Electronic information model for regulation of solid municipal waste management in the Krasnoyarsk Territory

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Abstract The article provides an analysis of the problem of pollution with solid municipal waste (hereinafter - MSW) and suggests a solution to this problem using the example of the city of Krasnoyarsk, Krasnoyarsk Territory. To achieve this goal, the study examined the introduction of an electronic model of the existing territorial scheme. This model can be an effective tool for a new waste management system. The object of the study is the municipal solid waste management system in the Krasnoyarsk Territory. The subject is regional regulation in the field of MSW management in the Krasnoyarsk Territory. As a result of the research, the article presents the result of the analysis of the regulatory framework, infrastructure, statistics in the field of solid municipal waste management in Russia and the Krasnoyarsk Territory in particular, identifies problematic issues, which in turn made it possible to develop the necessary additional measures and recommendations that contribute to improving the efficiency of activities in the field of MSW management.

1. Introduction

The problem of waste is currently one of the main problems of our time. The growing awareness of the waste crisis that our society is facing has made waste management from a secondary problem a central issue that attracts more and more specialists every year.

Large cities are sources of pollution, a territory with increased economic activity and high population density. In Krasnoyarsk, there is currently a need to review the existing management of solid waste. Regulatory legal acts on MSW management are not finalized, therefore there is no established system for collecting and processing secondary resources.

State and public organizations continue to actively deal with environmental problems, but the amount of municipal waste (MSW), one of the main sources of environmental pollution, is growing in Russia. The constant trend of increasing MSW volumes with a predominant part of packaging waste, with a total capacity of waste processing plants of only 3.5% of the required demand, requires the state to develop and implement effective methods for regulating the management of production and consumption waste. The legislative framework for such regulation plays a key role in a market economy. In this regard, the freedom of choice of production methods provided to business entities in market conditions should be limited not so much by command-administrative methods or prohibitions as by economic interest in observing the environmental safety requirements of their own activities. [1-6]

In recent years, the waste management area has undergone major changes in terms of legislation. The region aims to reduce waste collection by involving them in the economy.
Currently, the transition to the new waste management system continues. Therefore, this topic is more important than ever.

As part of the study, problems and ways of state regulation in the field of MSW management were examined using the example of the city of Krasnoyarsk, Krasnoyarsk Territory.

The object of research is a system of solid circulation of municipal waste in the Russian Federation.

Subject - state regulation in the treatment of MSW.

2. Research methods
When writing the work, the following research methods were used:
– analysis (regulatory documents);
– study and synthesis of information;
– synthesis method.

The work applied the methods of systemic, integrated, functional, statistical, structural and comparative analyzes, obtaining expert and statistical forecasts.

3. Study results and discussion
Waste is one of the main modern environmental problems, which carries a potential danger to human health, as well as a danger to the environment. In many countries, there is still a misunderstanding of the seriousness of the situation associated with municipal solid waste, in connection with which there is no strict regulation, as well as the necessary legal acts governing issues related to waste and garbage.

With the development of mankind, new materials appeared, decomposition or processing of which, can last more than a hundred years, and such anthropogenic impacts on nature no longer act. And an important factor is the current volume of garbage produced. It is just huge. But today, waste and garbage can be considered as raw materials. They can be recycled and reused. For each city dweller, approximately 450 to 800 kg of waste per year. According to scientists, for every person living on Earth, about 1 ton of garbage per year. And this number is constantly growing. The planet is literally inundated with garbage. Solid municipal waste is diverse: wood, cardboard and paper, textiles, leather and bones, rubber and metals, stones, glass and plastic. Rotting garbage is a favorable environment for many microorganisms that can cause infections and diseases.

For almost all constituent entities of the Russian Federation, one of the main tasks in the field of environmental protection is the solution of the problems of neutralization and disposal of household and industrial wastes. [8-12]

According to statistics from Rosprirodnadzor, in Russia more than 5 billion tons of all types of waste are generated annually, of which MSW is about 60 million, that is, about 400 kg of waste per person per year. Only 7-8% of collected MSW are involved in economic turnover, the rest of them are sent for recycling.

The low percentage of MSW disposal is associated with insufficient infrastructure development: currently in Russia there are 243 waste disposal complexes, 53 waste sorting complexes, and about 10 incineration plants.

