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WASTE MANAGEMENT: ACCOUNTING PROBLEM

***Annotation.** The research is devoted to the survey of statistical data in the sphere of solid waste utilization and recycling in different regions of Ukraine. In the article cited information as to amount, volume and morphological composition of solid waste products based on information received from local authorities of cities are regional centers of Ukraine (except for the temporarily occupied areas of Donetsk and Lugansk regions and the Autonomous Republic of Crimea). Based on the analysis of the reporting approaches that have developed in different cities, shown existence of significant differences and discrepancy between some accounting indicators that influence on the state work of mass counting and amount of solid waste products, and determination of their morphological composition. Formulated proposals for unification of the approach to the implementation of the accounting of quantitative and qualitative indicators of solid waste products, which will help to more accurately to determine their volume, mass and composition to increase the efficiency of their utilization measures.*

***Keywords:** solid waste products, utilization, proving ground (landfill), accounting, processing, morphological composition of wastes.*

Introduction

Strategic planning of activities in waste management field is possible only if there are specifications for a detailed analysis of the morphological composition of solid waste products, based on which the perspectives of sorting, proper subsequent using of each type of waste products in accordance with their physical, chemical, biological, energy and other individual specifications can be determined. However, today there is a lack of the only methodological system approach to waste accounting and analysis of their morphological composition, which makes it impossible for any reasonable and well-considered actions to reform the sector of sorting, processing and utilization of waste products at the national level. Waste management issues were the subject of attention of ecology-specialists, chemists, farmers and authors of concepts and government programs of rational nature management. The analysis of scientific publications of Ukraine and foreign scientists on this topic shows that the problem of environmental safety and soil condition monitoring was mainly investigated (Zhovinsky E., Klymenko V.I., Kovda V.A., Kravtsova V.I., Kuraeva I., Stepanchuk O.V.), land usage and protection (Krzhasovsky G., Greben O.S., Danylenko A.S., Radchenko K.G., Alboshchy U.M.), separate ecological aspects of waste management (Korablyova A.I., LIalko V.I., Medvedyev V.V., Rudko G.I., Shykula M.K.). At the same time, insufficient attention was pay to legal aspects of waste management in mentioned branch, and therefore the purpose of the article is to develop proposals for the introduction of a unified system of accounting for solid waste products in all regions of Ukraine.

1. Mass and volume indicators of the amount of solid waste products

In accordance with Article 30 of the Law of Ukraine «Local Self-Government in Ukraine», the issue of gathering, transporting, utilization and disposing waste products is belongs to the executive bodies of village, settlement and municipals councils [1]. In accordance with Article 20 of the Law of Ukraine «On Waste» the compilation and keeping a register of entities for the formation, processing and utilization of waste products and list of places for removing of these wastes belongs to the powers of local state administrations [2].

Within the framework of this research, which is part of the systematic scientific research on the issues of utilization and processing of solid waste products, was collected and summarized information from all regional centers of Ukraine about the amount and volume of solid waste that generated in each place. Also, concerning to the morphological composition of waste and the directions for their further utilization, including through processing.

For the formation of the following indicators, were use official answers to information request of executive bodies of local self-government of a number of cities – regional centers of Ukraine, including: Executive Committee of the Mykolaiv State Council from 28.07.2016 № 7687/02.02.01-21/14/16, housing Department of the Executive Committee of the Kharkiv State Council Committee from 27.07.2016 № c-1-10/1529/0/180-16/08-39-6873/0/129-16, Executive Committee of Kherson City Council from 14.07.2016 № 8-7576-18/23, Executive Committee Uzhgorod City Council from 07.07.2016 № 1928/03-17, Department of Housing and Communal infrastructure of Kyiv State Administration from 22.06.2016 № 058/4/2-6168, Executive Committee Lutsk State Council from 02.07.2016 № 1.1-814236, Executive Committee Ivano-Frankivsk State Council from 30.06.2016 № 3105/01-20/14, Department of Housing and Communal Services of Khmelnytsky State Council from 24.06.2016 № c-14573-16, the Main Department of Housing and Communal Services of Kirovograd State Council from 01.07.2016 № 4535/23-05-26 (also other official sources), concerning the volume of solid waste products for 2015 year about each of the mentioned cities.

