The organization of the unified system of waste management construction

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Abstract. This paper examines the question of organization and functioning of the unified system of waste management of the construction on the example of Kaliningrad region. Based on the analysis of the regulatory documentation in the field of waste management, as well as statistical data for the periods formed the purpose and objectives of the study with a view to ensuring environmental security in the region. The choice of a particular entity due to the important geographical position in relation to neighboring States, as well as the increasing role of the subject as a vector of economic development of the region in the context of solving important public tasks and directions.

The research is based on the assessment of waste sources, the share of construction waste in total, as well as the assessment of the potential of the region for reception, accommodation, waste treatment, taking into account the development programmes of the region. The paper also discusses the issues of the increasing role of recycling of construction and other waste types with the aim to improve the environment components.

Methodological basis of research were the work of specialists in the field of construction, Federal and regional development programs of the Kaliningrad region.

The study provides a data analysis on concrete examples of construction and reconstruction of facilities to assess infrastructure recycling waste within the subject and also discusses the possibilities for accommodation, waste management within the transport accessibility of the territory and the need to increase the number of licensed landfills. Consideration the issues of functioning efficiency of organizations specialized in the field of waste management allows to assess the structure and development of the system in terms of consideration in a number of issues.

The findings and results of research determine the functioning development features of the uniform organizational structure in the field of waste management construction and also determine the need for an integrated approach to solve problems from a position of nonlocal events, and to improve the overall structure because of the specific territorial location of the subject. The implementation of complex of measures on the development potential of the region is considered in the context of the implementation of the Federal target development program of the Kaliningrad region for the period until 2020.

Keywords: construction waste, environmental safety, organization of construction, management, waste management.
1. Introduction

In modern practice, questions of waste management are regulated by the Federal law №98 "Wastes of production and consumption" (Federal law of 24.06.1998 No. 89-FZ (ed. from 28.12.2016) "Wastes of production and consumption") [1]. The basic principles of the state policy in the field of waste management are: the maintenance or restoration of the environment, the use of best available technologies in waste management, organization of complex processing system, the development of international relations of the Russian Federation to exchange experience in the field of waste management.

In addition to national legislation in such subjects as Moscow and Saint-Petersburg, developed a special requirements. The peculiarity of the construction industry in Moscow is its territorial remoteness from sources of raw materials, the presence of a significant amount of waste. Taking into account these factors, in accordance with Moscow government Resolution "The procedure of waste management of construction and demolition in the Moscow" dated 25.06.2002 No. 469-PP [2] involvement of construction waste from its own production, other production waste and consumption waste through its recycling and further use is the most rational decision. In accordance with the decision of all waste producers, regardless of ownership and departmental belonging, are obliged to have technical and technological documentation regulating the process for the treatment of their waste, construction and demolition in the form of technological rules. This document should reflect full and accurate information on the whole process of waste management of construction and demolition from the time of their formation until their use or disposal. Development of technological regulations by specialized organizations. The revision of the legislative framework in the field of waste other subjects of the Russian Federation is a rational decision in modern conditions [3, 4, 5].

According to the Federal service of state statistics table. 1 "Generation of production wastes and consumption on types of economic activities of the Russian Federation" the share of generation of construction waste in the overall system is less than 1% and this share is increasing due to increase in relation to 2010, the production of waste.

Table 1. Education of production wastes and consumption on types of economic activities in the Russian Federation, million tons

|                      | 2010  | 2011  | 2012  | 2013  | 2014  | 2015  |
|----------------------|-------|-------|-------|-------|-------|-------|
| In total             | 3734.7| 4303.3| 5007.9| 5152.8| 5168.3| 5060.2|
| among them by types of economical activities: |       |       |       |       |       |       |
| agriculture, hunting and forestry | 24.0  | 27.5  | 26.1  | 40.3  | 43.1  | 45.8  |
| mining               | 3334.6| 3818.7| 4629.3| 4701.2| 4807.3| 4653.0|
| including:           |       |       |       |       |       |       |
| extraction of fuel and energy minerals | 2204.3| 2527.8| 3022.8| 3010.5| 3187.5| 3106.6|
| mining, except extraction of fuel and energy  | 1130.3| 1290.8| 1606.6| 1690.7| 1619.8| 1546.4|
| manufacturing        | 280.1 | 280.2 | 291.0 | 253.7 | 243.1 | 282.9 |
| among them:           |       |       |       |       |       |       |
| food production, including drinks                | 20.2  | 16.2  | 19.8  | 20.5  | 19.1  | 19.5  |
| manufacture of wood and manufacture of products |       |       |       |       |       |       |
| production of coke and petroleum products        | 9.6   | 3.9   | 3.7   | 5.3   | 5.0   | 4.5   |
| chemical production                                 | 1.7   | 1.7   | 2.1   | 1.5   | 1.8   | 1.5   |
| manufacture of other non-metallic mineral         | 25.9  | 41.9  | 14.4  | 16.6  | 12.7  | 15.2  |
| products                                          | 15.4  | 15.5  | 16.8  | 18.3  | 19.2  | 13.4  |
| metallurgic production and production of          | 194.1 | 186.8 | 220.8 | 172.7 | 168.3 | 215.0 |
| finished metal products                           |       |       |       |       |       |       |
| production of vehicles and equipment              | 2.2   | 3.2   | 3.0   | 3.1   | 2.7   | 2.2   |
| production and distribution of electricity, gas and water | 68.0  | 58.0  | 28.4  | 24.1  | 28.3  | 26.4  |
2. Methods