At the same time, the system for collecting and analyzing statistical information on MSW does not cover all sources of their formation; there are no funds for objective accounting of the number of generated MSW. [13, 14]

The current state of waste collection and disposal is generally characterized by significant shortcomings, including:
– insufficient economic interest of enterprises,
– low technical level of applied technologies, lack of modern equipment for MSW processing;
– a significant uncontrolled flow of waste from the city;
– the lack of a clear and effective system for regulating waste management activities and the regulatory framework for coercion of permitted landfills to ensure their technical structure, which guarantees the environmental safety of nearby territories.
The predominance of MSW disposal through disposal and violation of environmental and sanitary-epidemiological requirements for their location leads to a number of problems associated with negative impacts on the environment and the environment, including:

- pollution and land debris;
- pollution of the upper aquifers with toxic substances contained in the filtrate formed at solid waste landfills;
- the release of large volumes of biogas, the content of which is mainly methane and carbon dioxide, leads to climate change, as well as to spontaneous combustion and burning of solid household waste;
- negative impact on the environment in case of fire of landfills (smoke). [7, 15]

The electronic information model for regulating solid municipal waste management (hereinafter referred to as the electronic model) should become an effective tool for the new waste management system and the solution of most of the identified shortcomings in the existing MSW disposal system. At the moment, in the Krasnoyarsk Territory, such an electronic model is absent.

At the same time, territorial schemes in the field of waste management, including municipal solid waste in the region, were approved in 2016. By law, the scheme must be approved and published on the Internet.

The scheme of the Krasnoyarsk Territory was published on the "Official Internet Portal of Legal Information of the Krasnoyarsk Territory", as well as on the website of the subordinate institution of the Ministry of Natural Resources and Ecology of the Territory - the regional state budget institution "Center for the Implementation of Environmental Measures of the Krasnoyarsk Territory"

Next, consider a possible electronic model. The introduction of the model at the legislative level is currently not mandatory.

For example, in other areas there are requirements for the mandatory development of electronic models, these are models of water supply, drainage, heating and gas supply schemes.

The main goal of creating an electronic model is the formation of an integrated information system with expandable functionality. This will ensure the transparency of the waste management system, simplify and accelerate the interaction of all industry participants: waste producers, including the public, executive authorities at the regional and municipal levels, waste management operators, waste management organizations, specially authorized bodies for environmental protection and other interested side.

According to the experience of the regions, the electronic model of the territorial scheme of waste management is a database of a geographic information system (GIS), in which a topographic database is loaded as a substrate, as well as waste management tools (landfills, authorized and unauthorized landfills, waste processing), points and certain types of waste, waste recycling complexes, etc.), sources of waste generation, operator service areas, treatment facilities, garbage truck movement routes, container platforms, etc. As a result, the program complex uses a convenient graphical representation of all elements system.

The system developed during operation should solve the following problems:

- Formation of a database of the waste management industry related to GIS;
- visualization of information on the nature of movement and residual waste;
- reducing the time required to perform public functions, implement public services, provide services to operators and other suppliers in the field of waste management by obtaining electronic access to relevant reporting and analytical information, and also provide management and other electronic services;
- integration of industry participants into a single information space;
- Creation of an open information system with the possibility of expanding functionality;
- receiving feedback from operators and representatives of executive authorities from the public and other participants.

Let us consider the functions that the system must perform to solve problems:

1) Providing reference and regulatory information, including:
about sources of waste (with varying degrees of detail, indicating the planned volume of generation and types of waste, legal and actual addresses, availability of licenses, etc.);
about objects of burial and utilization;
at the service areas of facilities for processing, transportation, disposal and disposal of waste;
about zones served by different operators;
about points of reception of secondary raw materials;
at the points of reception of hazardous wastes, car wastes, mercury lamps, electronic wastes;
about the routes of the garbage trucks;
in waste collection areas with coverage areas;
on the objects of processing special waste (dead animals, tires, vegetable and bulky waste);
about organizations providing various services in the field of waste management;
on municipal, regional and federal executive bodies authorized to solve waste management issues;

The database includes tabular, cartographic and other information. Filling the database completely depends on the requirements of the customer, that is, for example, the executive branch.
In this case, the database may contain information on the processing of various types of MSW, including snow waste, bulky waste and automobile waste.

2) In addition, the open part of the electronic model can consist not only of an interactive map, but also be a full-fledged portal for communication with residents of the region and organizations.

Prompt feedback from customers, service providers, experts and other interested parties, which is ensured by the creation of an Internet portal. Feedback can be formalized and non-formalized in nature, including the processing and sending of applications, appeals, complaints, suggestions and questions; conducting surveys, contests, quizzes, information and entertainment events.
Sites can be created on the Internet portal that allow residents to post information about unauthorized landfills, violation of the rules for maintaining territories, and untimely waste collection.

