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PROBLEMS OF SOLID WASTE ACCUMULATION IN LARGE CITIES AND WAYS TO SOLVE THEM

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ABSTRACT

The rapid growth of urban populations and increased consumption patterns have exacerbated the challenges of solid waste management in large cities, leading to environmental degradation and public health concerns. This study examines the problems of solid waste accumulation in urban areas, using waste transfer stations in Tashkent, Uzbekistan, as a case study. The research evaluates the operational efficiency, sanitary conditions, and environmental impact of these facilities, with particular attention to seasonal variations in waste processing capacity and district-level waste intake patterns.

The investigations reveal significant challenges, including inadequate infrastructure, non-compliance with sanitary standards (particularly bacteriological contamination), and inefficiencies in waste compaction and transportation. The study also highlights the strain placed on existing systems by urban expansion and rising waste generation rates.

To address these issues, the research proposes sustainable solutions, including improved waste segregation, enhanced recycling initiatives, and the adoption of advanced compaction technologies. Furthermore, it recommends policy interventions and public awareness campaigns to promote waste reduction and proper disposal practices. By comparing successful waste management strategies from other major cities, the study provides adaptable recommendations for Tashkent's context.

Ultimately, this research underscores the urgent need for modernized waste management systems to mitigate environmental pollution and health risks. The scientific works aim to support policymakers and urban planners in developing more efficient, sustainable, and health-conscious waste management strategies for rapidly growing cities.

INTRODUCTION

An effective and comprehensive waste collection system is necessary to protect public health. The perfection of a waste collection system on a city or regional scale depends on the regulation of the work of the relevant service. A modern and efficiently managed waste collection and disposal system not only helps to prevent diseases among residents, but at the same time allows to create favorable working conditions for those working in this system or associated with it. These include waste producers, garbage collectors, sorters, workers engaged in the transportation and processing of waste, indirectly – all residents of the city, including children [1, 2].

As a matter of fact, half or more of all funds spent on solving the waste problem as a whole are spent on waste collection.

However, the financing of waste collection and disposal measures not only entails favorable environmental consequences, but also, ultimately, economic benefits. The volume of formation and accumulation of municipal solid waste is increasing every year. Therefore, today, the problem is acute not only to reduce the

amount of accumulated garbage, but also the proper handling of solid waste, the use of new methods and technologies that will help prevent serious problems associated with various types of waste [3, 4, 5].
Throughout the existence and activity of mankind, a huge amount of waste has been generated. In recent decades, there has been a significant increase in consumption, which leads to an increase in the amount of municipal solid waste (MSW). The volume of accumulated waste has already reached 2,100 billion tons [6, 7].
However, despite scientific and technological progress and advanced technologies, the issue of solid waste disposal and management remains relevant and unresolved to the present days.
Municipal solid waste (MSW) is waste that is formed in the process of human activity and accumulates in residential buildings, social and cultural institutions, public, educational, medical, commercial and other institutions and has no further use at the place of their formation [8,9,10].
Solid waste is also a serious problem for residents of the city of Tashkent, where the amount of waste, landfills and unauthorized landfills is increasing every year, and solving this problem requires significant financial investments and the active participation of the population and local authorities.
Increasing the distances to the sites of neutralization and processing of municipal solid waste, reducing their density, increasing sanitary and hygienic requirements for environmental protection require the use of modern systems for collecting and disposing of municipal solid waste. In Tashkent, two-stage removal of municipal solid waste using large-capacity transport garbage trucks and removable press containers is being further developed [11].
The two-stage system includes the following technological processes: collection of municipal solid waste in places of accumulation, their removal by collecting garbage trucks to a waste transfer station (WTS), reloading into heavy-duty vehicles.
As shown by the experience of using WTS, their use allows you to: reduce the cost of transporting MSW to disposal sites; reduce the number of garbage trucks collecting; to extract waste fractions from MSW; to establish control over the composition of incoming MSW; to eliminate the accumulation of collecting garbage trucks at landfills for storing MSW, to improve the technological process of storing MSW [12, 13].
From the point of view of environmental protection, the use of WTS reduces the number of landfills for the storage of MSW, reduces the intensity of traffic on highways, etc. The advantage that the use of WTS gives depends on the solution of a number of technical and organizational issues. These include the choice of heavy garbage trucks, the location of the WTS, its performance and determining the number of such stations for the city. The main classification feature of the applied WTS is their performance. According to productivity, t/day, WTS are divided into three groups: small (no more than 50); medium (50-150); large (over 150). According to the use of WTS, there are one- and two-level ones. On single-level WTS, belt, plate or scraper feeders, grab buckets are used as lifting mechanisms [14, 15].
WTS at two levels have become more widespread. During the construction of the WTS, the terrain is used in two levels. At the upper level, waste collection trucks are unloaded into the hopper, and at the lower level, MSW is loaded into transport garbage trucks. In this case, bunkers can play the role of a storage device or for feeding waste directly into the body of a transport garbage truck. The capacity of the storage bin must ensure that MSW reserves are provided for the smooth operation of the WTS in case of uneven waste delivery [16].

