

**SPECIFIC OBJECTS OF ACCOUNTING IN ORGANIZATIONS ENGAGED IN THE DISPOSAL OF MUNICIPAL WASTE IN ACCORDENCE WITH THE STAGES OF THE LIFE CYCLE OF THE LANDFILL**

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**Summary:** *The article describes the activities of organizations engaged in the disposal of communal waste and biogas extraction, which is determined by the stages of the landfill life cycle. The content and a certain sequence of business processes within each stage of the landfill of life cycle allowed to identify the specific accounting objects. Definitions of new objects in accounting as gaseous (energy) resource and assimilation resource are formulated, and the possibility to recognize them as an assets of the organization is proved. Obligations with an indefinite period of performance or value associated with the need to decommission the landfill and restore the environment, as well as contingent obligations associated with the potential ignition of the landfill, are highlighted. The presented objects of accounting contribute to the formation of an integrated accounting and analytical information base, providing management decisions in the framework of the tasks to eliminate environmental problems, consumption of natural capital and resource saving.*

**Keywords:** life cycle of the landfill, municipal waste, biogas extraction, technogenic energy resource, assimilation resource, assimilative potential, environmental obligations (liabilities) under uncertainty

**JEL Classifications:** Q29, Q42, Q53, Q57

**Introduction**

The growth of consumption in recent decades around the world has led to a significant increase in the disposal of municipal waste, which reduces the level of environmental safety.

In accordance with the National Strategy for the Treatment of Solid Municipal Waste and Secondary Material Resources in the Republic of Belarus for the period until 2035, the activities of organizations collecting municipal waste and their disposal are aimed at solving environmental problems and resources saving by improving systems and methods for treating municipal waste. The main current principle of the strategy in Belarus is «prioritizing the use of waste in relation to their disposal» (Elmqvist, T., Maltby, E., 2010).

The activities of organizations engaged in the disposal of municipal waste and the extraction of biogas have a number of features: the specifics of the acquired rights to collect, process and dispose of waste; various methods of waste collection and accumulation on specially equipped sites, sorting and neutralization; various methods of burial and degasification; acquisition of ownership of secondary resources; the lack of a direct link between the costs incurred for collecting, sorting at the site of the landfill and the volumes of secondary material resources received, which could be involved in the economic process with economic efficiency and expediency; the lack of a direct link between the costs incurred for the collection and disposal of waste and the amount of energy resources received (biogas); high cost of organization and implementation of activities related to minimization of environmental risks and environmental impact; the long period between the commencement of waste disposal, biogas recovery and landfill closure and land reclamation activities; significant amounts of landfill reclamation obligations. The results of the activities of the analyzed organizations directly depend on: qualitative and quantitative characteristics of waste, on the current climate in which the landfill is localized; controlled and uncontrolled emissions of pollutants in the process of waste destruction and assimilation of the final products of waste decomposition into the environment.

Thus, the activities of organizations engaged in the disposal of municipal waste and the extraction of biogas is complicated, focused on resource, energy conservation and environmental management. However, the completeness and content of accounting and analytical information does not fully comply with the requirements for effective management of municipal waste.

Taking into account the specifics of the activities of the organizations engaged in the disposal of municipal waste, the **purpose** of this study: to identify specific objects of accounting, which will form the information base necessary to solve environmental problems, resource conservation and environmental management in the context of the «green» economy. In order to achieve this goal, it is necessary to study the business processes of organizations engaged in the disposal of municipal waste at the appropriate stages of the life cycle of the landfill.

**Business processes of organizations carrying out municipal waste disposal in accordance with the stages of the life cycle of landfill**

In accordance with the technical code of established practice «KTP 17.11-02-2009 (02120/02030) Objects of solid municipal waste disposal. Design and operation» of the Republic of Belarus there are the following stages of the life cycle of the landfill: 1. Design and construction of the landfill; 2. Operation; 3. Closure and reclamation.

The requirements of regulatory documents do not prescribe certain terms of installation of equipment for the removal of biogas from the landfill body during the operation of the landfill. The technical code of the Republic of Belarus focuses on the creation of a degasification system (removal of biogas from the landfill body) at the stage of remediation of the burial site, when the object may still be in active formation of gas emissions.

