

Municipal Solid Waste and Morphological Composition Study

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Abstract: This article presents an analysis of municipal waste problems and research conducted in some countries, as well as a description and annual results of experimental research and chronometer work conducted on the study of the morphological composition of household waste in Tashkent city and Tashkent region.

Keywords: municipal solid waste (MSW), morphological composition, experimental research, collection, transportation, sorting, utilization, processing, resource potential of waste

1. Introduction

Currently, waste is becoming a problem that threatens environmental safety and public health. MSW (hereinafter-MSW) are a source of ecological danger for the environment and human health (pollution of surface and underground water and atmosphere, spread of bad smell, risk of fire, spread of various infectious infections). High air temperature leads to the rapid decomposition of organic substances in the MSW, the rapid development of microflora and microorganisms. All this requires reducing the shelf life of MSW. The requirements for handling many hazardous materials in waste, including their separate collection and disposal, are not always taken into account. It is not possible to expand landfills as much as desired. Due to the rapid development of economic sectors, there are problems such as creating an effective system for the collection, transportation, disposal, processing and burial of municipal solid waste, eliminating their harmful effects on the health of citizens and the environment. The issue of recycling and use of MSW, reducing its size is a matter of urgent importance for all countries. Due to the rapid growth of the population in our republic, an average of 7-8 million tons of municipal waste is generated per year [1]. The study and analysis of the existing system for the implementation of work related to MSW shows that the practice formed over many years for the implementation of work related to MSW is mainly focused on collecting and transporting them to landfills without burying them. Therefore, the analysis of scientifically based modern methods of using municipal solid waste and the prospects of their use in the urban economy is an urgent issue. At the moment, only reliable information on the composition of household waste is of particular importance, and in conducting studies to determine the proportion and characteristics of certain mixtures in the composition of household waste, single approaches should be used in residential Forecasting the amount of secondary raw materials that are part of household waste in order to introduce modern effective technologies for processing MSWs in certain regions. It allows to define and plan the directions, technologies, methods, methods of MSW disposal and processing enterprises, as well as to attract investments, including foreign investments, in the field of recycling of waste materials, ultimately to reduce the negative effects of waste on the environment. Paul Connett, professor emeritus of St. Lawrence University, wrote in his works that "waste is not a substance, but it is a variety of useful things and the art of mixing these things together.

The scientific and methodological aspects of waste management and its organization have been studied by specialists (foreign scientists) in many countries. The problems of the functioning of the housing and communal economy system under market conditions have been studied in the Commonwealth of Independent States (CIS) and others. Information on the accumulation standards and morphological composition of municipalsolid waste is also provided in the following sources: Z.I.Aleksandrovskaia., A.M.Kuzmenkova., N.F. Gulyaev., Ya.N.Krkhambarov. "Sanitary cleaning of cities from municipal solid waste" 1977, Moscow. Stroyizdat.

M.I. Myagkov., G.M. Alekseev., V.A. Olshanetskiyning "Solid municipal waste of the city" 1978, Leningrad. Stroyizdat sources provide information on 13 different morphological compositions of household waste in the cities of Moscow and Kharkiv. If we list the research carried out in the world practice, the research carried out on "Determining the morphological composition of solid household waste in landfills of the city of Bishkek and the garbage collection sites of the city of Osh", in 2014 "Determining the composition and specific gravity of solid household waste in various categories of objects" of the Moscow region Held in Cherepovets. These

studies include "Improvement of solid household waste management system in the Donetsk region of Ukraine" (May 2003-2004), "Determining the fractional composition of solid household waste in Ukraine" carried out within the framework of the European Union project.

The Sanitary and Epidemiological rules and regulations (SERR) No. 0297-11. Sanitary rules and norms of solid waste cleaning of settlements in the conditions of the Republic of Uzbekistan. The morphological composition of the MSWs was classified during the former Union of Soviet Socialist Republics (USSR) "Methods of accumulation and average morphological composition of the MSWs" T.I Iskanderova, R.A Atajanova, G.I. According to the results of research conducted by Malykhinoy (1982) in the last century, the daily and annual rate and volume of solid household waste generated in 13 organizations and institutions, as well as information on their 9 types of morphological composition are presented in these scientific sources.