Purpose of the research

The purpose of this research is to investigate the challenges posed by solid waste accumulation in large urban areas, with a focus on Tashkent's waste transfer stations as a case study. The study aims to assess current waste management practices by evaluating the operational efficiency, sanitary conditions, and environmental impact of these facilities, including their seasonal capacity variations and waste intake from different districts. It seeks to identify key problems such as inadequate infrastructure, non-compliance with sanitary standards (e.g., bacteriological contamination), and inefficiencies in waste compaction and transportation, while also considering the effects of urban expansion and population growth on waste generation.
Additionally, the research explores sustainable solutions by proposing improvements in waste segregation, recycling, and compaction technologies, as well as recommending policy measures and public awareness campaigns to reduce waste generation and enhance disposal practices. By comparing best practices from other large cities, the study aims to develop adaptable strategies for Tashkent. Ultimately, it strives to contribute to environmental and public health protection by highlighting the link between improper waste management and health hazards, advocating for stricter regulatory compliance, and promoting modernized waste processing systems to mitigate pollution risks. The findings are intended to provide actionable recommendations for policymakers, urban planners, and waste management authorities to foster cleaner and more sustainable cities.

Materials and Methods

In connection with the above, we have studied the sanitary condition of waste transfer stations (WTS) in Yakkasarai and Yunusabad districts of Tashkent. The studies were conducted to determine the total number of microorganisms. The total number of microorganisms was determined by direct microscopy, 1-2 drops of dye were added to 1 ml of soil dilution (1:10). After 5 seconds, a section of the counting capillary (2-2.5 cm) is placed in the soil suspension. After filling the capillary, it is placed on a slide and fixed with two drops of molten paraffin, applying them to the ends of the capillary segment. These paraffin drops simultaneously protect the contents of the channels. After that, the total number of soil microorganisms is calculated using a fluorescent microscope in 1 g of soil, then determined using a special formula. For bacteriological analysis, 10 combined samples are taken from one test site. Each combined sample consists of three-point samples weighing from 200 to 250 g each, taken in layers from a depth of 0-5 and 5-20 sm. Soil samples intended for bacteriological analysis, in order to prevent their secondary contamination, should be selected in compliance with aseptic conditions: selected with a sterile instrument, mixed on a sterile surface, placed in a sterile container.
The waste itself does not pose a danger to the environment and health. At the same time, waste that is not removed in time becomes a nutritious environment for pathogens and vectors of various diseases – insects, rodents. The rotting of waste is accompanied by the release of unpleasant odors, harmful gaseous substances and liquids that pose a serious health hazard. In addition, littered streets make a repulsive impression and do not encourage people to maintain cleanliness, while a well-maintained and tidy environment makes residents feel proud. An efficient waste collection infrastructure contributes to solving these problems. Effective control over the formation, storage, processing, transportation and disposal of waste is extremely important for health protection, environmental protection, rational use of natural resources and ensuring sustainable development.

Results and Discussion

At the first stage, garbage is collected and sorted at protected waste collection sites. There are more than 1,100 of them in Tashkent, they have containers for paper, cellophane, plastic, plastic bottles. People take out unsorted garbage from the house to this site. It is sorted by containers by an operator who is on site for 24 hours. Recyclable waste (paper, plastic, glass, bottles) at the garbage collection site are placed in separate containers, and all the rest — unsorted, non-recyclable - in another. The non-recyclable waste is picked up by a garbage truck and brought to the waste transfer station.
There are 3 such waste transfer stations in Tashkent; we studied the sanitary condition of waste transfer stations in Yakkasarai and Yashnabad districts of Tashkent. The Yakkasarai waste transfer station was put into operation in 2002, has a capacity of 600-800 tons/day in summer and 400-450 tons/day in winter. There are 16 employees at the station. Waste is brought to the wasre transfer station from 4 districts: from Chilanzar district 150-170 t/s per day, from Yakkasarai district 90-100 t/s, Uchtepinsky — 150-200 t/s, Sergelinsky — 100-150 t/s. The Yunusabad district waste transfer station serves three districts: Yunusabad -100 t/s,