The requirements of the European Union regarding the design, construction and operation of landfills provide for the design of disposal lands that will not create an excess load on the environment after their decommissioning.

This approach prevents the transfer of a solution to an environmental problem for an indefinite time in the future. The problem should be solved by the generation of those who pollute the environment. Accordingly, the cost of installing biogas equipment, its maintenance and other costs should not be passed on to future generations (Greedy D.R., 2010; Lechner P., Huber-Humer M., 2011). Thus, degassing is expected during the operation of the landfill, and not at the final stage. So, in international practice, the actual of existing approaches to the creation of disposal landfill that meet the principles of minimizing emissions at the post-operational stage is the construction of landfill-bioreactors.

After analyzing the documents of the Republic of Belarus, the Russian Federation and international approaches in terms of the design, operation and rehabilitation of landfills, in Table 1 we present the totality and sequence of business processes for organizations engaged in the disposal of municipal waste and the extraction of biogas to the surface of the landfill (Table 1).

**Table 1. Business processes of the organization engaged in the disposal of municipal waste and the extraction of biogas at the stages of the polygon-reactor life cycle**

Stages of the municipal waste landfill life cycle	Set of business processes	Content
1. Design and construction of the landfill	- the arrangement of the municipal waste landfill	Selection of the site for the disposal landfill; design, construction and installation of industrial and sanitary protection zones; placement of the production area for sorting and processing of municipal waste; Installation of devices, pipeline (biogas complex) for the collection, separation of gas-water mixture of filtrate and biogas.

2. Operation	<ul style="list-style-type: none"> <li>- collection and transportation of municipal waste to disposal sites;</li> <li>- waste sorting on special sorting lines just before their disposal;</li> <li>- municipal waste disposal;</li> <li>- filtrate collection, biogas extraction</li> </ul>	<p>Collection and transportation of municipal waste; unloading waste at the work site;</p> <p>sorting waste that can be re-involved in the economic process; the storage of waste in the pit of the landfill (burial);</p> <p>collecting filtrate and extracting biogas; filtrate neutralization</p>
3. Closure and reclamation	- landfill decommissioning and land reclamation	<p>Technical and biological activities.</p> <p>Technical activities include compaction of the landfill body, backfilling of the resulting dips, decommissioning of degassing systems for landfill gas, etc.</p> <p>Biological activities include work related to the preparation of the soil, the selection of planting material</p>

*Source: developed by the author*

In accordance with the designated stages of the landfill life cycle and the corresponding business processes, we will select specific accounting objects in order to build an integrated accounting system for organizations involved in the disposal and extraction of biogas, the information base of which will meet the interests of implementing tasks in the field of ecology, environmental management and resource economy in the Republic of Belarus.

### **Specific objects of accounting in organizations engaged in the disposal of municipal waste in accordance with the stages of the life cycle of the landfill**

At the first stage «Design and construction of the landfill» obligations arise, the fulfillment of which is expected in the future during the closure of the landfill: the costs of landfill decommissioning and land reclamation, as well as, the withdrawal of fixed assets from operation, intended for biogas extraction (wells, pipelines, compressor and other equipment).

These are environmental obligations with an indefinite period of performance and with an indefinite value, since between the design (construction) of the landfill and its closure can take a significant period of time - from 10 to 40 years.

During this period of time can not only change the cost of the above works, but also the technology of land reclamation and decommissioning of fixed assets.

In accordance with IAS 37: “an existing liability with an indefinite period of performance or an indefinite amount is a provision” (*IAS 37, 2017*). A similar definition of this category is given in the Instruction «Provisions, contingent liabilities and contingent assets» of the Resolution of the Ministry of Finance of the Republic of Belarus (December 28, 2005 №168). The uncertainty of the moment of fulfillment of the environmental liability by the organization is caused by a long period (up to 30 years and longer) of operation of the landfill, during which there may be various factors that can affect the premature termination of economic activity or the extension of the life of the landfill. Uncertainty of the value of liabilities may be caused by technological changes (risks) of landfill decommissioning, or by an increase (fall) in the discount rate, a reduction in the discounting period, which in turn requires a revaluation of the established provision. The existing uncertainty of the time of fulfillment of obligations and the determination of their value may cause difficulties in the formation of a provision at the design stage of the landfill, as well as difficulties in its subsequent revaluation and accounting for revaluation at the stage of the landfill operation.