In order to ensure the implementation of the decision of the President of the Republic of Uzbekistan dated April 17, 2019 "On approval of the strategy for the implementation of work related to solid household waste in the Republic of Uzbekistan in the period of 2019-2028" No. PQ-4291 In 2021, a project of experimental scientific research and chronology was implemented to determine the morphological composition of solid household waste (MSW) in the regions of Tashkent city and Tashkent region.

Research work on determining the morphological composition of household waste was carried out in accordance with the methodological recommendations "On determining the morphological composition of household waste in the territories of the Republic of Uzbekistan" approved by the Research Institute of Environment and Nature Conservation Technologies.

Decisions of the mayor of Almazor district of Tashkent city and Chirchik city and Parkent district of Tashkent region on the effective conduct of scientific research and chronometric work to determine the morphological composition of MSWs were adopted. The composition of the working commission was approved in order to determine the morphological composition of household waste, to carry out research and timing work in this field, to quickly solve the issues that arise in the work process, and to prepare analytical data on the results of the research. The appropriate project objects for carrying out scientific-research and chronometric work on determining the morphological composition by measuring the weight of the components of the MSWs collected in the city of Tashkent, Chirchik and Parkent districts were identified and the sanitary passports of the objects were filled out. Banners indicating the numbers of the research objects, location, affiliation to the sanitary treatment plant, year and season, as well as the names of the measured contents of MSWs were installed on the project objects. In order to determine the morphological composition of the MSWs, scientific research and timing work was carried out for seven continuous days in the spring season of 2021, the summer season of 2021, the autumn season of 2021 and the winter season of 2021. The results of the conducted daily and seasonal studies were formalized and analyzed by working groups. Experimental research and chronometry works on determining the morphological composition of the MSWs were carried out with the involvement of members of the working group established by the decisions of the hokims of Almazor district, Parkent district and Chirchik city.

In order to ensure that the research and timing works are carried out in the established order and according to the established requirements, all the participants involved in this research were experts in the field of sanitary cleaning, engineering-technical staff, sanitary-epidemiological control enterprises, representatives of citizens' self-management bodies.

The scientific research and chronometry work carried out in order to determine the morphological composition of MSWs were intended for the following:

Determination of the morphological composition of the MSWs collected in the regions and actually removed;
Determine the directions, technologies, methods and styles of sorting, utilization, processing, selection of MSW;
Determining, determining, planning, forecasting the activities of organizations providing services for sorting, utilization, processing, and neutralization of waste materials;

To determine the types of special techniques, mechanisms and equipment for sorting, disposal, processing, neutralization of MSW and the demand for them;

It is used for the purposes of increasing the effectiveness of attracting entrepreneurs, investments, including foreign investments, to the field of MSW management [2].

Based on methodological recommendations, the research was conducted in residential facilities of Almazor district of Tashkent city, Chirchik city of Tashkent region and Parkent district for seven consecutive days in all seasons of the year.

Household waste consists mainly of unusable items, objects and materials, for example: broken pieces of furniture, broken dishes, glassware, vials, bottles, broken glass, old books, newspapers, magazines, wrapping paper, cardboard, polyethylene includes films and other packaging, packaging materials, cans, broken toys, old clothes, shoes, food waste, etc. It also includes ash from heating stoves in the house, slag, scum from

yards, and fallen tree leaves. During the renovation of houses, household waste such as boards, broken bricks, wall paper, plaster and others may appear. During the period of improvement of people's life activity and high level of culture, broken radio-techniques, televisions, heating and lighting electrical devices also appeared in household waste.

Table 1 below shows the results of the research conducted in some cities of Russia in the period of 1970-1975[3].

Table 1 Morphological composition of MSWs of some cities during the Soviet Union

№	Composition of MSWs	Season of the year			
		Moscow	Leningrad	Kuybyshev	Volgograd
1	Paper	34	30	32,4	30
2	Food waste	33,3	28,1	34,3	38,7
3	Wood	2,4	3,9	4,3	2,9
4	Metal	4,8	4,7	1,8	2,7
5	Textiles	4,6	4,4	6,7	3,5
6	Bone	1,1	2,1	1,9	2,5
7	Leather, rubber	2,2	0,7	2,1	0,5
8	Glass.	4,6	7,4	6,1	4,8
9	Stone	2,9	2,2	1,2	2,4
10	Plastic	1,6	0,8	0,8	-
11	Other parts, including polyethylene and plastics.	0,8	0,5	2,6,	1.2
12	The width is 15 mm less	7,9	11,8	7,9	11,1

The amount of urban waste depends on the level of urbanization, the type and structure of consumption, the income level of the family, the lifestyle, the season and the type of housing, as well as the recycling and disposal policy. Income level also affects the consumption style. Food waste increases in summer and autumn, and street waste decreases in winter [3].

