ANALYSIS OF SOCIAL DIMENSIONS OF KNOWLEDGE OF EDUCATIONAL CONTENT IN MATHEMATICS EDUCATION

ANÁLISE DAS DIMENSÕES SOCIAIS DO CONHECIMENTO DE CONTEÚDOS EDUCATIVOS EM EDUCAÇÃO MATEMÁTICA

ANÁLISIS DE LAS DIMENSIONES SOCIALES DEL CONOCIMIENTO DEL CONTENIDO EDUCATIVO EN EDUCACIÓN MATEMÁTICA

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ABSTRACT: The present study aims to identify contextual and symbolic situations, such as family and school, for adolescents' success in mathematics. In this view, the role of contextual conditions, especially social, in all education and key cases and the socio-cultural nature of this concept is quite prominent. According to the facilities and nature of research, the method of conducting research is social assessment. The research sample included 398 adolescents from six different high schools in Russia. The research results, with 57% capability of changes in students' math score, show how to analyze research hypotheses. The results of multistage regression analysis indicate that classroom conditions as the most important symbolic place in mathematics and physics education have the most important reinforcing role in obtaining a mathematical grade.

KEYWORDS: School, Education, Mathematics, Classroom conditions.

RESUMO: *O presente estudo visa identificar situações contextuais e simbólicas, como família e escola, para o sucesso de adolescentes em matemática. Nesta visão, o papel das condições contextuais, especialmente sociais, em toda a educação e casos-chave e a natureza sociocultural deste conceito é bastante proeminente. De acordo com as facilidades e a natureza*

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da pesquisa, o método de condução da pesquisa é a avaliação social. A amostra da pesquisa incluiu 398 adolescentes de seis diferentes escolas de ensino médio na Rússia. Os resultados da pesquisa, com 57% de capacidade de mudança na nota de matemática dos alunos, mostram como analisar hipóteses de pesquisa. Os resultados da análise de regressão multiestágio indicam que as condições da sala de aula como o lugar simbólico mais importante no ensino de matemática e física têm o papel de reforço mais importante na obtenção de uma nota matemática.

PALAVRAS-CHAVE: *Escola, Educação, Matemática, Condições de sala de aula.*

RESUMEN: *El presente estudio tiene como objetivo identificar situaciones contextuales y simbólicas, como la familia y la escuela, para el éxito de los adolescentes en matemáticas. Desde este punto de vista, el papel de las condiciones contextuales, especialmente sociales, en todos los casos educativos y clave y la naturaleza sociocultural de este concepto es bastante prominente. De acuerdo con las instalaciones y la naturaleza de la investigación, el método de realización de la investigación es la evaluación social. La muestra de la investigación incluyó a 398 adolescentes de seis escuelas secundarias diferentes en Rusia. Los resultados de la investigación, con un 57% de capacidad de cambios en la puntuación de matemáticas de los estudiantes, muestran cómo analizar las hipótesis de la investigación. Los resultados del análisis de regresión de etapas múltiples indican que las condiciones del aula como el lugar simbólico más importante en la educación en matemáticas y física tienen el papel de refuerzo más importante en la obtención de una calificación matemática.*

PALABRAS CLAVE: *Escuela, Educación, Matemáticas, Condiciones del aula.*

Introduction

According to the Art. 1 of the Federal Law No. 89, solid municipal waste is the waste that is generated in residential premises as a result of human consumption, as well as garbage generated in offices and at enterprises during the activities of their employees.

Unlike MSW, solid household waste (SHW) is generated only at home:

- food cooking
- house cleaning
- minor repairs
- removal of damaged furniture, etc.

Thus, initially, the concept of SHW is broader than MSW, since it combines garbage that citizens take out of their homes on a daily basis, as well as similar waste from legal entities (enterprises, organizations, etc.).

According to the bill of 2014, the concept of SHW was canceled and is used only in colloquial speech. It was replaced by MSW, which is used in the official documentation.