Within the framework of the current national legislation on accounting, there are no recommendations regarding the determination of the discount rate and revaluation (recalculation) of the provision in case of its change.

Thus, at the first stage of the landfill life cycle, it is required to identify a new accounting object – a provision for the fulfillment of environmental obligations under uncertainty.

The second stage «operation of the landfill» includes a number of sequential business processes, the first of which involves the collection of municipal waste and their removal to landfills. This process ends with the transportation of accumulated municipal waste to sorting facilities, where secondary material resources are identified. For example, like rags, cardboard, plastic, etc.

Analysis of the regulatory framework in terms of resource conservation and waste management in the Republic of Belarus, the Russian Federation, the Republic of Moldova, Ukraine indicates the possibility of reuse of municipal waste in the presence of a fundamental feature - consumer properties that can be involved in the economic process. So, municipal waste with consumer properties that may be involved in economic activity are secondary resources.

Secondary resources are divided in international practice into «secondary material resources» and «secondary energy resources». State Standard of the Republic of Belarus «Energy Saving. Basic terms and definitions 1770–2009», Law of the Russian Federation «On Energy Saving and Increasing Energy Efficiency», Law of Ukraine on Energy Saving, Law of the Republic of Moldova «On Energy Efficiency» interpret secondary energy resources from the perspective of the energy potential of various energy carriers (including waste).

The study of domestic and neighboring countries of the regulatory framework in terms of resource conservation, secondary material resources and waste management showed that the category of «secondary material resources» can have both material and energy consumer properties (potential). We understand that the assignment of a secondary resource to a material or energy category depends on the intentions of further use of the resource and on the prevailing consumer properties of the waste, as well as the technological capabilities of the organization.

Thus, the «secondary material resources» category may include the «secondary energy resources» category. For example, sorted broken glass is a secondary material resource that can act as a raw material for the production of finished products or semi-finished glass. At the same time, cardboard waste, sawdust, rags can be used in the further production of fuel briquettes, thereby acting as a secondary energy resource.

In addition to the costs associated with sorting work, in the process of sorting secondary material resources are formed that have consumer value, which are the object of accounting and are subject to evaluation. Wastes that do not have resource value are subject to storage and tamping in a specially prepared pit (landfill).

In the body of a typical landfill, where waste is continuously accumulated, there is a continuous interaction of waste with the natural environment, which leads to a gradual methanogenesis - the process of biogas formation. Moreover, gas formation, as a rule, is uneven and reaches the maximum stocks and emissions at the final stage of operation of the landfill. The landfill bioreactor with decomposition of organic substances in anaerobic conditions implies additional wetting of waste for optimal life of microorganisms for the purpose of active gas formation during the operation of the landfill. With insufficient moisture of the massif, excessive heat release can lead to a fire of the landfill, and cause serious negative environmental, technological and social consequences.

Accordingly, at the second stage of the landfill operation, during the period of active formation of biogas in the thickness of the landfill, the likelihood of environmental and social obligations arises.

Again, these obligations have uncertainty: the period of occurrence of obligations and their value cannot be determined with accuracy, however, as 100% probability of their occurrence.

Considering that the costs of eliminating the consequences of fire can be very high, it makes sense to create a provision for the elimination of socio-environmental and technological damage either at the design and construction stage of the landfill, or in the first phase of the landfill operation during a period of minor formation of flammable substances in the mass of waste.

The presence of methane in biogas indicates the natural origin of the resource. Confirmation of the fact that biogas is a part of minerals is evidenced by almost identical chemical composition with natural gas. Biogas stocks as a component of mineral resources form the energy potential of an individual organization and the state as a whole. In turn, mineral resources are an element of the national wealth of each country. Biogas stocks in the body of the landfill can act as a resource base

in production if there is a technological possibility and economic profitability of its extraction to the surface of the landfill.

So, in our study, biogas represents an energy-economic potential (methane stocks) generated by decomposition of municipal waste in the body of a landfill under the influence of microorganisms, which can be extracted to the surface of the land by its ecological and economic viability (Trubovich, R.O., 2018).