The main sources of waste in construction is the activity of construction organizations and construction companies. Construction waste production occur during the execution of works on reconstruction, repair and new construction.

The largest proportion of construction waste accounts for execution of works on demolition (dismantling) of buildings and structures.

Important in the analysis of the structure and dynamics of the construction industry in the context of its consideration of the issue of waste management to consider specific regions.

The great interest in recent times of many scientists-researchers focused on the most Western subject of the Russian Federation – Kaliningrad oblast.

Vector of socio-economic development of the subject determines the Federal target development program of the Kaliningrad region for the period until 2020.

The main objectives of the program are: ensuring of geostrategic interests of Russia in the Baltic sea region to ensure energy security through the renovation of existing and introduction of new energy sources, transport infrastructure development; creation of infrastructure in preparation to the world Cup in 2018, and improvement of the environment components.

According to data of the target program “waste management of production and consumption in the Kaliningrad region for 2012-2016” one of the main problems of development is the accumulation of production and consumption waste in the absence of a system to return them in raw materials.

The main part of waste is dumped at landfills, where about 85% of the waste, only 5% of waste is recycled, about 10% of the waste is lost during transportation.

On the average household garbage contains food waste (organic) – 33%; other organic wastes – 9%; paper, cardboard – 12%; metals – 2%; glass 8%; plastic bottles and other plastic waste – 16%; construction waste – 11%; other inorganic wastes – 9%.

In accordance with the state register of waste disposal facilities the region operates three permanently licensed landfill, disposal of waste, including construction waste:
• the range of solid household and industrial waste near the village Barsukovo (Neman district);
• the solid waste landfill near the village Javoronkova (Gusev urban district);
• the object of accommodation TBO “Elenaki” (Gvardeyskiy city district).

The analysis of statistical data in the field of waste processing showed that in the Kaliningrad region infrastructure for the recycling of waste is at the stage of formation.

In recent years, organizations engaged in collection, disposal and recycling of individual types of construction waste (roofing waste, tires), including waste dangerous to the environment (car batteries, oil products, mercury and other waste types).

Principal activities of specified organizations in the field of waste management are given in table 2.

| Types of activities in waste treatment sphere | Number of organizations |
|---------------------------------------------|-------------------------|
| Special collection and recycling waste oils  | 7                       |
| Recycling non-ferrous metals                | 3                       |
| Recycling rubber waste, used tyres          | 1                       |
| Recycle construction waste                  | 2                       |
| Collection and disposal of mercury-containing waste | 1                     |

Table 2. Types of activities in waste treatment sphere
The first steps to improvement and development of the waste management system was undertaken in 2009 in the framework of creation in the Kaliningrad Regional Union of waste recyclers.

The Union is a public organization that unites organizations and individual entrepreneurs are the operators of the market of secondary resources, or somehow involved in the field of waste management in the Kaliningrad region.

The need for the development of recycling of construction waste is also caused by increasing load from the construction and renovation of facilities in preparation to host the world Cup in 2018.

In 2016-2017, the region is further stressed by increasing of construction waste generated in virtually all 23 municipalities of the subject in the framework of the preparation for the championship.

When the unified system of waste management in the Kaliningrad region, it is important to consider experience of Moscow, as well as countries of the European Union. Analysis of the legislation of the European Union reveals 20 directives relating to various aspects of the problem of waste management. Until the early 1970-ies of the legislation on the treatment of waste belonged to the domestic jurisdiction of member States of the EEC. In 1975, for the convergence of different national practices, the European Council adopted framework Directive on waste (the Waste Framework Directive -75/442/EEC), which established General requirements and basic definitions (concepts and terms) in this field.

In the European Union, the coordination of waste management implements European Environmental Agency (European Environmental Agency, EEA), and the licensing of waste management and control are the national Agency for Environmental Protection of the member States (Environmental Protection Agency, EPA).