In accordance with the definition contained in the Article 1 of the Federal Law No. 89,

MSW is:

- the waste generated during consumption (cleaning of vegetables, fruits, paper, packaging, etc.);

- similar waste generated in the course of legal entity activities;

- the items that are out of order.

In 2019, municipal solid waste management has become an independent utility service provided by regional operators.

Garbage collection costs are calculated now based on the number of people registered in that residential area. But some regions still work according to the old scheme, that is, the price of the service depends on the area of a rented apartment or a house.

In accordance with the order of Rosprirodnadzor No. 242 (05/22/2017), the code 7 30 000 00 00 0 was assigned to solid household waste. This group includes:

1. Garbage from living quarters.

2. Waste from cleaning the territory of urban and rural settlements associated with solid waste.

3. Vegetable debris resulting from cleaning flowers, lawns, etc. in some area.

4. Waste from office and household premises of enterprises, and organizations.

5. Garbage and waste after cleaning railway and automobile stations; airports, terminals; ports; Metro stations; any public transport.

6. Waste from the provision of wholesale and retail services related to solid household waste.

7. Garbage generated in places of temporary residence (public hospitals); the premises where social services are provided (post office, hospital, etc.).

8. Waste arising from the provision of services in the field of entertainment, education, grooming, etc.

The garbage reform involves the introduction of a separate collection of MSW in large cities of the Russian Federation. Two types of containers are installed for this, designed to sort "dry" and "wet" waste. A dry container must contain recyclable materials: paper, plastic, metal, glass. Food and plant residues are classified as "wet" waste.

It is assumed that this innovation will be able to increase the volume of MSW processing by 30% in 2019. You can find out more about the colors of the trash cans and the kind of waste to throw away.

The concept of “waste management” includes the following in the Article 1 of the Federal Law No. 89: collection, accumulation, transportation, processing, disposal, and

placement of MSW.

The new rules have delimited the areas of responsibility:

1. The bodies of local self-government are obliged:

- to provide special sites for the accumulation of solid household waste;

- to develop schemes for the location of these sites and maintain a register of waste accumulation sites in accordance with the rules approved by the Government of the Russian Federation (4, the Article 13.4 of the Federal Law No. 89).

2. A management organization is obliged to maintain cleanliness in the places of waste accumulation and garbage disposal.

3. A regional operator should equip each yard with several containers for "dry" and "wet" waste. If it is not possible to place containers for the collection of MSW (for example, in the private sector), citizens have the right to negotiate with the operator about the unauthorized removal of waste. In this case, the company must provide the consumer with special bags for waste storage (MSW Handling Rules, page 10).

The regional operator is responsible for handling human activity remains since the moment they are unloaded from a container to a bin. Vehicles should be equipped with GPS beacons and weight sensors to monitor the movement of waste from a container to a disposal site. This measure is aimed at landfill volume reduction and the emergence of new illegal landfills.

According to statistics, 50% of the waste can be recycled. The rest of the garbage must be disposed of in landfills. The location of the landfills is chosen by the regional administration with the obligatory approval of the population. Thus, they expect MSW accumulation volume decrease and the number of landfill reduction scattered throughout the Russian Federation in the coming years.

According to the European Environment Agency, household waste accounts for 14% of all waste. This is significantly less than the waste from the mining industry (29%), industrial waste (26%) and construction waste (22%), but significantly more than energy waste (4%) and waste water (5%).

The state of the environment in the country is a public good, since when conducting an environmental and economic assessment of the of municipal solid waste (MSW) processing and disposal efficiency, one can judge the share of social security that is lost in case of an irregular nature and harms the environment. Table 1 shows the morphological composition of MSW in Russia.

