REGULATION OF WASTE AND SECONDARY RESOURCES MANAGEMENT

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ABSTRACT

Tasks of regional development comprise among core objectives maintenance of ecological safety of the territories, cleanliness and improvement of the human environment. The article deals with issues of monitoring, planning, as well as of technical, economic regulation of processing of waste and secondary material resources of production and consumption sectors. The approaches to improving of management and efficiency growth in that field are studied. Particular emphasis is placed on the use fo waste and secondary resources as of raw material for production of various types of goods, items and semi-finished household products and energy.

Keywords: environmental safety, production and consumption waste, waste management, secondary resources, industry, transport infrastructure, monitoring, regulatory system.

Background. *Constantly growing volumes of industrial and household waste disposal increasingly complicate the environmental situation, creating a threat to safe human activities. This factor dictates the need to search for new scientifically based approaches to organization of a system for collecting, processing, recycling, increasing the share of the use of secondary material resources for new production and other economic activities [1–3].*

Objective. *The objective of the authors is to consider the issues related to regulation management, particularly regarding regional development models. management.*

Methods. *The authors use general scientific methods, expert assessment, statistical method, evaluation approach, comparative method, factor analysis and forecasting.*

Results.

Strategy is not missing anymore

The Russian Federation has a significant potential of the use of secondary material resources (SMR) in the form of regularly generated and accumulated production and consumption wastes, which can be characterized as renewable raw materials, material and fuel and energy resources [4–10]. However, the scale and level of utilization of various SMR is significantly uneven and depends on resource value of waste, ecological situation that arises when it is treated as environmental polluters, and real economic conditions that determine profitability of each type of economic activity using the waste as SMR.

At the same time, in the EU countries, Japan, legislative instruments and economic conditions have been in place for more than a decade for a high level of waste disposal and the attraction of secondary material resources [11, p. 07005; 12, pp. 15–20; 13, pp. 45–56; 14, pp. 265–290, 356–400; 15, pp. 68–72; 16, pp. 18–40; 17, pp. 212–266, 384; 18, pp. 1327–1336].

One of the unresolved tasks at the federal and regional levels is creation of an innovative organizational, legal and technical-economic system, which allows minimizing the amount of stored waste, while at the same time ensuring resource saving, re-engagement of recyclable components in the form of raw materials, materials, products, waste transformation to the source of new products, cheap energy.

Significant problems in the field of planning, organizing and regulating activities for dealing with secondary resources are associated with a lack of information on wastes, including their composition, resource value, and the possibilities for producing goods from them.

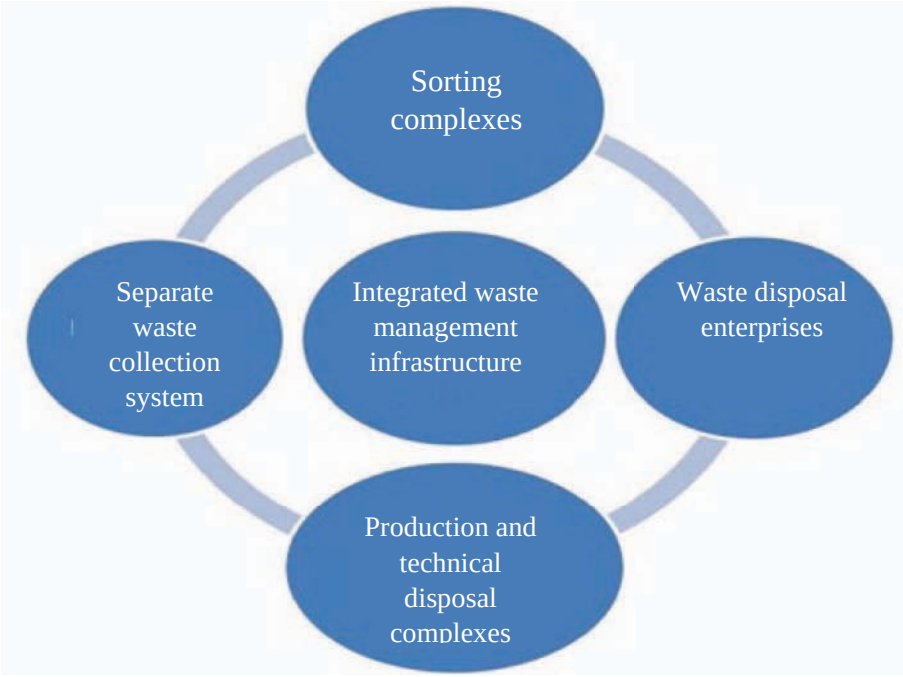
The used form of federal statistical observation in the field of industrial and consumer waste management No. 2-TP (waste) is intended primarily for obtaining balance information and solving environmental problems. There is no systematization of data on movement of waste in economic sectors in the territorial context regarding federal entities of the Russian Federation, economic regions, industrial clusters. There is no data on waste treatment, utilization enterprises, their location, either official statistical information on indicators characterizing the state of the industry as a whole, production of equipment, machines, and aggregates for treatment, recycling, and neutralization of production of wastes.

