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INVESTIGATION OF MORPHOLOGICAL COMPOSITION AND EVALUATION OF THE EFFECTIVENESS OF MUNICIPAL SOLID WASTE RECYCLING METHODS IN UZBEKISTAN

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Abstract. *This article deals with the problem of Municipal solid waste (MSW) in the Republic of Uzbekistan. In the process of research, the methods for the disposal of MSW that are still used in the country, such as incineration and disposal at landfills, were examined. For the necessity to implement innovations in the work of handling MSW, the basic morphological composition of MSW in the winter, spring, summer and autumn seasonal periods was researched. Based on the results obtained, an innovative direction is proposed for the processing of MSW into secondary raw materials in order to solve the problems of resource savings and jointly with the solution of environmental and economic problems of the republic. To solve the problem of waste management, an innovative technology has been proposed for the transition from landfills to waste recycling plants.*

Key word: *morphological composition, municipal solid waste (MSW), industrial waste, recycling, utilization, disposal, pyrolysis, innovative technology.*

INTRODUCTION

Municipal solid waste management is one of the main fields in the world practice. As the harmful impact of waste on the life activities of citizens, as well as on the environment is a real threat not only to the environment, but also to public health. The demand for rational waste management is related to population growth and increase in the amount of waste. Every day, each inhabitant of the republic is produced about 0.6 kg and 200 kg of municipal solid waste. In central cities, this indicator is 0.87 kg/day and 300 kg/year for each resident. In 2017, more than 7 million tons of MSW were generated in the republic. About 3.9 million tons or 46% of MSW are formed in Tashkent city (1.1 million tons or 11%), Fergana (2 million tons or 22%) and Samarkand (799.7 thousand tons or 7%) regions. The Law of the Republic of Uzbekistan № 362-II of 2002 “ON WASTE” and the Decree of the President № PP-2916 of April 21, 2017 “On measures to radically improve and develop the waste management system for 2017-2021” indicate the prevention of the harmful effects of waste on the life and health of citizens, the environment, reducing waste generation and ensuring their rational use in economic activities [1].

Modern analysis of literature data indicates the demand for strategic approaches to solving MSW management tasks. According to research in the US, the level of recycling, separate collection and reduction of generated waste directly depends on the degree of education of the population [2]. In China, the main problems [3] are related to the growth of household waste and changes in its composition. Some measures have been proposed to turn the disposal and management of garbage into a profitable sector of economy, to strengthen the control over the sources of garbage, separate collection of garbage; the profit from this activity should be directed to the processing of garbage and increase the reliability of its disposal. In European countries the

main directions of the waste management process are: protection of human and environment, protection of resources (energy, materials, and territories), management without further external interference [4]. As a result of this approach, less than 20% of MSW is disposed of, and the rest is involved in recycling (including 40 - 65% used as secondary material resources (SMR), and 25 - 35% incinerated with energy recovery) [5]. Creation in Uzbekistan of specialized infrastructure for collection, storage, transportation, neutralization and processing of MSW allows avoiding accumulation of huge volumes of garbage at landfills. It should be noted that the use of MSW as a secondary raw material helps to reduce the need for primary resources and subsequently reduce the environmental impact at the stage of resource deposit development, production and processing. In 9 large cities of Uzbekistan (Nukus, Urgench, Angren, Kashkadarya region, Bukhara, Guliston, Jizzak, Samarkand and Termez) waste processing clusters have been constructed and efforts have been made to follow global trends in recycling waste into resources [6].

Thus, the development of a waste management system to provide technological solutions for collection, use, decontamination, transportation, placement and disposal is a very relevant and practically significant problem.

THE EXPERIMENTAL PART

In order to carry out research work to determine the morphological composition of MSW in the city of Tashkent, 34 garbage containers were selected and taken under observation to avoid unauthorized removal of waste suitable for subsequent disposal. The containers were emptied and their contents were analyzed. A total of 4 campaigns (autumn, winter, spring and summer) to investigate the morphological composition of the waste were conducted. Research materials: plastic bags with capacity up to 20 liters, floor scales with weighing error not more than $0,5 \pm 1\%$, shovels, tape measure, forms for filling the research results. When using containers, the container volume was calculated using the formula [7].

$$V = \frac{1}{3}H(S_1 + \sqrt{S_1S_2} + S_2)$$

Where, V-volume container, m³;

H- Height of container, m;

S1 - the area of the lower base of the container, m²;

S2 – the area of the upper base of the container, m².