Table 1. Morphological composition of solid household waste in Russia

Component	Content, %
Paper and cardboard	18,2
Food and vegetable waste	25,0
Glass	10,1
Polymers	10,1
Non-ferrous metal	0,4
Metal black	4,0
Stone and ceramics	1,6
Textile	5,0
Leather, rubber	2,0
Batteries and radio waste	0,3
Tree	2,0
Medical waste	0,0
Bulky waste	0,3
Other	11,0
Screening (less than 16 mm)	10,0
Total	100,0

In practical terms, the assessment of environmental and economic efficiency serves as a justification for the allocation of funds to develop the facilities for MSW processing.

The main feature of MSW problem is that they are formed in large quantities (each person has about 400 kg / year), and they must be removed from the places of formation every day.

To increase environmental and economic efficiency, it is necessary to form a system for the selective collection of individual MSW components.

The main task in the field of solid waste disposal and processing organization is the economic component. As soon as the population becomes interested in the fact that garbage should be taken out in special containers, and not thrown around, when entrepreneurs see that MSW is a huge resource that can bring significant profit, the situation will be changed dramatically.

Analysis of recent publications on the problem

The theoretical and methodological basis of the study is the main achievements of domestic and foreign scientists in studying the issues of solid waste management concerning nature management, environmental protection, and environmental safety.

Such scientists as I.S. Barsola (2019), Boravskaya T.V. (2019), Dahl H.M. (2018), Militsin Yu.A., Fomin S.A. (2017), Mikhailov A.V. (2016), Nikitin A.T., Militsin Yu.A., Stepanov S.A., Fomin S.A., Klevaein E.V. (2019), Pavlenkov M.N., Voronin P.M. (2016) are engaged in the consideration of solid waste management issues within the spheres of nature management.

However, despite the large number of scientific and practical developments in the field of studying the organization of utilization and processing of solid waste, it is especially important to study the issue of solid waste utilization and processing improvement. The ecological state of the country is a public good. Therefore, by performing an ecological and economic assessment of municipal household waste (MSW) processing and disposal efficiency, one can judge the share of public welfare that is lost due to improper use of natural resources and harms the environment. In practical terms, the environmental and economic assessment of efficiency serves as a justification for fund allocation to construct the facilities for MSW processing and disposal.

Currently, the issue of municipal authority activities to ensure the work with solid municipal waste has not been developed adequately.

Materials and methods

As part of this article preparation, the following methodological methods and techniques were used: logical analysis; factorial and comparative analysis; cost methods. The information base of the research is made up of published statistical materials on MSW. The scientific novelty of the results obtained is in the theoretical substantiation and development of practical recommendations related to the implementation of "Smart" technologies concerning MSW collection at Lyubertsy, Moscow region.

Results

According to 2016, about 9.3 million tons of production and consumption waste is generated annually In the Moscow region.

According to 2016 data the total amount of solid municipal waste generated on the

territory of the Moscow Region during the year is about 3.835 million tons, of which: the hazard class 4 - 2.401 million tons; the hazard class 5 - 1.434 million tons. At the same time, the increase of waste amount is projected proportional to the growth of the Moscow region population at the level of 1.5% annually (in 2016, the population growth was 1.43%).

According to the studies of the amount and morphological composition of solid municipal waste in the Moscow region, carried out as the part of the work to determine the standards for waste accumulation, solid municipal waste has the following morphological composition (Figure 1).