We studied municipal solid waste into 21 different morphological compositions. According to the results of this study, the valuable components of the waste can be used as secondary raw materials for industry (paper, metal, glass, rubber, textiles) or as animal feed (food), as well as the choice of the method of waste disposal (fertilizer production through biothermal processing or turn them on) a specific task is defined.

Table 2 below presents the results of research on determining the morphological composition of household waste in Tashkent city and Tashkent region.

Table 2 Annual results of scientific research and chronometer work conducted in order to determine the morphological composition of solid household waste (MSW) carried out in the territories of our republic.

№	Names of the morphological composition of MSWs.	Tashkent city	Parkent district	Chirchik city
		%	%	%
1	Food waste: fruits, peels, peeled and organic part of other wastes, etc.	32,76	9,35	15,14
2	Paper and cardboard,	5,29	3,85	4,94
3	Paper packaging from milk products, juices and wines	0,55	0,95	0,86
4	Polymers	10,04	5,95	14,60
5	Positron emission tomography (PET) bottles (containers)	4,19	2,05	3,03
6	Polypropylene (pipes)	1,24	1,64	2,49
7	Polyethylene (packages)	4,61	2,26	9,08
8	Glass	3,82	5,18	3,04
9	Metal	1,26	0,73	0,84
10	Black metals; iron, iron alloys, manganese, chromium, cast iron	0,86	0,57	0,53

11	Non-ferrous metals (lead, zinc, tin, nickel, aluminum, titanium, magnesium)	0,4	0,16	0,31
12	Textiles (clothes, blankets)	3,79	2,47	3,50
13	Woods	2,8	0,54	0,62
14	Hazardous waste	0,44	0,56	0,67
15	Medical waste	0,42	0,42	0,51
16	Contains mercury and its compounds (fluorescent lamps, thermometers, barometer)	0,01	0,07	0,12
17	Uninterruptible power supplies (accumulators. Batteries).	0,01	0,08	0,05
19	Skin, rubber and bones	1,98	2,35	1,36
20	Bones	0,78	0,52	0,43
21	Leather	0,6	0,86	0,57
22	Rubber	0,6	0,97	0,36
23	Plant waste: branches, roots, stems, leaves	10,33	36,63	21,41
24	Others	25,58	32,39	33,89
25	Diapers	6,0	6,29	3,21
26	Stones which are constructional waste	10,0	2,70	4,74
27	and others (scum, soil, fine-grained inorganic waste)	9,58	23,40	25,95
	Total	100,0	100,0	100,0

The composition of municipal solid waste depends on the level of development of the region and the country, the cultural level of the population and its customs, the season and many other factors. The results of our analysis of the components showed significant vibrations of many components. The morphological composition of MSWs changes in each season. More than a third of the KMC consists of packaging materials, and their number is constantly growing. The amount of polymers in the composition of MSW is also increasing year by year. Polymer components include lightweight disposable razors, toothbrushes, shampoos, disposable paper cups, plates and utensils, disposable synthetic resins, plates and utensils, dinnerware, disposable spoons, forks and knives, disposable paper. The presence of bags and polyethylene bags is proof of our word.

According to the results of the research, food waste, polymers, and paper products in the city of Tashkent are more than the content in the Tashkent region. Due to the development of production and the growth of its use, the increase in cultural level and the distribution of packaging in commerce, the amount of paper in the waste is constantly increasing. In the last four years, the production of paper in the world has increased 4 times[4]. In addition, the modernization of the system of providing heat energy to the population has a decisive effect on the increase in the amount of paper in the waste; gasification and electrification. With the transition to gas and electricity, the composition of other components has also changed: to appear such as ash, coal, slag and others which are new components of synthetic materials.

In recent years, a very rapid development of plastic production has been noted all over the world, its global production has increased 8 times between 1990 and 2020. Such a rapid development of this production, the wide use of plastics for household and commercial packaging has led to a rapid increase in the amount of waste.

In countries where 20-25 kg of plastics are produced per person per year, their amount in the MSWs is 1.5-2%. According to information, in France in 2000, the amount of plastic in the waste is 5%. The highest indicator is in the city of Tokyo, where the amount of plastic in waste is 9.7% [3]. According to the results of our research conducted in the territory of our republic, the amount of plastic is also high. In the city of Tashkent, the polymer index is higher than the average of 10%.