Waste management in the EU represented eleven Directives and other documents. The purpose of these documents is to build a hierarchy that includes basic elements such as [6]:

- prevention;
- secondary usage;
- recycling;
- usage for other aims;
- disposal.

Prevention is the basis of the General system of education management of waste. In Western Europe the concept of "prevention" is action oriented and is being implemented in all spheres of life including education. So in France, the company carried out training, mainly engineering students profile, on minimizing packaging waste materials. In Ireland, under the auspices of the National Committee for the prevention of waste is the so-called "green business Initiative", assisting companies and organizations in three areas – waste, water and energy. Created the clean technology Centre is a non-profit research organization that provides scientific support in this area.

Reuse the next level of hierarchy in the system. In practice, the EU re-use shall be as household items and industrial products and manufacturing, including the construction industry.

Recycling is an important element of waste management. In practice, up to 80% of municipal solid waste and waste construction and demolition waste is amenable to this process. Directive 2008/98/EC ordered to bring by 2020 the level of recycling waste in the European Union, at least up to 50 %. The use of recycled plastic for road construction at the moment an ongoing issue. The concept of using modular plastic plates instead of asphalt coatings involves providing durability, ability to withstand significant changes in temperature.

An important issue is the recycling of construction and demolition of structures. In the process of construction waste is generated, such as: concrete, bricks, tiles, wood, glass, plastic, plaster, bitumen mixture and resin, metals (ferrous and non-ferrous), stones, insulation materials, chemical substances, packaging materials, etc. Directive 2008/98/EC set out a goal by 2020 to reduce the class of waste in the EU by 70% (by weight) methods to reuse and / or recycling: to date, member countries this task is in the range from 10 to 90% [7].

Experts developed measures to reduce construction waste. One option is to use the assumption instead of the traditional demolition of buildings to practice their demolition "deconstruction", in
which, to save the flooring, window and door frames, a brick, plumbing components, etc. In the development of design documentation and construction are encouraged to require designers and contractors detailed plan for waste reduction, reuse or recycling [8,9,10,11,12].

"Other uses" in the EU, most often, be the processes of waste recycling for energy purposes. A promising direction is the method of processing waste into biogas production.

The least desirable option in the waste management system of the EU is the use of landfill. The legal basis of European legislation is the Council Directive of the European Union on the landfill of waste adopted in 1999 (Directive 1999/31/EC on the landfill of waste).

Thus, in the European Union there is a unified system of waste management, which is subordinated to a strict hierarchy based on legislative framework. The problem of waste generation is considered in a global context use of resources and economy sectors. The European Commission adopted the program "Closing the circle: the EU action plan on creation of a circular economy" (Closing the loop – An EU action plan for the Circular Economy). The transition from a linear economy to a circular use of resources is a major component of the "green economy". Important role in the development of circular economy plays such a powerful financial institution like the European investment Bank [13-20].

In Russia construction waste also can be recycled, which is a priority in environmental policy of the country.

As the best available technologies for recycling construction waste, it is envisaged, in particular, the use of concrete, crushed stone, brick, sand, soil in the manufacture of crushed stone mixture, as well as partial use as an insulation material at landfills of municipal solid waste. The remaining components of construction waste, which are secondary raw materials, are subject to delivery to the processing enterprises.

Plastic waste is sorted by type, condition, pollution. Sorted material undergoes preliminary crushing, after which it is re-sorted, washed and dried. The prepared raw materials are processed in thermal installations until the melt of uniform consistency is formed. The main difficulty of this method is the need for pre-sorting, separation and cleaning of plastic waste.

The method of hydrolysis consists in splitting the waste of polymeric materials with aqueous acid solutions under the influence of high temperature.

In addition to the above mentioned waste management methods, there is also a combustion method in practice. Thus, the combustion of tires is made in order to obtain energy. Since harmful substances, including carcinogenic substances, as well as a small amount of dioxins, are released during the combustion process, tire combustion plants should be equipped with a perfect exhaust gas treatment system.

In practice, there is pyrolysis - a method of thermal decomposition of the organic part of the waste in the absence or lack of oxygen, respectively, distinguish between dry and oxidative pyrolysis. This is one of the promising areas of solid waste processing in terms of both environmental safety and the production of secondary useful products.

3. Results

The analysis of design decisions on reconstruction and construction of facilities in the Kaliningrad region determines the direction of solving issues of development of the overall system. Consider the example of implementation of measures for waste management in the Kaliningrad region on the example of the construction the electric substation Romanovo (table.3).