The empirical basis of research is official information received in response to requests directly from mentioned organizations.

Based on the results of analysis of statistical and other information it was determine that at the local level there is in fact absolutely unavailable the only balanced systemic centralized approach: at the very stage of calculation of the volume of waste products and its composition, there are significant differences in the approaches of reporting entities, which, in turn, prevents the development of any qualitatively new proposals and recommendation for reforming the industry and improving the legal relationship in this area.

As shown results of the researching, in some cities waste accounting is carry out in their volume, in others by their weight (mass), some are not at all.

As the first example, one should look at the approach of Chernigiv State Council to the calculation of total annual waste generation in Chernigiv city, which are located at the landfill of solid waste (Masany district) m^3/t (table 1):

Table 1. Annual volumes of waste generation in Chernigiv city

Year	Mixed type of waste	Waste of green economy	Street garbage	Building waste	Industrial waste of the fourth grade of danger	Just a year
2012	585,9 thous.m ³ /171.2thous.ton	10380m ³ /2076t	11869,3 m ³ /2373,86 t	126m ³ /25,2t	7446,86m ³ /1489,3t	615,7thous. m ³ /123,1thous.t
2013	599,5 thous.m ³ /119,9 thous.ton	6411m ³ /1282,2t	10935 m ³ /2187t	44m ³ /8,8t	6523,26m ³ /1304,65t	623,4thous. m ³ /124,7thous.t
2014	598,8 thous.m ³ /119,8 thos.ton	11481m ³ /2296,2t	-	60m ³ /12t	5175,7m ³ /1035,4t	615,5 thous.m ³ /123,1thous.t
2015	600,3 thous.m ³ /120,1 thous.ton	8900m ³ /1780t	-	85m ³ /17t	3960,35m ³ /792,07t	613,2thous. m ³ /122,6thous.t

The scheme of sanitary cleaning of Chernigiv City provides for solving the issues of solid household waste management in the city with the use of sorting, processing and repeat using of waste products. Among the main directions of strategic development in waste management of this sphere in Chernigiv City is planning for construction of a city waste recycling complex.

In accordance with the Program of Improving the Environmental conditions of Chernigiv City for 2016-2017 (approved by the decision of Chernigiv City Council from 31.03.2016 № 6/VII-20) in Chernigiv City is foreseen for providing of utilization of danger wastes which are formed in a sleeping area of city (fluorescent lamps, thermometers).

As for other examples, in Mykolaiv City accounting of solid waste gives in meters of cubic: thus, for 2015 was accumulate and transfer to landfills in general 905799 m³. The population of Mykolaiv is 487 thousands citizens, that is, to the arithmetical calculation per year, for one resident of Mykolaiv average is 1,86 m³ of wastes.

In Kharkiv City on two landfills were send in general 3121000 m³ of waste products, at the same time, considering the population of Kharkiv City (1,43 million citizens) volume of manufactured waste per one person per year is 2,18m³.

In Kherson City, waste accounting is carry out by mass: in 2015 to landfill was deliver 60488000 tons of waste products, considering the population (296 thousand citizens) – per one resident of city account for almost 205 kg. of waste per year.

In Uzhgorod City, the annual accounting of waste is carry out as by volume, so as by weight, and an average of 250000m³ (29377000 kg), and therefore, considering the population of city (115 thousand citizens) per one resident per year is 2,17 m³ (255 kg) of wastes.

In Kyiv City, more than 1,2 million tons of waste is produced per year (6 millions). The annual volumes of waste generated on the territory of the communal property and private sector housing in Kyiv, forming 3,9 million m³, or 780 thousand tons; on the territory of enterprises, organizations and institutions – about 2 million m³, or 400 thousand tons. That is, considering the population of Kyiv City (almost 3 million people) – up to 400 kg (2 m³) of waste per one resident.