Almazar-150 t/s, Shaikhontokhur district — 120 t/s. WTS of Yakkasarai district has a total area of about 2.5 hectares, the territory is fenced, landscaped and paved. There are the following areas on the territory of the waste transfer station: an administrative building, an open—type container storage area with an area of about 2,200 m2. On average, 110-120 commute go through the weighing room per day, in terms of garbage 400-450 tons / day /, in summer up to 600-650 tons / day. At waste transfer stations in both districts, MSW is compacted using a press. Thanks to the solid waste compactor, it is possible to maximize the useful load capacity of garbage trucks. According to bacteriological indicators, only 1214 samples were taken, of which 469 did not meet sanitary standards and hygienic requirements, for the rest of the indicators — all samples met hygienic standards (Table 1).

Table 1

Waste Transfer Stations (WTS) in Tashkent

Category	Yakkasarai District WTS	Yunusabad District WTS
Year of Operation	2002	Not specified
Capacity (Summer)	600-800 tons/day	Not specified
Capacity (Winter)	400-450 tons/day	Not specified
Total Employees	16	Not specified
Served Districts	Chilanzar, Yakkasarai, Uchtepa, Sergeli	Yunusabad, Almazar, Shaikhontokhur
Waste Intake per District	- Chilanzar: 150-170 t/day - Yakkasarai: 90-100 t/day - Uchtepa: 150-200 t/day - Sergeli: 100-150 t/day	- Yunusabad: 100 t/day - Almazar: 150 t/day - Shaikhontokhur: 120 t/day
Total Area	2.5 hectares	Not specified
Infrastructure	- Fenced & paved - Administrative building - Open-type container storage (2,200 m^2)	Not specified
Daily Traffic (Weighing Room)	110-120 vehicles/day (400-450 t/day winter, 600-650 t/day summer)	Not specified
Waste Processing	MSW compacted using a press to optimize garbage truck loads	MSW compacted using a press
Sanitary Conditions	- **Bacteriological samples:** 1,214 total, 469 failed standards - Other indicators: All samples met hygienic standards	Not specified

WTS of Yunusabad district has a total area of about 1.5 hectares, the territory is fenced, landscaped and paved. The following areas are located on the territory of the waste transfer station: an administrative building, an open-type container storage area with an area of about 1200 m2. On average, 90-100 commute to per day, and waste go through the weighing room per day are, in terms of garbage 200-250 tons / day /, in summer up to 300-350 tons / day. According to bacteriological indicators, only 900 samples were selected, of which 350 did not meet sanitary standards and hygienic requirements, for the rest of the indicators, all samples met hygienic standards (Figure 1).