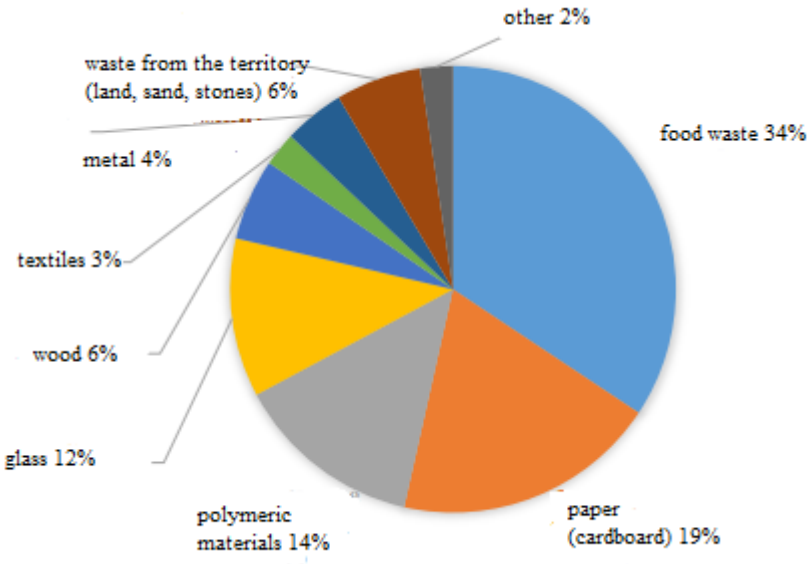

Figure 1. Morphological composition of solid municipal waste

The amount and morphological composition of solid municipal waste varies throughout the year. In particular, with the same volume of waste, their mass and density increase. This is due the amount of food residues growth in the composition of solid municipal waste, which have a relatively high density and mass. In summer, the amount of waste from public catering facilities, parks and squares, hotels and cultural and leisure facilities increases due to the tourist flow increase, but it decreases from educational and administrative institutions due to the period of vacations. Also, in the summer, there is solid municipal waste increase from horticultural, cottage, and gardening non-profit partnerships. In the autumn, the waste is more humid and has an increased weight. In connection with the beginning of the school year, the amount of waste in educational institutions, museums, libraries, and other administrative and cultural institutions increases. There is less solid municipal waste in winter. With the specified composition of waste

at modern sorting stations, it is possible to allocate up to 15 percent of useful secondary material resources. The allocation of a larger share of secondary resources is possible as the result of separate waste accumulation introduction and additional capital investments in sorting yards with long payback periods.

The analysis of the existing system of municipal solid waste accumulation, carried out on the basis of an in-depth study of the waste accumulation system, performed in 18 settlements of the Moscow region, in which 449 thousand people live, showed that the organization of additional container sites is required to create an efficient system for solid municipal waste accumulation on their territory, the total number of which can be estimated at 15 percent of the existing number. A significant number of containers for the accumulation of municipal solid waste (about 73%) are also subject to replacement. In the areas of apartment buildings, the scheme suggests installation of new emptied containers with the capacity of 1.1 cubic meters. m, which are unloaded by garbage trucks with front or rear loading. At the same time, the presence of the lid and the absence of gaps between the lid and the body of the container minimize the occurrence of odors and provide a favorable appearance of the container.

Alternatively, it is possible to install the containers with a volume of 2.5 or 5 cubic meters. m in the places of intensive waste generation, which also allow you to optimize the cost of waste transportation. Plastic or metal tanks with the capacity of 0.12 to 0.24 cubic meters can be installed near the houses of individual residential buildings can be used for the separate accumulation of municipal solid waste. Such containers should be located at each individual house or at a group of several houses and displayed by their owners on the day of solid municipal waste removal.

According to the new rules for solid household waste handling and the number of regional waste operators, the Moscow region was divided into seven territories (clusters). Each operator has its own tariffs for garbage collection, established by the Committee on Prices and Tariffs of the Moscow Region.

In Lyubertsy, EcoLine-Voskresensk is the enterprise that collects and disposes of solid household waste.

"EcoLine-Voskresensk" LLC is a single regional operator for the management of municipal solid waste in the Voskresensky cluster of the Moscow region. The service area includes Voskresensky and Ramensky municipal districts, the urban districts Bronnitsy, Yegoryevsk, Zhukovsky, Lyubertsy, Roshal and Shatura.