In Lutsk City, per one resident is 2,4^m of wastes annually.

A similar situation with regard to the amount of waste per one resident of other Regional points (in the weighting – one resident Regional center «produces» more than 2 m³ of waste with weight more than 250 kg per year.

At the same time, it should pay attention that there are significant differences between the volumes of «produced» rubbish per person – from 200 to 400 kilograms per year.

2. Specific of morphological composition of waste products

The category of waste, as defined in Article 1 of the Law of Ukraine «On Waste», are wastes, which formed during the process of life and activity of a person in residential and non- residential buildings (solid, large-sized, repair, liquid, except for wastes associated with production activity of enterprises) and are not used at its place of accumulation.

Concerning to situation with morphological (qualitative) waste composition, it is absolutely complicated and confusing.

For example, the indicative morphological composition of solid waste placed on the landfill of solid wastes (Masany area) in accordance with the scheme of sanitary cleaning of Chernigiv City, approved by the decision of the executive Committee of Chernigiv City Council from 15.04.2016 № 125, Fig. 1:

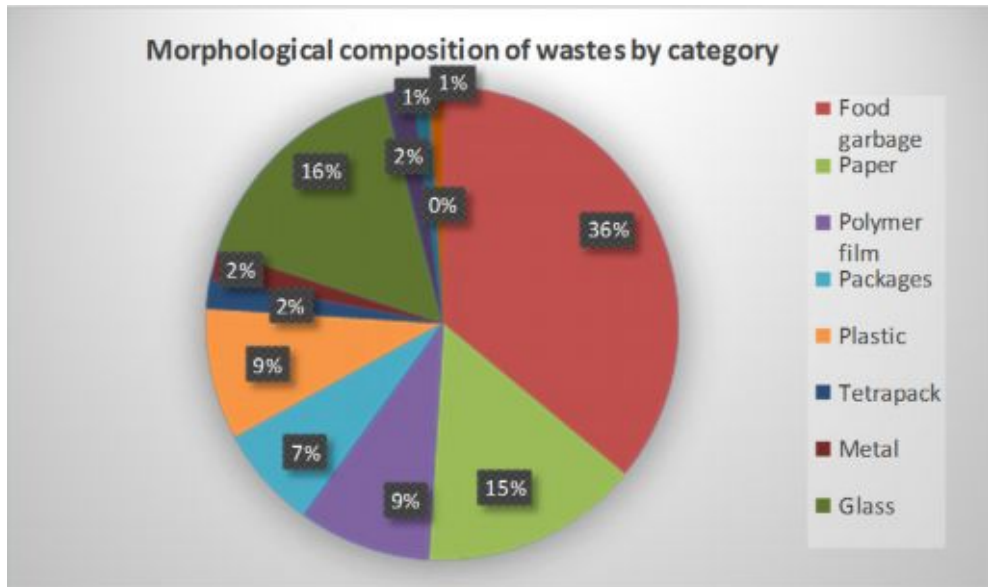


Fig. 1 –Morphological composition of waste on the example of Chernigiv City

In Vinnytsya City accounting of waste products by types of human activity, as a result of which they are form is not conducted.

Competent morphological composition of waste products in Vinnytsya City shown on Fig. 2.