Below is The Sanitary and epidemiological rules and regulations, No. 0297-11. Sanitary rules and norms of solid waste cleaning of settlements in the conditions of the Republic of Uzbekistan. The morphological composition of the MSWs was classified during the former USSR "The average morphological composition of the MSWs" T.I Iskanderova, R.A Atajanova, G.I. Based on the results of Malykhinoy's (1982) research conducted in the last century[5].

Table 3 The average appearance of the morphological composition of MSW in cities, in % by weight (according to T.I. Iskanderova, R.A. Otajonova, G.I. Malikhina)

No	Fractions	Season of the year				By year
		winter	spring	Summer	Autumn	
1	Paper	20,5	18,3	18,8	18,1	18,9
2	Food waste	35,3	36,8	39,2	42,2	38,4
3	Wood	4,7	4,2	3,0	7,8	4,9
4	Metal	5,0	3,9	2,2	2,3	3,4
5	Textile	3,7	3,3	3,9	4,3	3,9
6	Leather, rubber	2,0	0,7	0,4	0,4	0,8
7	Glass	4,7	4,5	0,3	1,9	3,7
8	Stone	6,4	10,5	16,8	8,0	8,9
9	Other parts, including polyethylene and plastics	17,7	17,8	15,0		17,0

According to the results of the research conducted in the city of Tashkent, paper is 6.5% in the spring season, 18.3% in The Sanitary and epidemiological rules and regulations No.0297-11. Food waste in Tashkent city averages 32-33%, T.I. According to the research results of Iskanderova, R.A. Otajonova, G.I. Malikhina, it is 36.8%.

The municipal waste of southern cities, where residents use fresh vegetables and fruits throughout the year, is much richer in food waste than the waste of northern cities (or countries). Large amounts of slag, ash, and household waste are generated in the regions of our republic and in the cities of other countries that use coal for heating. In the city of Tashkent, it can be seen that the composition of food waste, bottles and filter parts is changing especially strongly. The lowest amount of precipitation (less than 15 mm) was observed in winter and autumn periods. The components of municipal waste are greatly influenced by the level of prosperity of the housing stock, seasons, years, climate, etc. Local and foreign experience shows that over time significant changes in the composition and characteristics of waste occur. Certain regularities were noted in the change of the composition of food waste in household waste, and in 1935 they consisted mainly of potatoes, vegetables and bread products [4].

Most of the waste in most cities of our republic is characterized by a high content of nutrients. Therefore, organic fertilizers are valuable raw materials for production. The development of catering facilities and the use of semi-finished products has led to a decrease in the amount of food waste in the form of vegetable peels, bones, etc. As a result, the number of single-use light packaging products has increased. For example; disposable dishes, plastic spoons, forks and other things.

The amount of ash in the garbage of houses with different levels of improvement is much less than in the garbage of households that are heated by stoves. As a result of gasification, electrification, liquid fuel and central heating system of the cities in the regions, the amount of ash and coal in municipal waste has decreased sharply. In this regard, as well as due to the increase in the level of improvement of yard areas, the amount of small (fireplace) (less than 15), consisting mainly of street sweeps, has decreased.

The composition of household waste to the average statistical value of GDP (gross domestic product) per capita of the population;

- Food culture;
- The level of development of buildings (availability of waste pipes, heating system, availability of stoves for cooking and household needs, availability of water and sewage pipes);
- use of separate waste collection places;
- Air conditioning conditions;
- Type of fuel for local heating;
- Development of public catering and household services;
- Depending on the level of paper supply.

The effect of heating systems can be determined in the following. When gas is used for central heating or electricity is used for cooking, there is no waste in households. In the mixed system of heating (central heating and strong burning of kitchen stoves), the indicated factors have a partial effect. The development of catering establishments, kitchens, cafes, home kitchens, family restaurants and household services (for example, home repair) will reduce the amount of waste from residential buildings, but the total amount of household waste in the city may increase. The analysis of literary sources shows that the relative density of waste has been decreasing recently, which in turn is reflected in the processing technology. For example, in the USA, paper,

cardboard and plastic waste in MSW makes up about 50% of the total volume [6]. A few decades ago, the morphological composition of the MSW was drastically different from today. The widespread use of packaging materials and semi-finished products in the daily life of the majority of the population is simultaneously causing an increase in the content of paper and polymers in the composition of the consumer goods [7].