The company received the status of a regional operator during an open competition to determine an official organization for the management of solid municipal waste in the

Voskresenskaya zone of the Moscow region. The powers of EcoLine-Voskresensk LLC are secured until 2028 in accordance with the Agreement “On organizing activities for the management of municipal solid waste in the Voskresensk area of the regional operator activities” dated on April 28, 2018.

Since January 1, 2019, the company has been responsible for the full cycle of MSW management: collection, removal, processing, disposal and removal of solid municipal waste. The priority areas of our work are the organization of separate waste collection, increasing the percentage of recyclable materials, and reducing the number of unauthorized dumps.

The enterprise is the part of the EcoLine group of companies, one of the largest federal associations in the field of waste management. The company is actively introducing separate waste collection (SWC).

In order to increase the level of external improvement and sanitary condition of the city territory, to create and ensure the most comfortable living conditions, the municipal subprogram "Renewal of the container fleet and special equipment in the urban district of Lyubertsy, Moscow region for 2016-2020" was developed. As the result of the program activities, modular pavilions and containers (at the cost of 2067 euros) will be installed at 870 container sites. Rear loading garbage trucks are purchased to service euro containers.

104 modular pavilions were manufactured and installed during 9 months of 2019, 448 euro containers with a volume of 1.1 cubic meters, as well as two garbage trucks for euro container servicing were purchased and installed. Due to the introduction of European containers, a shift from side-loading garbage trucks to more efficient rear-loading garbage trucks with a higher compaction rate takes place, which allows loading all types of European containers.

In order to optimize the route schedules of the vehicle fleet and improve the quality of control, the line was fully equipped with modern satellite monitoring equipment. The intelligent navigation system allows for complex monitoring of vehicles in real time using GLONASS/GPS technologies.

Discussion

The annual increase of solid municipal waste development, the morphological composition of which is becoming more complex every year, is one of the main environmental problems in many countries of the world. The problem is especially acute in Russia. In the context of a steady trend of population decline, there is an annual increase of municipal solid waste.

According to many experts, the main problem in the field of municipal solid waste management in Russia is the poorly organized initial stage of treatment - collection and sorting. Efficient separation of waste into fractions is one of the conditions for obtaining secondary raw materials from MSW and helps to simplify waste processing during the production of goods.

Within the framework of this study, a survey was conducted among the residents of Lyubertsy, the purpose of which was to study the factors that promote and hinder the introduction of separate collection of MSW.

The population of various social status, occupation and gender from Lyubertsy took part in the study. 380 people were surveyed. The survey data show that 80% of the surveyed population consider the problem associated with the annual increase of municipal solid waste to be one of the acute and priority ones.

Respondents point out to sorting at the source of generation (51%) as the most effective way to reduce the amount of generated waste. This will facilitate the involvement of municipal solid waste into the economic circulation. Sorting of waste at waste sorting stations is preferred by 34% of the total number of respondents.

Answering the question about their readiness to sort MSW depending on the morphological composition, only 13% of the respondents are not ready to sort waste, 7% find it is difficult to answer.

According to the respondents, the main reasons hindering the implementation of the system for the selective collection of MSW are the lack of places in residential premises for separate storage of waste. This is the opinion of 25% of respondents. The second reason is the Russian mentality (22%) and the lack of information about recycling points (22%).

Thus, summarizing the results obtained, we emphasize the following:

1. A concept of a phased transition to separate collection of municipal solid waste should be developed in the region Lyubertsy, which should outline the priority tasks, medium and long term ones. Organizing the collection of the most profitable MSW (paper, glass, plastic) in terms of the level of processing may be a priority task. In the medium term, it is necessary to envisage the collection of medium-income waste, the volumes of which are insignificant and the price of its processing is high. In the long term, it is necessary to introduce a fee for low-income waste. The answers of the residents of Lyubertsy indicate their readiness to take part in the separate collection of municipal solid waste.

2. The main emphasis on the introduction of separate collection is made by the respondents to increase the level of ecological culture. A law should be developed and adopted at the regional level for the development of environmental culture.