RESULTS AND THEIR DISCUSSION

In order to carry out this research, monitoring was conducted to analyze all aspects of waste management, including characteristics and properties of waste, processing technology. Fig.1 indicates MSW generation in regions of the republic by years.

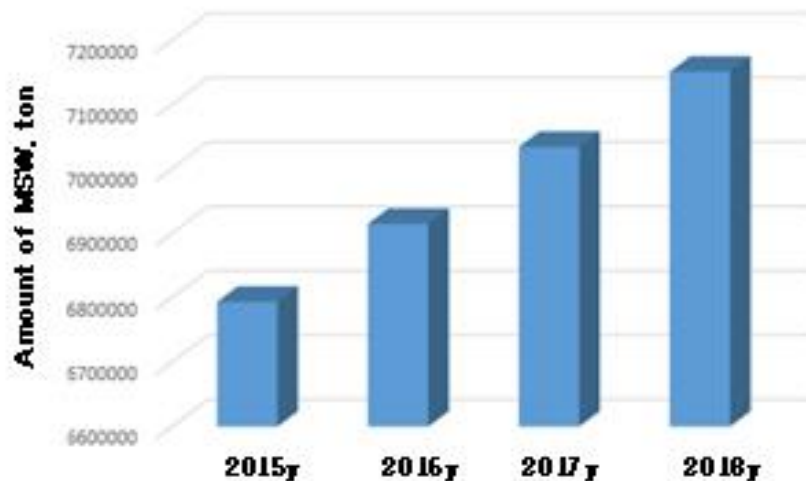


Fig.1. Amount of MSW (ton) by years

From Fig.1 it can be seen that the amount of MSW formation is increasing, indicating a high demand for disposal and neutralization of MSW. There are 221.0 landfills with the area of 1 493.2 ha for disposal of the generated waste in the country. The total volume of wastes makes 80 949.0 thousand tons on republic. In order to increase efficiency of waste management process, the government has reorganized local authorities and transferred waste management in regions under control of the central office of the State Committee on Ecology and Environmental Protection of the Republic of Uzbekistan.

Disposal and incineration are currently the only solution for MSW utilization in the country. But the problem of utilization of industrial waste using these methods is not solved, especially in large cities of Uzbekistan. We have analyzed the situation with accumulation and utilization of industrial waste. To solve the problem of waste management, we propose an innovative technology for transition from landfills to waste processing plants, which has long been practiced in foreign countries.

Efficient recycling and reuse of MSW requires in-depth research of their morphological and fractional composition, as the morphological composition of household waste is diverse and contains many popular components. In recent years, the growth of industrial turnover has changed the morphological composition of MSW, which is characterized by an increase in non-degradable harmful fractions, such as plastic and plastic products, glass containers, rubber and rubber products, as well as used mercury-containing products: lamps, thermometers and others. Researching the composition of MSW allows you to choose effective technologies for disposal - recycling or disposal of waste. The main purpose of which is the recycling of waste into secondary raw materials with its subsequent use.

The conducted research of morphological composition in Tashkent was the first in the history of the city. The works were carried out by specialists of UNDP/UNEP/UZHYDROMET project "Program on preparation of Uzbekistan to access GCF resources" in two seasons (warm and cold).

