sample being analyzed for strontium detection. When processing the results of measuring the amount of sodium, potassium, lithium and strontium in the analyzed water, the dilution of the sample was taken into account and the amount of metal in the sample was calculated. To determine calcium by the titrimetric method, distilled water, sodium hydroxide solution, murex ide indicator were added to the water being tested and titrated with triton B solution until the color changed from dirty green to blue. The results of determining the amount of calcium in the water of wells are presented in Table 4.

Beryllium, vanadium, bismuth, cadmium, cobalt, copper, molybdenum, arsenic, nickel, tin, lead, selenium, silver, antimony, chromium, iron, manganese, zinc were determined by the flame atom-adsorption method.

Table 3. Potassium and sodium content in the filtrate

Sampling site	the permitted amount, mg/l	1	2	3	4	5
Concentration, mg/l	200	3200,5	311,2	528,0	40,7	299,8

Table 4. Calcium content in the drilled well

Sampling site	the permitted amount, mg/l	1	3	5
Concentration, mg/l	140	358,9	325,4	128,0

Table 5. The amount of cadmium in the water content in the drainage tank

Sampling site	the permitted amount, mg/l	1	2	3
Concentration, mg/l	0,001	0,004	0,005	0,0060

Table 6. Aluminum content in drilled well water

Sampling site	the permitted amount, mg/l	1	2	3	4
Concentration, mg/l	0,5	0,72	0,78	1,71	0,68

Table 7. Mercury content in drilled well water

Sampling site	the permitted amount, mg/l	1	2	3
Concentration, mg/l	0,001	0,00	0,0009	0,008

Table 8. The amount of chlorides in the drainage water

Sampling site	the permitted amount, mg/l	1	2	3	4
Concentration, mg/l	350,0	4150,1	4459,9	4480,1	4481,2

Table 9. Fluoride content in drilled well water

Sampling site	the permitted amount, mg/l	1	2	3	4
Concentration, mg/l	1,5	4,19	3,9	4,75	5,9

Table 10. The amount of phosphates in the drainage water

Sampling site	the permitted amount, mg/l	1	2
Concentration, mg/l	3,5	4,77	4,55

Table 11. The amount of rhodanides in the drainage water

Sampling site	the permitted amount, mg/l	1	2	3
Concentration, mg/l	0,1	7,17	7,45	7,22

Table 12. The amount of phenols in drilled well water

Sampling site	the permitted amount, mg/l	1	2	3	4
Concentration, mg/l	0,1	729,9	34,37	699,11	30,0

Table 13. The results of determining the demand of water for oxygen in the drainage water

Sampling site	the permitted amount, mg/l	1	2	3	4
Concentration, mg/l	15,0	42,8	34,4	32,5	39,1

Table 14. The amount of petroleum products contained in the drainage water

Sampling site	the permitted amount, mg/l	1	2	3	4
Concentration, mg/l	0,3	0,65	0,55	0,51	0,64

To do this, a sample of filtered water delivered to pH=3 was sprayed in a Bunsen burner flame and the absorption of the element was recorded at the required wavelength. The results of determining the amount of cadmium in the water of the clarifier are presented in Table 5.

The concentration of aluminum was determined by a photometric method. To do this, a solution of ammonium sulfate, an acetate buffer, ascorbic acid and aluminum were added to the neutralized solution. The optical density of the solution was determined at a wavelength of λ = 525-540 nm. The results of determining the amount of aluminum in well water are presented in Table 6.

The mercury content was determined by the method of atomic absorption in cold steam. To do this, the prepared water was blown with nitrogen and an absorbent solution was added, then a solution of tin (II) chloride was added and Mercury was blown. Distilled water was then added. The resulting solution was introduced into the reaction vessel of the instrument, and measurements were made by adding a solution of tin chloride. The results of determining the amount of mercury in well water are presented in Table 7.

Sulfates were detected titrimetrically. To do this, ethyl alcohol and a ditizon indicator were added to the flask until a blue-green solution was formed with filtered cationite and the water being analyzed. The sample was then titrated with a solution of lead nitrate until it turned red-purple.

The concentration of chloride ions was determined by a mercurimetric method. To do this, the processed and filtered water to determine the yield was transferred to a conical flask for titration, distilled water was added to it and mixed with an indicator. After that, a solution of sodium hydroxide was dripped until the yellow turned blue, then a solution of nitric acid was dripped until the solution turned yellow, and a solution of nitric acid until pH=2.5. The resulting solution was titrated with a solution of mercury nitrate until it was colored purple. The amount of chlorides in the detection results is given in Table 8.

Fluorides were detected photocolorimetrically. To do this, alizarin-complexone solution, buffer solution, lanthanum nitrate and distilled water were added to the sample of water being examined. The resulting solution was placed in a dark place after thorough mixing, and then the optical density was measured at a wavelength of λ=610-620 nm. The data is given in Table 9 of the fluoride content in the water of wells.