The analysis of the MSW management system in Lyubertsy revealed the following main problems.

1. If new houses have garbage chutes, then they are either dismantled or welded tightly in most houses (built in the 70-ies and 90-ies), and the residents take out their garbage to the containers located near the entrances (spontaneous areas), which is the violation of SanPiN requirements. And actually, there should be no container sites on the territory of such houses, because they do not exist for an architectural project. There is no access to garbage chutes on the floors of such houses, since they have long turned into various auxiliary rooms (so-called storerooms). If a decision is made to return the chutes to work, then there will be a long work with the residents. The creation (or approval) of new container sites, which have been formed spontaneously and have been operating for several years, also requires serious work in terms of equipping and approving their location.

2. The existing container fleet is very "colorful": it consists mostly of old and deformed metal design, simultaneously replacing the entire fleet. Either everything you need to install a container of the same type (one project), or you need to establish production and substantially satisfy a fleet of existing metal containers. New and modern containers have appeared in some places. At the same time, it is necessary to eliminate the differences in the cubic capacity of the existing containers (0.64; 0.75; 1.1 m).

3. The number of containers currently existing in the city does not correspond to the required number and makes 1/3 of the required, according to SanPiN 2.1.2.2645-10. The bins for household waste will now need to be linked with the bins for other types of household waste (for glass, plastic, etc.) and this leads their number increase. The trend of separate collection of household waste is just beginning to develop, and its practical implementation in the field is not clear yet. There is an urgent need to educate the population on this issue.

The digitalization and automation of cities affects more and more areas: road safety, settlement centers, smart intercoms, and the services of management companies. IT developers got to the dumpsters. Soon, everything will be wiser, in fact, even the rubbish.

The IT race to create smart solutions for the urban environment is not a tribute to fashion. The main goal of development is economy. They allow you to manage cities effectively, make these processes transparent and open to citizens, involve them in problem point solution and, of course, predict the situation with different time periods.

With the separate collection system, containers are fill up with waste more slowly than with traditional collection. The sorted waste is removed by different machines. These facts require the operator to work with MSW to introduce new business processes that are easier to

cope with when there is a “smart” system that will take over some of the tasks.

Based on the data concerning the fullness of garbage containers received from sensors and the automatic re-routing of garbage trucks, vehicles do not remain not empty. Accordingly, fuel is consumed efficiently. It is profitable not only for the regional operator, but also for the population, which pays monthly for the operator's services to remove MSW.

Another advantage of the system is its ecological effect. The volume of exhaust gases from garbage trucks is reduced.

The use of the information system provides access to data on the volume of waste generated in a particular area. These data can be used to assess the investment attractiveness of waste processing in a particular region and to calculate the efficiency of investment in such production, as well as the payback period.

Smart containers have appeared at two container sites for separate waste collection located in the cities of Kazan and Innopolis. The project was launched in pilot mode by the Kazan company "Etton", a Skolkovo resident. Special sensors installed on the inner wall of the garbage container work together with the software package. They allow you to analyze the fullness of tanks, "call" garbage trucks to the filled containers and form their routes, as well as predict the situation for the future.

When the waste container is 80% full, the sensor transmits this information to the information system, which notifies the nearest garbage truck and reroutes its route according to the situation. If one garbage truck could not take out the entire volume of garbage, then it may not come back, since the signal goes to the nearest trucks, which can empty the remaining containers along the way.

The operation of the sensors is reflected on the interactive map of the regional operator for MSW management: green - the container is empty; yellow - half full; red - full.

The system collects geolocation data from waste collection machines, information about the container condition, fixes the date and time of the MSW removal and warns of the problems at the waste collection point, for example, about a waste fire or container theft.

The sensors can be additionally installed in the tank of the garbage truck, this will allow scanning it from the inside to the press wall. When this “smart” system is closed in one process, access to data is opened: the volume of garbage in the container, the amount left in the garbage truck and the number of residues after unloading at a landfill or in a recycling center.