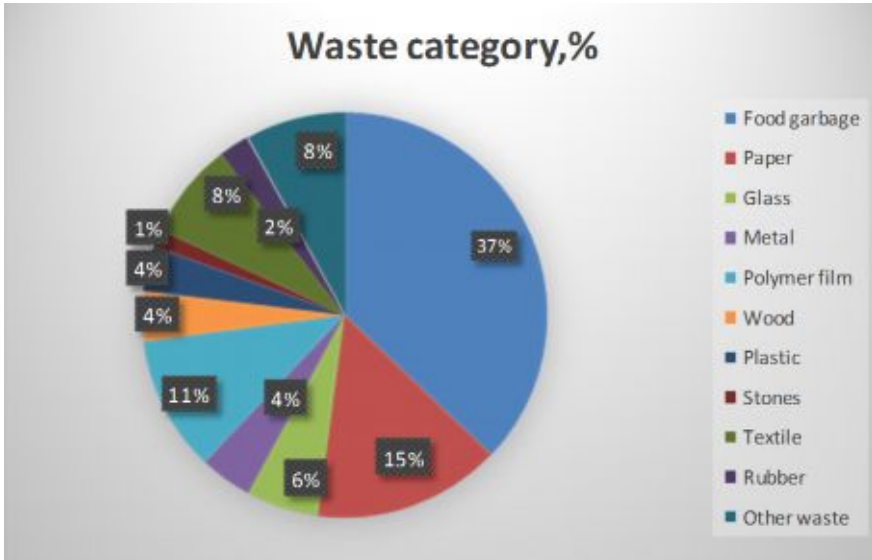


Fig. 2 – Morphological composition of waste on the example Vinnytsya City

The approximate morphological composition of solid waste in Odessa City shown on Fig. 3:

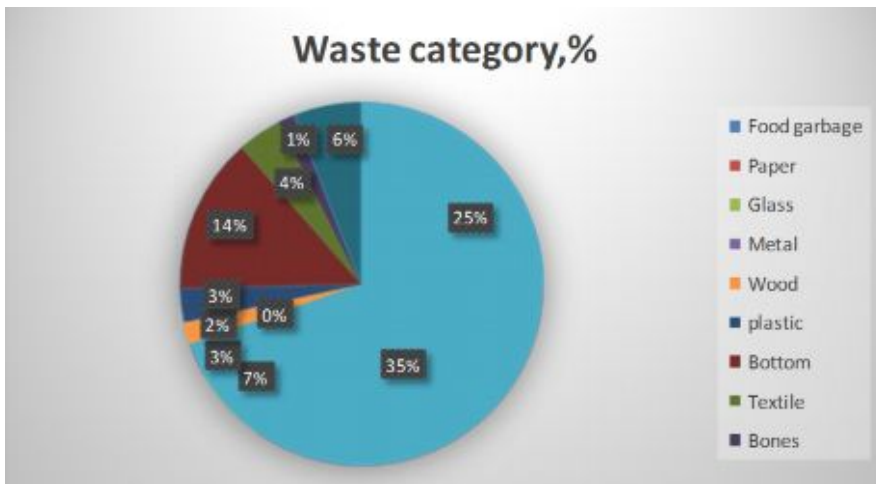


Fig. 3. – Approximate morphological composition of solid Waste in Odessa City

Detail of solid wastes by periods, districts, composition and types of human activities in Odessa is not carry out.

According to researches of the morphological composition of solid waste, which are formed in Kharkiv city (Fig. 4), on average, contain (as a percentage of the mass) – in residential buildings.