Phosphates were detected photometrically. To do this, solutions of dilute sulfuric acid, ammonium molybdate, ascorbic acid, potassium antimony tartrate and sulfamic acid were added to the water being filtered on the day the sample was taken. Then, after a short time, a solution of ascorbic acid is added again. The optical density was measured at a wavelength of λ=880 nm. The relevant data on the amount of phosphates in the drainage water is presented in Table 10.

Rhodanide concentration was determined photometrically. To do this, a zinc chloride solution and distilled water were added to the sample being analyzed, the resulting solution was mixed, and then solutions of hydrochloric acid and ferrous chloride were poured. The optical density of the solution was measured at a wavelength of λ=480 nm. The amount of rhodanides in drainage water is given in Table 11.

Phenols were identified by the gas chromatography method. To do this, water being analyzed was placed in a container intended for gas extraction and washed off with diethyl ether. The ether fraction was analyzed in the chromatograph "Chromium 5".

The determination of the chemical consumption of oxygen was carried out in a titrimetric way. To do this, Solutions of potassium dichromate, silver sulfate and concentrated sulfuric acid were added to the studied water sample, after which a ferroin solution was added to the mixture. With a solution of excess potassium dichromate mor salt, which did not react, the indicator color was titrated until it switched from blue-green to red-brown. The results of determining the chemical consumption of oxygen in drainage water are presented in Table 13.

The concentration of petroleum products was determined by the method of UV-spectrometry. To do this, the wastewater sample was sanded and sodium chloride was added. It was then extracted with four chlorinated carbon. The extract was

dried, the optical density measured at a wave number of 2926 cm1. The concentrations of petroleum products in drainage water are listed in Table 14.

3. Results and Discussion

The first turn of the Akhangaran landfill, where solid household waste is disposed of, does not fully comply with the requirements of the landfill, it can be called more wasteland. But its second turn, built in 2024, fully complies with the requirements of the landfill. The total land area of the landfill was 59 hectares, of which 40 hectares were allocated of land for buildings and structures.

The municipal capacity of the landfill is designed to receive 800,000 tons of domestic waste per year, receiving an average of 2,200-2,500 tons of domestic waste in one day by alternative companies from Tashkent city and Tashkent region.

A checkpoint has been established at the entrance to the city central landfill. Roads are paved for access roads to the landfill hall and for the disposal of special cars.

The landfill employs a total of 42 staff, all with special work clothing. There are locker rooms, dining rooms and rest rooms for workers and staff. A shower was set up for bathing. There is a single-seat enclosure. The water supply is decentralized, technical water is used. Drinking water is brought and used. There is no sewer network.

The number of cars and mechanisms in the landfill is 35, of which there are 8 bulldozers, 7 loaders, 4 excavators, 2 compactor special mechanisms and 14 dump trucks, all of which are in a state of good working condition.

Currently, a new solid waste storage landfill is being set up on the basis of mud on 32 hectares of land. On the basis of the settlement, the construction of new administrative and domestic buildings is envisaged.

To carry out preventive disinfection, disinfection and deratization work, the "Maxsustrans production management" State Unitary Enterprise concluded contract No. 1 with the Akhangaran district disinfection station of the Tashkent region on March 01, 2023.

The findings of this study highlight the significant environmental and sanitary-hygienic risks associated with the operation of solid household waste landfills. The results confirm that improper management of waste disposal sites can lead to large-scale contamination of soil, surface water, and groundwater with heavy metals, petroleum products, phenols, phosphates, and pathogenic microorganisms.

A comparative analysis shows that the first section of the Akhangaran landfill does not fully comply with modern sanitary standards and can only partially perform the functions of a regulated waste disposal site. In contrast, the second section, constructed in 2024, was organized in accordance with established landfill requirements and demonstrates a higher level of environmental safety. This difference illustrates the importance of engineering design, construction quality, and regulatory oversight in reducing ecological and health risks.

The chemical analysis data indicate that several indicators in water and soil samples (e.g., cadmium, chlorides, phenols, petroleum products, fluorides) exceeded the maximum permissible concentrations. Such excesses create long-term threats, particularly with regard to groundwater contamination, which directly affects drinking water quality. Biologically, the presence of intestinal bacteria, Salmonella, Staphylococcus aureus, and helminth eggs confirms the microbiological hazard of landfill filtrates, which can become a factor in the spread of infectious diseases.

When compared with international experience, it becomes evident that the adoption of modern waste management methods—such as waste segregation, recycling, energy recovery, and sensor-based monitoring—could substantially mitigate these risks. Countries such as Germany, Sweden, and Japan have demonstrated that integrating recycling into the waste management system significantly reduces the burden on landfills and lowers the level of chemical and microbiological contamination.

Thus, the research emphasizes the need for:

1. Modernization of landfill infrastructure in accordance with international sanitary requirements.
2. Introduction of automated monitoring technologies, including sensors for detecting chemical and microbiological pollution.
3. Expansion of recycling and waste separation practices to reduce the overall volume of landfill waste.
4. Implementation of strict sanitary control measures, including disinfection, pest control, and continuous environmental monitoring.

Overall, the study provides a comprehensive picture of the risks posed by landfills and offers a scientific foundation for developing preventive and remedial measures aimed at improving environmental safety and public health protection.