The popularity of disposable hygiene products has led to the expediency of separating such a category from hygiene products.

For example, "disposable diapers" make up 6% of the MSW composition. According to world experience, the composition and characteristics of waste have changed significantly in the last 10-15 years. First of all, their relative density. Thus, with the increase in the volume of light components of litter, its specific density decreased. For example: mostly paper [7].

The change in the composition of product consumption can be observed not only taking into account different time periods, but it can also differ from one settlement to another. Regardless of the general trends of changes in the morphological composition of solid household waste, the indicators of the composition of individual waste can vary several times or even tens of times for different cities and regions. The morphological composition of solid household waste depends on the level of development of life of the population, climatic conditions and the source of MSWs [8]. The value of the components of household waste - the technology of their collection and transportation and decontamination of waste, has a decisive influence on the construction of waste processing enterprises, the selection of technological processes for their operation, the development of machine and equipment parameters (shredders, compactors, and screens).

The use of appropriate research results and current data on the morphological composition of MSW for a certain area or in residential areas, for example, for other cities or countries, may lead to unrealistic errors.

The information about the morphological structure of the MSW should be updated every 3-5 years [9].

In waste management systems, the morphological structure of MSW is of particular importance, and modern concepts of MSW management, as a rule, are based on the maximum use of resources.

The results of research carried out in these areas have been approved by the Ministry of Ecology, Environmental Protection and Climate Change in coordination with the Sanitary-Epidemiological Peace and Public Health Service of the Republic of Uzbekistan and are currently being used in practice.

At the same time, reliable information about the morphological composition of solid household waste - the efficiency of one or another technology chosen for the processing of this waste, the full use of waste, adequate assessment of resources and energy, the organization and determination of the system for the optimal selective collection of solid waste, the possible negative effects of solid waste impact assessment serves as a basis for an objective assessment of the efficiency of this or that technology being chosen for the processing of these wastes.

2. Reference

1. Ministry of Natural Resources Department reports on "Determining Waste Management Policy" in 2023.
2. I. Ruzieva. Scientific Research Institute of Environment and Nature Conservation Technologies. "Methodological recommendations for determining the morphological composition of solid household waste in the territory of the Republic of Uzbekistan" in 2021y.
3. Z.I. Alexandrovskaya, A.M. Kuzmenkova, N.F.Gulyaev, Ya.N.Krkhambarov. Sanitary cleaning of cities from solid waste. Stroyizdat 1977
4. M.I. Myagkov., G.M. Alekseev., V.A. Olshanetsky. City municipal solid waste. Leningrad. Stroyizdat. Leningrad branch. 1978.
5. The Sanitary and Epidemiological rules and regulations (SERR) No. 0297-11. Sanitary rules and norms of solid waste cleaning of settlements in the conditions of the Republic of Uzbekistan.
6. O.V. Ulanova S.P. Salhofer Wunsch. K. Integrated waste management device. Housing and communal services: Textbook / O.V. Ulanova and others. General ed. O.V. Ulanova. M.: Publishing house Academy of Natural Sciences, 2016.-520 p.
7. Sanitary cleaning and cleaning of populated areas: Handbook / Ed. A.N. Peaceful. M.: Academy of Public Utilities named after. K.D. Panfilova, 1997. - 314 p.
8. Decree of the President of the Republic of Uzbekistan dated April 17, 2019 "On approval of the strategy for the implementation of activities related to solid household waste in the Republic of Uzbekistan in the period 2019-2028" PQ - 4291.
9. I.D. Ruzieva Change of the morphological composition of municipal solid waste. X International Scientific and Practical Conference "Science and Education in the Modern World: Challenges of the 21st Century Nursultan-2022 56-59 b.

10. I.D. Ruzieva "Sorting of solid household waste" Materials of the republican scientific-practical conference of the Ecological Party of Uzbekistan in the faction of the Ecological Party of Uzbekistan in the legislative chamber of the Oliy Majlis of the Republic of Uzbekistan on the topic "Implementation of ecological startups dedicated to the World Environment Day". Tashkent -2022 p. 29-33.
11. M.I. Myagkov., G.M. Alekseev., V.A. Olshanetsky. City municipal solid waste. Leningrad. Stroyizdat. Leningrad branch. 1978.
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