Considering methane formations at disposal sites as the final link in the chain of substance conversion: «organic substances (*primary resource*) –products — organic waste — methane (*secondary resource*) —energy, then using the term «secondary» to the energy resource is quite acceptable. In this context, it is understood that the primary resources are formed and accumulated in bio-natural (natural) conditions, and the secondary resources are undergoing transformation and are already being formed in the technogenic conditions of economic activity.

It should be noted, when the waste is immersed in the soil of the landfill, the waste becomes a direct source of pollution of the ecosystem. Decomposing waste has an anthropogenic impact on soil, groundwater, air, etc. At the same time, the interconnected components of the natural environment can, within certain limits, absorb waste, recycle it and take it outside the ecosystem, thereby ensuring a stable state and functioning of the natural environment.

Today, the ecosystem (natural) capital in the international practice involves all the elements of the natural resource potential that contributes to the increase in national wealth. The ecosystem (natural) assets include natural resources, resources regulating and supporting the functioning of the ecosystem and other resources. In economic literature, publications, international reports «Ecosystem Resources» are frequently identified with the category of «environmental services». This identification of the concepts is due to the fact that the very ecological services of the ecosystem are just a special form of consuming the ecosystem resource, the use of which brings certain benefits. According to the main international standards focusing on the classification of ecosystem services (resources), ecosystems from a functional point of view are provided by regulatory and supporting (preserving) services (resources), one of which involves a waste assimilation.

R. Constanza, H. Daley, F. Torez, S.N. Bobylev, V.M. Zakharov, N.I. Bazylev notice the ability of ecosystems to rework (decompose) waste, to control pollution, to maintain the level of detoxification. Consequently, the category of «ecosystem services (resources)» includes the service (resource) of waste assimilation by ecosystems, providing benefits to society by ensuring the undisrupted functioning of an ecosystem.

Exploring the concepts of “assimilation capacity”, “assimilation resource” and “assimilation potential” in the works of such authors as Vishnyakova S.M., Vishnyakov G.A., Aleushkin V.I., Bocharova N.G., Nikitenko Yu.V. (*Vishnyakova, S.M. and others, 1998*), Sharon Beder, Tom Barker, Martin Mortimer (*Elmqvist, T., Maltby, E., 2010; Sharon Beder, 1996*), as well as the international standard “Biodiversity, ecosystems and ecosystem services” (Biodiversity, ecosystems and ecosystem services), we proposed the following definition: assimilation resource- the continuous flow of the ecosystem resource produced by the system of functionally interconnected components of the natural environment, which is able to neutralize, absorb, recycle a certain amount of waste or emissions within the permissible anthropogenic load, to remove them beyond the limits of this ecosystem, thereby ensuring its stable (sustainable) functioning; as well as the resource, changes in the flow of which depend on the qualitative characteristics of the ecosystem itself (components of the natural environment), on the one hand, and on the anthropogenic impact on it by the business entity (humanity) on the other hand (*Trubovich, R.O., 2018*).

At the moment, the biogas reserves in the landfill and the assimilation reserves of the ecosystem are not reflected in the accounting system of the organizations of the Republic of Belarus engaged in the disposal of municipal waste and the extraction of biogas as elements of natural capital, while there is a need. The absence of accounting for the consumption of natural capital eliminates the possibility of further calculation of national welfare, the size of national wealth and «green» GDP. Today, at the international level, there are reforms in the system of accounting and reporting of economic entities,

which are caused by the conscious need to include information on the use of ecosystem (natural) capital.

Gaseous (energy) resource and assimilation resource can be assets of the organization if they meet the criteria of the asset. In the Republic of Belarus, one of these criteria is the presence of ownership of the object, which corresponds to the static balance theory. Under the current legislation of the Republic of Belarus gaseous resource (biogas) and assimilation resource can not be included in the assets, as the exclusive ownership of the components of the natural environment belongs to the state (*Law of the Republic of Belarus. Constitution of the republic of Belarus, 1994*).

The absence of these indicators in the balance sheet distorts information about the resource and economic potential of the organization. While the economic and natural potential of the business entity reflects the ability to ensure its long-term operation and the solution of its strategic objectives. In order to disclose the information content about the facts of management, which meets the interests of a number of users, we believe that it is permissible to use the dynamic accounting theory to recognize the gaseous resource of municipal waste and assimilation resource as assets. Thus, IFRS adopt a dynamic accounting theory, which is based on the principle of reflection in the balance sheet of all used assets, regardless of ownership.