Referring to the data of table 3, we can conclude about the presence of sources of wastes and classes of danger. Most of the waste of 3-4 classes to be disposed of at nearby landfills, as recycling of construction wastes in this region rather poorly developed (table.2).

In accordance with the data table.3 disposal shall be waste resulting from construction works, such as sand and scrap of uncontaminated concrete products (temporary roads and landings). The nearest waste disposal landfill – TBO landfill near the village Barsukovo Neman district of Kaliningrad region. Distance from site of works to the landfill is -154 km.
Thus, the initial stage of creation of the common system can serve the development of a network of processing plants in the Kaliningrad region.

**Table 3.** The list and the amount of waste generated during construction

| Waste name                                                                 | FKKO code  | The name of the production            | The movement of waste | Hazard class | Amount t/period |
|----------------------------------------------------------------------------|------------|---------------------------------------|-----------------------|--------------|-----------------|
| Floated petroleum products from oil capturing system and similar structures | 4 06 350 01 31 3 | Installation of washing the wheels of vehicles for neutralization | 3                     |              0.005          |
| **Summary III hazard class**                                              |            |                                       |                       |              0.005          |
| The trash from the office and amenity rooms of organizations, unsorted (except for bulky) | 7 33 100 01 72 4 | Household-domestic premises | burial*                | 4             2.18            |
| The trash from the territory of the enterprise of low-hazard               | 7 33 390 01 71 4 | Harvesting                            | burial*                | 4             21.608          |
| The precipitate (sludge) mechanical cleaning of oily waste water containing oil in an amount of less than 15%, watered | 7 23 101 01 39 4 | Installation of washing the wheels of vehicles | burial*                | 4             0.2405          |
| Waste (sediment) from cesspools                                           | 7 32 100 01 30 4 | Household premises, Toilets           | burial*                | 4             16.83            |
| **Summary IV hazard class**                                              |            |                                       |                       |              40.8585         |
| Waste uncontaminated sand                                                 | 8 19 100 01 49 5 | Construction work                     | burial*                | 5             1592.64          |
| Scrap concrete products, concrete waste in lump form                      | 8 22 301 01 21 5 | Construction work                     | burial*                | 5             747.98           |
| Scrap electrical products from aluminium (wire, bare conductor of cables and cords, tires switchgear, transformers, rectifiers) | 4 62 200 02 51 5 | Demolation                            | for processing (for further use) to the warehouse of the customer | 5             0.33            |
| The soil, formed when carrying out excavation work, not contaminated with hazardous substances | 8 11 100 01 49 5 | Excavation work                       | In the blade (confirmation ) | 5             573.49          |

*landfill near the pos. Barsukovka of Nemanskiy rayon Kaliningrad region. Distance from the site of works to the landfill is - 154 km.

**Summary IV hazard class**

**Total**

2914.44

2955.3035
4. Discussions
In recent years, the Russian practice of waste management there are significant changes in the framework of the project "Pure country." It is planned to build five large plants for the thermal processing of solid household waste – four in the Moscow region and one in Kazan.

Rapid development of treatment inhibits the presence of contradictions in the Russian legislation. Experts noted that the new edition of the Federal law "On wastes of production and consumption" significantly advanced the situation of convergence with international standards and declarations.

The modern infrastructure of recycling in many regions of the Russian Federation is not developed properly. According to statistics, about 90% of existing landfills operated with violations of environmental laws.

The state support will allow to implement programs not only in big cities and their agglomeration, but also in any other regions, such as Kaliningrad oblast.

5. Conclusions
Thus, the main problems preventing increased use of secondary resources in the economy of the Kaliningrad region are:

1) the lack of effective legal and regulatory framework, stimulating the processing and consumption of secondary material resources and the lack of a systematic approach to organizing the collection of waste aimed at the recovery of secondary resources;

2) lack of organization of a single information space, providing market participants with reliable information on volumes and sources of waste, needs in the secondary material resources, the available methods of their processing;

3) lack of development of tariff policy in the field of collecting and moving waste from the territory of municipal formations of the Kaliningrad region;

4) the distance of the collection points and the lack of industries that use secondary raw materials for production of finished products;

5) lack of capacities for primary sorting of waste and the inability of large stable supply of recyclable materials for processing;

Thus, the existing system of the reference with production wastes and consumption in the Kaliningrad region is inefficient, does not ensure the implementation of the existing requirements of environmental, sanitary and epidemiological legislation, as well as trends in national and European legislation.

The geographic situation of the Kaliningrad region dictate the necessity of an integrated approach to solving problems of waste management. The implementation of local measures on the territory of municipalities not integrated into a unified system of waste management in the Kaliningrad region, may not lead to expected results.

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