Experts believe that one of the main drawbacks of the garbage disposal reform that has begun in Russia is that it will actually deprive local administrations of the opportunity to influence the solid waste collection regime, since the end contractors will conclude contracts

with a regional operator. But as public awareness of the environment grows, more residents are turning to municipalities with independent initiatives to organize separate waste collection in their homes, courtyards, or entire neighborhoods. And local administrations, in general, could assume the role of intermediaries between citizens and regional operators for MSW processing.

Separate collection of garbage and its subsequent processing would make it possible to reuse millions of tons of useful resources, but today no more than 10% of garbage is recycled in Russia, and in European countries this figure reaches 60% on average.

According to experts, there are about 400 kilograms of municipal solid waste (MSW) per year for each inhabitant of Russia, and its total volume makes 60 million tons. The lion's share of garbage goes to landfills, where, according to some estimates, about 100 billion tons of industrial and domestic waste have been accumulated already. The total area of landfills in Russia reaches 4 million hectares, which is slightly less than the area of the Moscow region, for example. And landfills, both official and illegal, will only grow if the current state of affairs continues.

Although the experiments with separate waste collection have shown that not everyone in Russia is ready for this, but in other countries people can gradually adopt a new waste management scheme, if conditions are created for this. These, in addition to environmental education, include the organization of accessible individual waste collection points, as well as a system of bonuses and benefits that encourage this behavior.

Regions should adopt territorial waste management schemes and use an open tender to select operators who will organize waste collection and disposal over the next 10 years and sign contracts with enterprises directly involved in MSW export, disposal and processing. At the same time, all landfills must be brought into line with the new requirements, and waste sorting lines must be installed there.

In 2019, Russia was expected to recycle 20% of cardboard and paper, 20% of tires, 30% of metal containers, 15% of oil and battery waste, 10% of glass, plastic bottles and printing waste, and 5% of electronics. The share of recycled waste should increase every year.

However, only 13 regions timely approved territorial schemes in the government, and they have begun to work on the new system since January 1, 2019. For all other regions of the Federation, the start of the reform has been postponed again - until January 1, 2021. Since the beginning of this year, only the rule has come into force prohibiting the disposal of waste that can be disposed of, but even the list of such waste types will be established by the government only by the end of the year based on a project prepared by the Russian Ministry of Natural Resources. At the same time, despite a special opinion of environmentalists and, in particular,

Greenpeace, mandatory separate collection of garbage by citizens will not be introduced.

Thus, the containers for separate waste collection will coexist with traditional tanks for a long time where everything is disposed of. However, both educational measures and economic incentives can be adopted at the local government level.

Conclusion

The garbage problem is very relevant in Russia. According to the Ministry of Natural Resources, a family of four people dumps about 150 kg of plastics, almost 100 kg of waste paper and over a thousand glass bottles a year. It turns out that there are about 400 kg of garbage per year for every citizen of the Russian Federation. 50 million tons of municipal solid waste is accumulated in Russia annually. Almost all the garbage we throw away is stored in landfills and then it is buried in the ground.

Less than 2% of waste is incinerated in Russia, and only about 4% is recycled. All methods except disposal are harmful to the environment.

As soon as regional waste management operators emerge, maintenance fees will have to be reduced by the amount of waste collection fees. In this case, the bills that the population receives will be supplemented with an additional line about the new utility service. At the same time, the volume of waste processing will directly depend on the cost of waste processing (incineration and disposal).

Recycling may be free of charge in many regions. You will only need to pay for the unsorted waste tanks. However, it should be noted that the proposed scheme will work only if there is a significant difference between the rates for sorted and unsorted items. It was noted that 55-60% of useful fractions can be recovered from MSW. It is necessary to reduce the tariff for waste sorting by this amount.

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