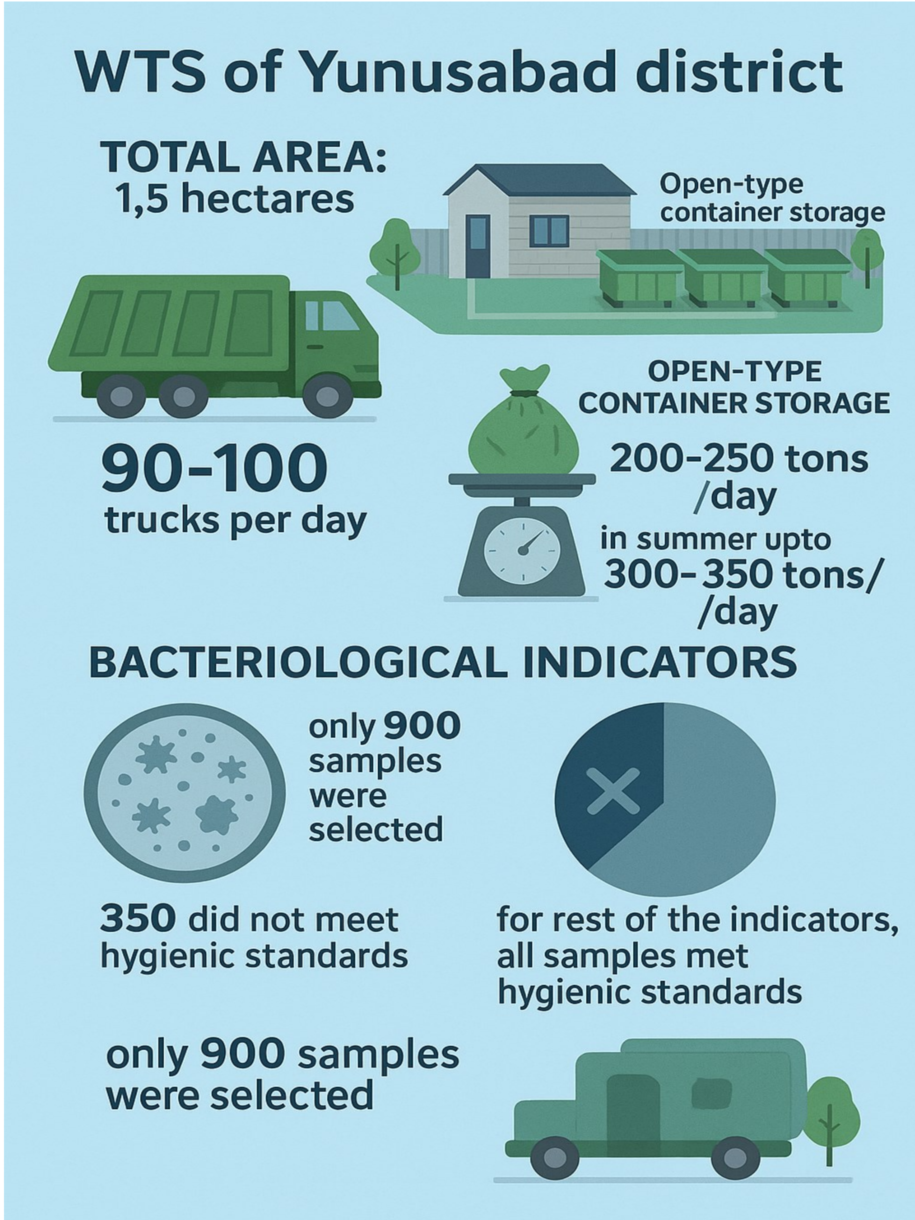

Figure 1

The analysis of the data obtained on the total number of bacteria showed that the soils of the sanitary protection zone of the WTS were characterized by statistically significant differences in this indicator. The number of bacterial cells in the studied soils ranged from 17.55 ± 6.17×106 CFU/g of soil of Yunusabad MP to 26.04 ± 7.21×106 CFU/g of soil of Yakkasarai MP (Table 2).

Table 2

Microbiological indicators of the sanitary condition of the soil

Sampling areas	Total microbial number		Thermophiles		Coli-titer	
	spring	autumn	spring	autumn	spring	autumn
Yunusabad WTS	17,55±1,85	44,02±3,00	8,06±3,54	9,43±1,68	0,01	0,01
Yakkasarai WTS	26,04±2,56	15,02±2,01	14,63±0,67	23,05±6,75	0,01	0,01

In the autumn period, the largest number of saprophytic bacteria was recorded in the soil of the Yunusabad WTS, where this indicator was 44.02 ± 3.00×106 CFU/g of soil. This indicator was 2.8 times higher than the indicator of the total microbial number in the Yakkasarai WTS. During the analysis of the results obtained, we found that the content of thermophilic microorganisms in the soils of the studied territories of the WTS did not differ statistically significantly. The content of thermophilic microorganisms ranged from 8.06 ± 3.54 to 9.43 ± 1.14×103 CFU/g of soil in spring and from 9.43 ± 1.68 of soil in autumn. If we compare the results of accounting for the content of thermophiles in the soils of parks in different periods of the study, we can say that these indicators practically coincide in spring and autumn. This allows us to talk about some general patterns of the development of the microbial community in the soils of the WTS. When comparing the total microbial number and the number of thermophilic bacteria, it was found that their titer correlated as 2:1. This indicates that 50% of the microbiocenosis of the studied samples is represented by thermophilic microorganisms, the presence of which indicates fresh fecal contamination of the studied soils. The determination of the titer in the soils of the studied parks in the spring and autumn periods gives reason to classify them, as well as in the case of the index of thermophilic bacteria, into the category of moderately polluted soils, since this indicator in all samples was 0.01. This value did not change during the study period, which makes it possible to talk about the presence of a constant source of fecal contamination and a low level of sanitary and hygienic conditions in the WTS. Analyzing the data obtained, we can say that the soils of the Yunusabad WTS are characterized by the most pronounced toxicity both in spring and autumn. Which can be explained by the proximity of this territory to the industrial zone of Tashkent (Figure 2).