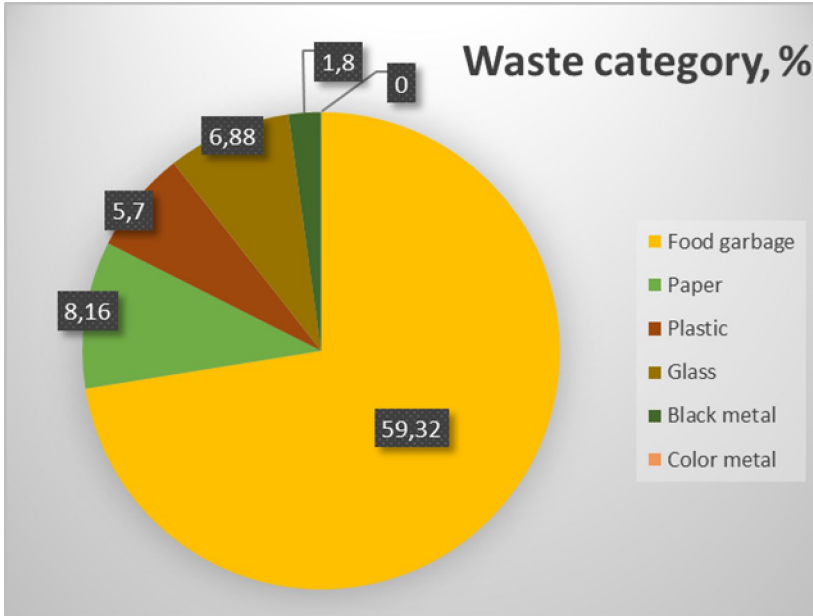


Fig. 4. – Morphological composition of wastes on Kharkiv City example

Also, we can see morphological composition of landfill waste of Ternopil (1 ton or 4 m³), as shown on Fig. 5:

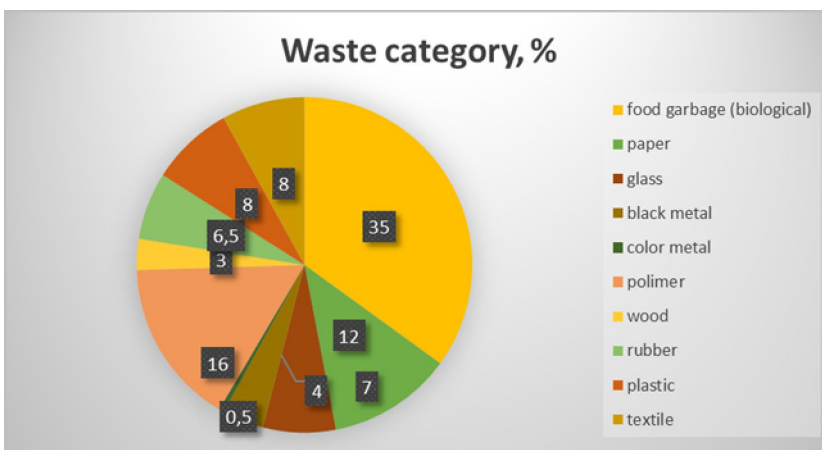


Fig. 5. – Morphological composition of Ternopil landfill

According to these indicators, morphological composition of waste in Uzhgorod significantly different: the largest part is not food (garbage) waste (as in most other regions), but streaks, stones and construction rubbish. As for the last one, building waste (construction rubbish) using at the landfill for spillage of garbage layers to prevent fire. For every 2-3-m of compressed garbage, the earth or construction waste is plummeted by 0,5 m – in the case of fire appearing, the fire spreads only to the upper layer and does not spread to the depth.

In many other cities, where there is no separate collection of waste, it is impossible (there is no possibility) to provide even an approximate detail of them, according to the morphological composition.

In the case of food waste, their composition in the total volume (mass) is follow:

- Mykolaiv city - 55,54%,
- Kharkiv city – 59,32%,
- Uzhgorod city – 10%,
- Lutsk city – 25%,
- Khmelnytsky city – 40%,
- Kropyvnytsky city – 64,4%,
- Odesa city – 25%,
- Chernigiv city – 36%,
- Ternopil city – 35%.

Approximately the same differences there are in other cities, where the waste volume oscillate from 10% almost to 60%.

It can't be consider, in some cities of Ukraine the structure of nutrition (consumption of food products) of residents is different from consumption in other cities, for explaining of these differences in traditions of food consumptions and production of food residues. Obviously, these discrepancies arise because of incorrect displacement and arbitrary «mixing» of the mechanisms and calculation principles when incompatible combinations of mass and volume as reporting criteria are applied at different stages of accounting.

The same situation with construction waste: in Khmelnytsky, the volume of construction waste (garbage) – is 8%, in Uzhgorod city together with stones and street garbage, this category reaches 40%, in Kropyvnytsky city – 6,2%, in Ternopil – 6,5%.

For other components of waste: for example, in Chernigiv city, the declared amount of waste glass is 16%, while in other cities it does not exceed 5-6%.