Poor condition of machinery and equipment for the collection and removal of waste. You can collect suggestions for optimizing the scheme. Also, using the Internet portal, it is possible to inform the public about changes in the sphere of waste management, involving the population in solving waste management issues.

On the site it is advisable to place electronic reception rooms for officials and specialists in the field of waste management and territory maintenance, to which citizens and contractors can apply.

3) Organization of a multi-level electronic system for monitoring the industry to obtain:
real-time reporting for operational decision making;
mandatory reporting to executive authorities, etc.;
management reporting (annual, monthly, etc.);
financial and economic reporting (balance sheets, expenses, etc.);
public reporting (for the public).

For the functioning of the monitoring system, a number of tools are developed and implemented in an electronic model that provide ease of analysis of the available information and make it possible to compile samples according to one or many criteria (Figure 1), visualize analytical information in the form of graphs, charts and figures, create layers containing the analysis results.

As an element of the monitoring system, a real-time navigation information module for tracking garbage trucks based on GLONASS / GPS technology can be included in the electronic model. This will allow you to monitor their activities and determine the location of unauthorized storage of garbage. This item is used in an electronic model of one of the regions.

4) Integration into the electronic model of the billing system (automated system for accounting for the services provided, their prices and billing) and payment for waste management services (the public and other consumers can pay, for example, services for the removal and disposal of waste).

5) Construction of various waste balance sheets at the regional, municipal and local levels with reference.
Treatment
Disposal (Prom.)
Disposal (MSW)
Disinfection
Accommodation (Prom.)
Accommodation (MSW)
Zones of regional operators
Transport infrastructure
Waste handling

Figure 1. Possible criteria for an electronic model.

We can conclude that the optimal electronic model should consist of two key elements: a database describing the state of the industry, and an Internet portal for communication between interested parties. As a third component, various functional modules are allocated to ensure the provision of various services to users of all levels and types.

And managerial and analytical data processing will allow government agencies to exercise operational control over the activities of regional operators, to carry out competent and timely planning of activities and setting targets for the development of the industry.

Any user will be able to get the information he needs (within his access clearance) and visualize it by building a balance of materials for waste movement, diagrams, etc., with the ability to print and convert to any other graphic and information systems.

It should be noted that in addition to systematization and centralization of information on the state of the industry, the electronic model will solve a number of applied problems, such as:

– automation of data collection and maintaining a unified database on the generation, processing, disposal and use of waste from municipalities in the region;
– ensuring industry transparency for executive authorities and potential investors;
– operational planning for the development of the industry (including financing) and adjustment of the territorial scheme of waste management;
– collection of operational information on the state of the waste management industry: reviews of consumers of services, experts, contractors;
– informing and discussing with industry stakeholders the issues of restructuring the industry (holding public hearings, discussing bills, etc.).

The server part of the electronic model can be installed both on the basis of the customer’s information infrastructure and remotely, in any other data center. As a rule, two types of client software are used to access the model: a web application that allows you to access the system from anywhere in the world through an Internet browser, including using mobile devices; A stationary application that is installed on a user's computer and has advanced functionality. The system operator in the Krasnoyarsk Territory may be the Regional State Budgetary Institution “Center for the Implementation of Measures for Nature Management and Environmental Protection of the Krasnoyarsk Territory”.

Typically, the system is designed in such a way as to enable the creation of various types of maps, as well as to manage the object composition and design of maps in such a way as to provide the maximum convenience of displaying information for authorities, customer dispatchers and contractors; Build complex applications and embed them in other regional, federal and municipal resources.

In fact, the regional executive authorities receive a flexible, easily customizable instrument for monitoring the state of the industry and planning its development, not burdened with the need for constant adjustment of the developed documents.
4. Conclusion
The waste management industry is developing quite dynamically, while the created electronic model is a tool that allows executive authorities to quickly respond to changes. And the use and study of multivolume documents and their corrections is a complex process, especially for the population, although information in the field of waste communication, in particular the territorial scheme, is published on the Internet resources of the Internet.

As a result of using the electronic model, authorities can timely make changes to the territorial scheme of waste management. Based on the electronic model data, the executive authorities may have the impression of the effectiveness of the activities of regional operators. Thus, the actions of market participants will become more transparent and controlled. At the same time, regional operators will have a good working tool in the fight against unauthorized landfills.

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