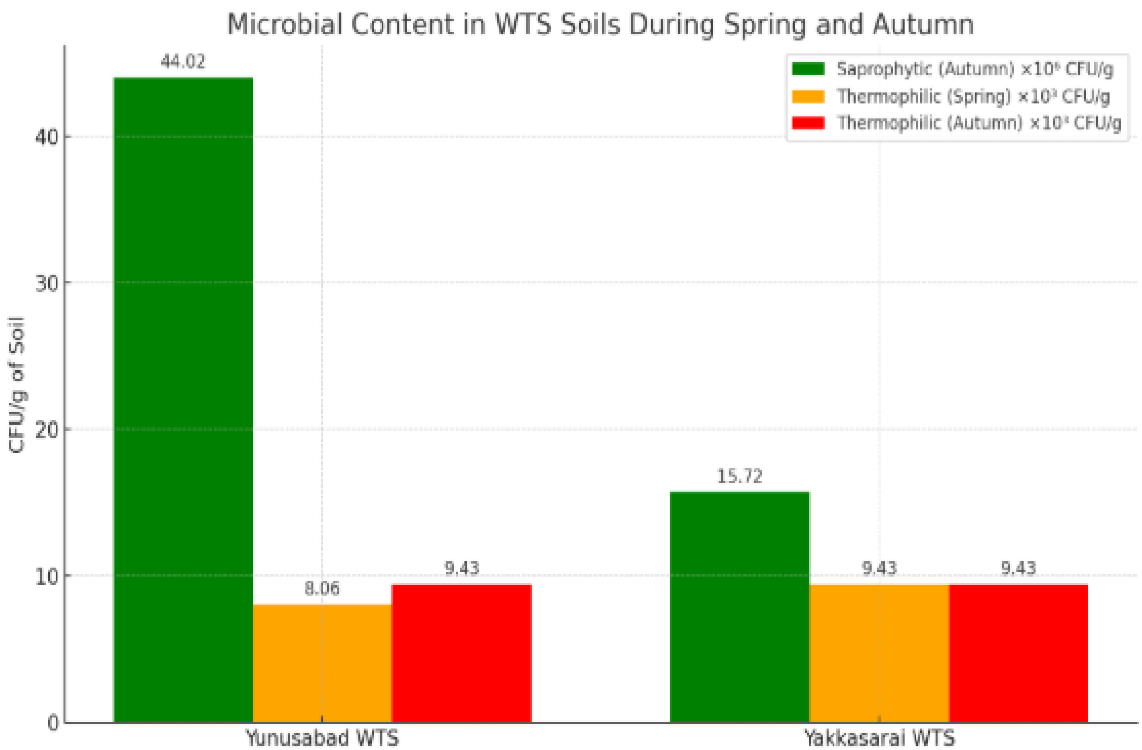

Figure 2

At the same time, in the autumn period, this soil sample had more pronounced toxic properties in relation to all test microbes under study. It should also be noted that the increase in toxic properties of soils in the autumn period was noted for all soil samples. This may be due to an increase in the intake of heavy metals and other pollutants during leaf fall. It should be noted that the toxicity of the studied samples was more pronounced in relation to gram-negative microorganisms. But at the same time, low values of the number still indicate that the spread of pathogens of intestinal infections is poorly restrained by the toxic properties of soils. Low toxicity to representatives of Bacillus is due to the presence of spores in them. As for non-spore-forming bacteria, the results obtained are quite natural, since spherical shapes are characterized by higher natural resistance to the action of chemicals. Thus, it can be concluded that the soils of recreational areas have a weakly pronounced toxic effect on the soil micro flora. The toxicity of pollutants is a problem for humans rather than for microorganisms, which have learned to adapt to such substances in different ways. The low degree of toxicity of the soils of the Yakkasarai and Yunusabad WTS indicates the presence of favorable conditions for the survival of pathogens in it. Thus, the conducted studies allow us to conclude that the soils of the Yakkasarai and Yunusabad WTS of Tashkent correspond to the class of moderately polluted soils according to established standards.

Summarizing the data obtained, it can be concluded that the soils of the Yakkasarai and Yunusabad WTS territories are not safe from the point of view of sanitary and hygienic standards. Therefore, a comprehensive study of the current situation is necessary.

CONCLUSION

The described system of collection and disposal of MSW reduces the cost of removal of 1 m3 of waste by up to 25%, reduces capital investment (by reducing the number of collecting garbage trucks) by up to 30%, reduces the number of maintenance personnel and allows the storage of fuels by up to 35%. From the above data, it can be concluded that the indicators of the sanitary and epidemiological state of the soil do not meet hygienic requirements, and only such an indicator as the content of chemicals is within the limits of hygienic standards.

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