In Kherson, Ivano-Frankivsk, Cherkassy and Kyiv cities (and more than half of regional centers), accounting of morphological composition of waste products is not carryout at all. For example, in Poltava city general annual volume of wastes for 2015 is 604 721 m³, of these, the wastes of enterprises, institutions and organizations of all forms of property amounted to 186621, 02m³, the population (department housing, housing stock №2, private housing sector) is 418100 m³ (letter of Department of Housing and Communal Services of the Executive Committee of The State Poltava Council from 24.06.2016 № 010501/09/35-zi).

Separate waste collection is not conduct in the city; therefore, it is not possible to provide detailed information on morphological composition. Disposal of waste products, their final placement is carry out at the Poltava city dump, located in Makukhivka village of Poltava district, Poltava Region.

3. The problem of waste accumulation and classification

Any landfill (besides the fact infiltrate leaks into the soil and contaminate water resources and atmospheric air is spoiled by rotting), it is also the source of methane gas that gives rise to the surface and cause fire. Waste sorting, their processing and the practice of using as an alternative source of electric or thermal energy are used only in some cities, while in other settlement this issue is only at the stage of discussion. Specifically, in Vinnytsya from 2015 started the project of minimization and separate collection of waste, which realize by «ECOVIN» communal unitary enterprise. The project is competent on reducing environmental pollution and minimization of waste amount, saving natural resources, reducing the load on the existing landfill of waste products and more efficient exploitative of waste sorting station. Wastes in Vinnytsya are divide into two fractions: «dry» and «wet» for which installed separate containers. To the «dry» are PET-bottles, paper, glass and metal, to «wet» - food garbage, dirty packages, waste of green economy. During the last ten years, CUE «EKOVIN» tares care about this landfill.

City landfill of wastes is located on territory of Stadnytska village council outside of a settlement, exploitations from 1982. Nowadays, nobody can remember about ecological tragedy, which threatened in 2000s on the landfill, as it happened on territory some other settlements, which located near the waste landfills. But in Vinnytsya than began the first attempts to develop their own projects, German colleagues came to the aid, and thanks to determination they managed to achieve significant positive changes.

So, square of landfill is 16,0128 hectares, the total amount of accumulated wastes for the entire period of operation – 16,2 million m³. Wastes are stored only within the determined landfill on specified work cards. Also, for reducing load on waste landfill installed waste sorting station. Resource valuable waste products, which classified, using for further processing. According to rough estimates, due to the introduction of waste sorting, landfill load discharged to 10% (primarily due to the removal of plastic containers and some other resource-wasting waste). In plans – increasing this indicator to 30%, what is average in Europe.

Considering that the huge amount of wastes accumulated on landfill, this place is using for extraction of methane, which is the main component of natural gas. On landfills, methane is formed as a result of organic traces rotting without access to air, when the wastes decomposes in naturally way under soil layers.

From methane at the Stadnytsky landfill, than they produce electrical energy. And, biogas, according to experts valuations, will suffice for at least the next 15 years. On waste landfill territory, there are installed more than 10 mobile pores (wells), each of which can reach up to 20 meters. This, above all, contributes for degassing of landfill and reduces the risks of explosive mixtures formation and fire occurrences.

Subsequently, methane is supplied to the block-modular thermal power station, where use on a special installation for generation both energy: electric and thermal. The daily capacity (plant operates 24h) is about 24 MVt of electricity and 43,2 MVt of thermal energy, this amount is enough to meet the needs of the entire neighborhood of city. According to Vinnytsyaoblenergo convinces, such amount of generated electricity allows to compensate for its shortage in «rush hours» periods and to ensure consumer's needs, accordingly. Unfortunately, in many other regions such projects are absent. In addition to «official» landfills, in Ukraine there are