Considering the gaseous (energy) resources of municipal waste, as an asset, we believe that the recognition of this object as long-term stocks will be true. The explanation for this is the uneven (unstable) emission of biogas in the body of the landfill over several years.

Thus, in accounting, the stocks of gaseous resources are long-term assets that are part of the stocks of mineral resources (established by the results of laboratory testing and expert evaluation).

Since the organizations engaged in the disposal of municipal waste, produce emissions of waste into the environment regularly, the consumed flow of assimilation resource is carried out on an ongoing basis. That is, the use of this resource is a continuous long-term nature. In this connection, we consider it expedient to recognize the stocks of the assimilation resource in accounting as a long-term asset.

Thus, at the stage of landfill operation, it becomes necessary to introduce into the accounting system new accounting objects: biogas stocks and assimilation stocks of the ecosystem as elements of natural capital.

In our search, we will proceed from the fact that the secondary energy resources (REM), subjected to processing (treating), are secondary raw materials (SRM), which is the starting material for the subsequent production of heat or energy. As part of the study of landfill gas extraction activities, «treatment» should be understood as the extraction of biogas to the surface from the landfill body, its purification in special installations from unnecessary impurities. Accordingly, the next object of accounting is secondary energy raw materials-biogas extracted to the surface of the landfill and cleaned of unnecessary impurities, that is, passed additional processing.

At the third stage, “Closure and reclamation,” it is planned to carry out relevant technical and biological activities. Technical activities include the costs of landfill body compaction (tramping down), backfilling of the resulting failures, decommissioning of degassing systems to collect landfill gas, etc. Biological activities involve costs associated with the preparation of the soil, the selection of planting material, etc. Therefore, at the stage of landfill decommissioning and land reclamation, a business entity fulfills its environmental obligations. At this stage, accounting reflects the use of the formed provision for decommissioning and reclamation of the landfill, assesses its generated (revalued) value in accordance with current expenses during the period of the landfill closure.

It is assumed that at the final post-operational stage, the waste array that has not been destroyed or is at the final stage of decomposition and biogas formation, carries a certain ecological load on the ecosystem, which does not exceed acceptable norms and is assimilated within the polygon ecosystem. Thus, during the reclamation period, the assimilation resource should also be considered as an object of accounting.

In table 2, we present specific objects of accounting in organizations engaged in the disposal of municipal waste and biogas extraction, in accordance with the selected stages of the life cycle of the landfill.

**Table 2. Specific objects of accounting in organizations engaged in the disposal of municipal waste and biogas extraction, in accordance with the selected business processes for the stages of the life cycle of the landfill-reactor**

Stages of the municipal waste landfill life cycle	Set of business processes	Specific objects of accounting
1. Design and construction of the landfill	the arrangement of the municipal waste landfill	-provision for environmental obligations (liabilities) under uncertainty
2. Operation	- waste sorting on special sorting lines just before their disposal;	-secondary material resources (waste, serving as a resource for further production);
	-Disposal(burial) and accumulation of municipal waste in the landfill;	-assimilation resource (assimilation stocks of the ecosystem); -secondary energy resource (biogas stocks); -provision for environmental obligations(liabilities) under uncertainty
	- biogas extraction	- secondary raw materials (biogas after processing and extraction to the surface of the landfill); -assimilation resource (assimilation stocks of the ecosystem);
3. Closure and reclamation	- landfill decommissioning and land reclamation	-provision for environmental obligations(liabilities) under uncertainty; -assimilation resource (assimilation stocks of the ecosystem);

*Source: developed by the author*

### Conclusions

Thus, the activities of organizations engaged in the disposal of municipal waste, focused on rational and efficient waste management, has its own distinctive specifics. The business processes of this activity are determined by the relevant stages of the landfill life cycle. At each of the noted stages, we identify particular objects of accounting, which will contribute to the formation of an integrated accounting and analytical information base that ensures management decision-making in the framework of the tasks to eliminate environmental problems, natural capital consumption and resource conservation.

The direction of further research is to build a model of accounting for ecosystem resources (assimilation and biogas resources) as elements of natural capital, as well as consideration of the assessment (revaluation) and accounting for environmental obligations (liabilities) under uncertainty

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