4. Conclusions

The studies carried out made it possible to obtain a complete picture of the chemical and biological contamination of the solid waste landfill. Waste landfills can become the main source of chemical and microbiological pollution of the environment. Chemical pollution falls on soil and water resources through harmful chemicals in landfills, industrial waste and radioactive elements. These substances adversely affect the ecological system, endangering the health of humans and animals. Microbiological contamination, on the other hand, is due to the proliferation of microorganisms and causing infections in the process of waste decomposition. This condition can contaminate all environmental factors, water, soil, atmospheric air and, through it, have its harmful effects on the population and animal world. Therefore, proper planning of landfills, focusing on its proper use makes it possible to reduce the incidence associated with it and improve the environmental and sanitary-hygienic conditions of the area.

REFERENCES

[1] Ustavich, G. A., et al. Zoning and land surveying of territories adjacent to nuclear test sites for their economic use (on the example of the Semipalatinsk Nuclear Test Site). *Bulletin of the Siberian State University of Geosystems and Technologies*, 2016, No. 4 (36), pp. 145–160.

[2] Korenkov, I. P., Lashchenova, T. N., & Shandala, N. K. Justification of a комплекс of radiation-hygienic approaches to the management of very low-level radioactive waste. *Hygiene and Sanitation*, 2015, Vol. 94, No. 1, pp. 21–27.

[3] Andrishunas, A. M., Maksimova, E. V., & May, I. V. On the issue of revising sanitary regulations for the design and maintenance of municipal solid waste landfills. *Fundamental and Applied Aspects of Population Health Risk Analysis*, 2018, pp. 303–308.

[4] Kuznetsova, E. B., Kopytenkova, O. I., & Bulavina, I. D. Waste management facilities as a source of acoustic impact on populations living in adjacent territories. *Public Health and Environment*, 2019, No. 10 (319), pp. 54–58.

[5] Yatina, A. Ya. Ecological and hygienic assessment of groundwater conditions in areas of non-toxic industrial and municipal solid waste landfills in the Gomel region. 2022.

[6] Prituzhalova, O. A., & Zhovanik, I. A. Analysis of landfill leachate studies at Russian municipal solid waste landfills. *Bulletin of Udmurt University. Series: Biology. Earth Sciences*, 2023, Vol. 33, No. 4, pp. 413–426.

[7] Dregulo, A. M., & Kudryavtsev, A. V. Transformation of technogenic-natural wastewater systems into objects of past environmental damage: problems of regulatory and legislative framework. *Water and Ecology: Problems and Solutions*, 2018, No. 3 (75), pp. 54–62.

[8] Malyukhin, D. M. Ecological aspects of using organogenic substrates in the reclamation of municipal solid waste landfills. Abstract of PhD dissertation in Geography, Saint Petersburg, 2018.

[9] Selikhovkin, A. V. Ecological aspects of the use of organogenic substrates in landfill reclamation.

[10] Aterekova, A. V., & Sivaev, S. B. Selection of sites for municipal solid waste management facilities based on spatial analysis and multi-factor assessment. *Urban Studies and Practices*, 2016, Vol. 1, No. 1, pp. 70–85.

[11] Mindibaeva, M. R. Land and environmental protection in municipal solid waste management. Institute of Justice, Ural State Law University, 2021, p. 309.

[12] Rumak, V. S., et al. Initial assessment of dioxins contaminating the environment beyond the sanitary protection zone of the "Lesnaya" waste landfill (Serpukhov, Moscow region). *Occupational Medicine and Industrial Ecology*, 2023, Vol. 63, No. 9, pp. 617–626.

[13] Khisamutdinov, R. A., et al. Medical-ecological and hygienic aspects as a factor of national security. *Bulletin of Bashkir University*, 2017, Vol. 22, No. 2, pp. 398–402.

[14] Muratov, O. E. Problems of handling industrial waste containing natural radionuclides. Conference abstracts, 2023.

[15] Sheremetova, A. A., & Godyina, I. V. Features of land use for municipal solid waste processing facilities. *Bulletin of Donbas National Academy of Civil Engineering and Architecture*, 2024, No. 2.

[16] Iskandarov, A. B., & Safarov, M. B. Efficiency of the automated process of municipal solid waste accumulation. January 28, 2025, pp. 24–26.

[17] Iskandarov, A. B., & Safarov, M. B. Improving the efficiency of municipal waste removal systems. *European Journal of Interdisciplinary Research and Development*, 2025, pp. 28–31.

[18] Iskandarov, A., & Safarov, M. The importance of improving the solid waste disposal system. *Galaxy International Interdisciplinary Research Journal (GIIRJ)*, 2024, Vol. 12, Issue 12.

[19] Iskandarov, A., & Safarov, M. Hygienic approaches to municipal solid waste disposal. *Uzbekistan Military Medicine*, 2025, Issue 1.

[20] Iskandarov, A., & Safarov, M. The importance of improving municipal solid waste removal systems. ISSN 2181-7812, www.tma-journals.uz, pp. 53–55.