more than 30 thousands of illegal - spontaneous wastes' landfills. Accumulation of wastes brings huge geoeconomical, economic and social damages, - according to G. Krasovsky and O.S. Grebin affirmations, - the task of mapping, monitoring of storage sites for various types of waste – one of the most urgent in the environmental protection sphere. For solving this problem, researches are suggests using modern geoinformation technologies and remote sounding of Earth. In particular, using the means of constructing a multi-criteria system based on software of ArcGIS will allow not only solving the problem of dealing with existing spontaneous landfills, but also brings possibility for planning placements, volumes and priority types of waste depending on the quantitative population size and the type of activity of region for organization of management by established landfills [3, pages 44 – 45]. Such proposal, of course, deserves for attention, but, even the practical application of such program means does not eliminate the cause of excessive accumulation of waste, which is due, first of all, to imperfect approaches to their accounting at the stage transporting to utilization places.

All places for waste utilization – landfills, complexes, foundation pits, structures, subsoil areas (those are functioning, closed, and preserved) should be included to the list of waste utilization. The register of waste disposal sites, as defined in p.4 of Cabinet of Ministers of Ukraine Resolution from 03.08.1998 № 1216 «On the approval of the register of all waste disposal sites», this is a system of data obtained as a result of registration and description of all facilities and specially designed places where removal operations are carry out.

The Law of Ukraine «On waste» determine that state classificatory of wastes – is a systematic list of codes intended for using in national statistics in order to provide comprehensive and substantiated information about formation, accumulation, treatment (recycling), rendering and waste utilization. Paragraph 2 of Article 33 of mentioned Law also prevision a special passport is drawn up for each place or object of storage or disposal wastes, which specifies the name and waste code (according to the state classification of waste), their quantitative and qualitative composition, origin, as well as technical characteristics of places or objects of storage or elimination and information about control methods and safe operation of these places or objects.

However, the practice shows that in some regions of Ukraine, there are many problems with certification of waste elimination places; first of all, because existing waste elimination places (landfills) have exhausted their technological capabilities, their exploitation periods are over. This requires the solution of the question of determining of new locations of such facilities, or, in the case of impossibility, – to continue the term of exploitation of existing ones. For example, Cherkassy region, the term of exploitation of landfill is over, so as rubbish dumping in Barvinok village of Zakarpatska region, already in the summer of 2017, has filled so much that it will be impossible to export the waste somewhere. Seven years ago this landfill was supposed to be closed, but it still functions – at the last limit of those technological possibilities that have remained. Issues related to the placement of new waste landfills for disposal in Cherkassy, and ideally for the construction of waste recycling plant, were particularly discussed only shortly after the tragedy in Grybovychi, but during few months this activity decreased.

Conclusions

Analyze the above discrepancies in approaches of local self – government bodies to the formation of reporting and accounting of amount of solid waste products determine the existence of number negative factors that impede the effective resolution of waste management issues, including the involvement of investors. Among such factors are corruption offenses and misuse of funds from local budgets spent on waste utilization.

However, in order to implement each of the options for solving the problem, the obligatory guarantee of success is the introduction of universal sorting, that is, the separate collection of different waste categories at the stage when garbage is collect at home, and then placed in containers – this issue became relevant in Ukraine more than 10 years ago. Unfortunately, at present, only private enterprises carry out of this problem, which buy some types of waste products from the population for further processing, while municipal communal services do not even ensure of normal installation of containers for the most widespread waste (glass, paper, plastic).

Deserves special attention experience of organizing work in Vinnytsya region (Stadnytsya), which should be use in other large cities and region of Ukraine, as the installation of facilities for degassing landfills will allow extracting methane continuously and using it in the fuel and energy complex.

Besides that, it is consider necessary to introduce a single integrated centralized reporting system for accounting of solid wastes, an integral detail analysis of their morphological composition, introduction of common accounting standards. Such unified system should be based on the obligation to calculate the mass, volume and morphological composition' parameters, which, accordingly, is possible provide in condition of waste sorting adjusting. However, future compliance with these requirements will significantly improve the reporting process (eliminating existing imbalances in indicators) and control of execution determine standards and waste management rules.

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