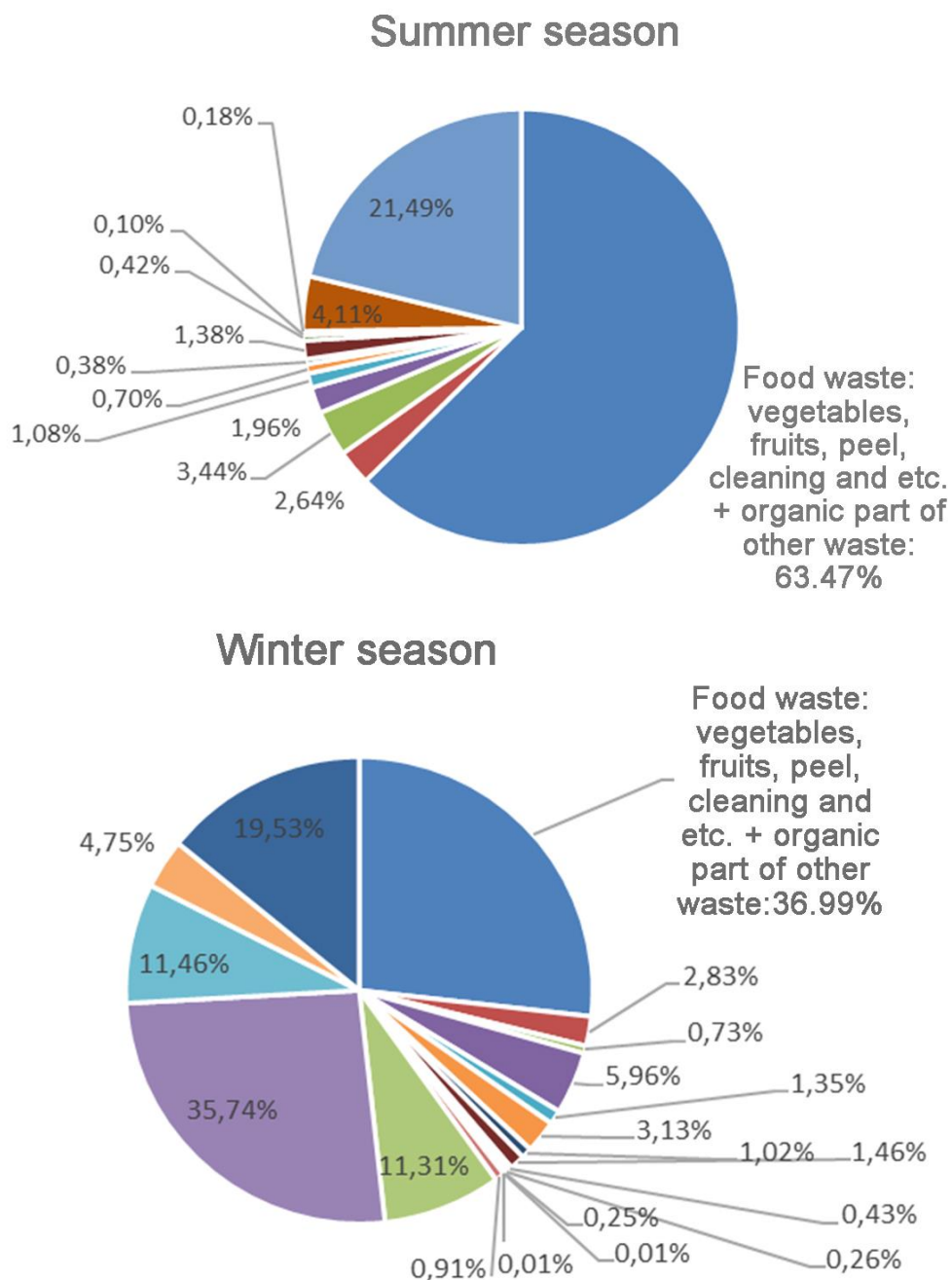


Fig.2. Morphological composition of MSW in Tashkent region in summer and winter period 2017-2018

It can be seen from Fig.2, that the main part of MSW by weight at the investigated areas during cold and warm periods was organic waste 63.47%, taking into account their 90-100% percentage humidity; waste paper is 2.64% in the cold period and 3.51% in the warm period; plastics is 3.44% in the cold period and 5.96% in the warm period. Such differences (twice) are probably due to the fact that the research was conducted in December in the cold period and in late April in the warm period. With the onset of spring, both consumption of soft drinks in plastic containers and consumer demand for food increases. As we know, in Uzbekistan, in the markets and shops food is packed mainly in cellophane and plastic packages.

Table

Main morphological composition of MSW in Tashkent region and Tashkent city

Components	Share, %, in the total volume
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	Throughout the Tashkent region	In the city of Tashkent.	By province of Tashkent region
Food waste: vegetables, fruits, peel, cleaning and etc. + organic part of other waste	42,21	53,42	24,07
Paper and cardboard, including:	2,60	3,59	1,45
Paper packaging for dairy products, juices, wine	0,71	0,92	0,29
Polymers, including:	5,80	5,91	7,42
PET bottle	1,58	2,02	0,93
Glass	2,82	3,50	2,33
Metal, including:	1,06	1,28	1,05
<i>Black metals</i>	0,64	0,93	0,55
<i>Non-ferrous metals</i>	0,44	0,38	1,63
Textile	1,94	1,65	3,08
Wood	0,56	0,70	0,58
Hazardous waste, including:	0,28	0,23	0,39
<i>Medical waste</i>	0,20	0,09	0,38
<i>Fluorescent lamps</i>	0,01	0,01	0,00
<i>Uninterruptible power supplies (accumulator, batteries)</i>	0,07	0,14	0,01
Leather, rubber, bones, including:	0,68	0,36	1,36
<i>Bones</i>	0,10	0,20	0,18
Plant waste: branches, roots, stems, leaves	16,00	1,96	30,62
Others, including:	26,10	27,46	27,64
Diapers, diapers	8,91	5,42	8,88
<i>Stones, construction garbage</i>	2,87	1,01	3,13
<i>Other (street estimates, soil, fine fraction inorganic waste)</i>	22,00	22,52	15,63
Total:	100	100	100

The above data indicates that 58.6% of waste in Uzbekistan consists of combustible materials and 41.4 % of non-combustible materials. Of food waste, 70% is combustible waste, which accounts for most of the waste produced. The majority of food waste is currently disposed of in landfills. Municipal waste in Uzbekistan is not separated into food waste and recyclable waste and is mixed at unloading, which creates many management and operational problems.

There are 8 MSW sorting facilities in Tashkent region, where the applied technology is manual sorting of unprepared mass of initial MSW ("dirty garbage"). The technology is environmentally and economically unjustified. The technological process of sorting is carried out in unsanitary and uncomfortable conditions.

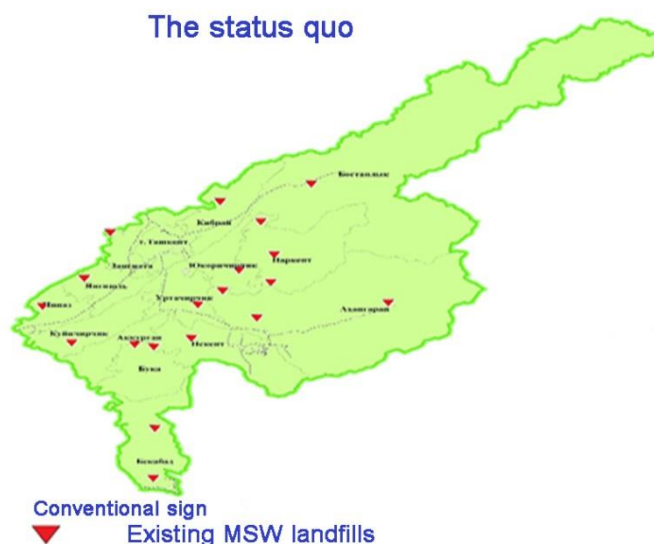


Fig.3. Disposed municipal solid waste at landfills and amount of MSW in regions (ton)



Fig.4. Improvement of MSW management system in Tashkent region

According to the data of the State Committee of Ecology of the Republic in Tashkent region there are 87 objects for disposal of production and consumption wastes (Fig.3) with total area of 926,5 ha, out of which only 42 objects (with total area of 707,2 ha) have licenses. In Uzbekistan the Concept of optimization of integrated MSW management in the Republic and creation of progressive model of waste management, which provides for step-by-step solution of MSW problem taking into account perspective scheme of MSW flow distribution, was developed and submitted to the Ministry of Ecology (Fig.4):

- Increasing the coverage of the population with services for collection and disposal of solid domestic waste from 48% (16 million people) to 100%;
- Increase in the volume of processed solid domestic waste from 18% (1.3 million tons) to 65% (4.6 million tons).

In all stages of management there is a partial sorting of waste, the selection is made of waste that is a secondary raw material for entrepreneurs specializing in recycling such waste as: metal, paper, plastic (polypropylene, polyethylene), food waste (expired bakery products, slops, vegetables). This partial sorting is performed by stakeholders and is not controlled by the State. These wastes are in demand. At the same time, the city residents generate unclaimed waste that

goes to garbage collection points (GCP) and further to the landfill, which is not subject to processing and disposal due to its complex mixed morphological composition. Among the unclaimed wastes, any mixed waste of biological origin is of the greatest interest. Recycling the organic part of MSW has an important management advantage as environmentally sound waste management and recycling, which will lead to a significant reduction in the environmental impact of solid waste management, including greenhouse gas emissions.

In this regard, we offer an improved scheme of MSW management in the city of Tashkent. This technological scheme will allow reduce the load on the landfill the entering of unclaimed waste organic origin mixed character (UWOOMC), which is not subject to processing.

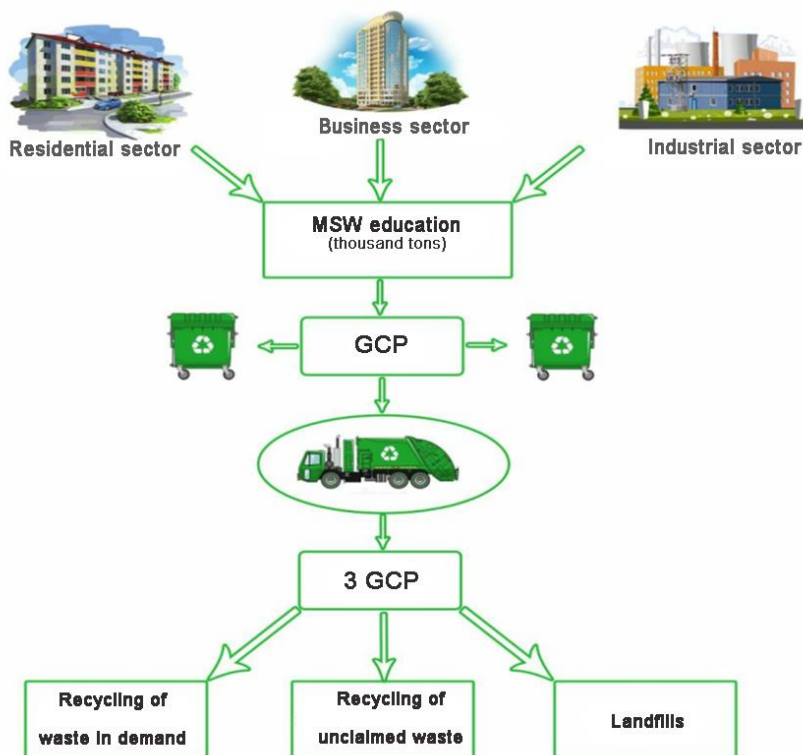


Fig.5. Advanced scheme of MSW management in Tashkent city.

In this scheme (Fig.5), the traditional management model is adopted, which is currently in force, with introduction of an additional stage of processing of UWOOMC. Processing of UWOOMC consists in application of the proposed unit for thermal and thermochemical processing of organic part of municipal solid waste (Pyrolysis unit), with subsequent obtaining gaseous and liquid hydrocarbons in a continuous cycle. This unit allows solving to a great extent the problem of UWOOMC input, thus improving the environment in the area of landfill location.

CONCLUSIONS. Analyzing the technique for the location and organization of the territory of MSW landfills, we conclude that it is necessary to place the territory of the MSW landfill where reclamation can be replaced by the organization and operation of the MSW landfill. It is important to take into account the structural composition of types of waste in the total volume of waste. The proposed method of MSW utilization by recycling into secondary raw materials is initially costly, but it is only at the first stage of organization of this method. Development of qualitative strategy of industrial processing of solid domestic waste will allow in Tashkent and Tashkent region to receive essential benefits at the expense of advance definition of volumes and sources of formation of all types of waste and increase of controllability and strengthening of control over movement of waste, formation of statistics on schedules and routes of waste removal for the purpose of their

optimization. This will have a characteristic impact on ensuring environmental safety and economic benefits. Since MSW is a source of secondary raw materials, their processing can provide significant savings of natural resources, as well as solve the social problem by creating new jobs.

From the environmental and economic point of view, the preference should be given to recycling. Since we use resources that have been created over millions of years of the planet's existence, our task is to use our capabilities and abilities to care for our republic and the planet as a whole. After all, in many respects, our future depends on how we will waste management.

The organization of this method also contributes to the reduction of costs for the purchase of primary raw materials by various enterprises of the processing industry, and to the reduction of the area of landfills required for incineration and disposal.

This method of MSW utilization is the most acceptable option for solving the waste management problems in the country, as it allows solving not only environmental, but also economic problems, which, directly, is an important argument in choosing one of the methods of MSW utilization.

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