A breakthrough document in this area, for the first time in the entire quarter-century period of the history of modern Russia, was the industry development strategy for treatment, recycling and disposal of industrial and consumer waste for the period up to 2030, approved by decree of the Government of the Russian Federation of January 25, 2018 No. 84-r. The sectoral strategic planning document provides for creation of a de facto new industry, it is planned for the future to solve a significant block of basic tasks, primarily in resource-saving and waste-processing industry [10, pp. 3, 43–46]. And we can use it as a basis to evaluate the results of current scientific research and expected proposals from just this angle.

Municipal production clusters

As shown by the results of the analysis of the situation in the area of circulation of SMR carried out by the authors (in particular, in the transport and industrial sectors, taking into account the research data carried out at the Scientific and Research Institute Center for Environmental Industrial Policy, Russian University of Transport and other scientific institutions) efficient development of monitoring systems, of accounting, management, regulation of waste management and SMR requires a fairly universal scientifically based approach to creating a targeted infrastructure for treatment, disposal of production and consumption waste, the use of secondary material resources.

As part of our research, we have developed our own original methodological principle of planning the composition and division of labor of infrastructure facilities aimed at collection, recycling and disposal of waste, which consists in the fact that this infrastructure is formed in conjunction with the sources of industrial waste generation which are industrial enterprises, and the system of disposal, utilization of consumption waste, including solid utility, packaging is formed in relation to the industrial and waste-processing industry by means of accumulation, separate collection, sorting, processing, transportation of such waste.



Pic. 1. Integrated waste management infrastructure.

The organization of the optimal composition and location of the industrial infrastructure, creation of a high-tech production process for processing waste into secondary products, and the transport and logistics complex are becoming an important factor in building an effective integrated waste management system (Pic. 1).

Taking this into account, the system of forming the industrial infrastructure for processing, recycling and disposal of waste considers not only creation of new facilities (environmental technology parks, sorting plants, industrial waste treatment facilities for secondary raw materials and products), but also the existing industry infrastructure. Existing enterprises of building materials are potential recyclers of construction waste; metallurgical production – of scrap; glass factories – of cullet, etc.

When developing the proposed approach, we take into account expert community's assessments of efficiency and feasibility of forming production-communal symbiosis or clusters in Russia for organizing regional and interregional waste management systems, including: a waste sorting complex (collection and treatment), an industrial waste disposal facility (neutralization, high-temperature roasting, pyrolysis and other methods), a production and technical complex (utilization, production from secondary raw materials), ecotechnoparks (technologies of deep processing of waste). From the point of view of economic efficiency, such clusters can be located in industrial centers with a wide range of various industries and sectors of the economy with annual generation of hazardous industrial wastes of at least 300 thousand tons per year, including those requiring deep processing and neutralization (acid, alkali, heavy metal salts, organic, oil-containing, electroplating, non-utilizable polymeric, mercury-containing items, and a number of others).

The composition and structure of such formations are determined by effectiveness of transport and logistics decisions on accumulation, collection, processing, transportation, utilization, use of SMR; by rational territorial combination of interrelated enterprises and industries; optimization of waste streams and flows of secondary raw materials; the nature of the existing engineering and technological infrastructure for collection and storage of waste.

Nodal centers for collection and treatment of waste with creation of waste sorting complexes should be rationally located in areas where enterprises produce a significant amount of industrial waste, the main groups of which are simultaneously in their aggregative state, composition and hazard level similar to recycled SMR fractions (enterprises manufacturing rubber products, tires, polymers (polyvinyl chloride, polyethylene, polystyrene, polypropylene, plastics); woodworking, pulp and paper mills, glass factories, food processing plants, metallurgy). The multifunctional sorting complex should also contain a system of consumption waste collection points at enterprises and in residential areas.

From the economic evaluation, it follows that the most appropriate option for processing construction waste is to place the processing production in such a way that the material is delivered from the place of origin, undergoes primary processing (size change: crushing, grinding) on a separate storage site and only after that is sent to a separating installation. For example, the optimal technological scheme for processing construction waste (large lumpy waste of wall panels, blocks, interfloor ceilings, stairs, foundations from waste concrete, reinforced concrete, bricks) can be: preparing the material for primary crushing; primary crushing; metal separation; screening fines, wood, plastic waste, cleaning fines; secondary crushing (open or closed cycles); metal separation; sorting by fractions [2, pp. 95–110; 4, pp. 260–272].

Optimization of choice

In order to ensure efficient sorting, separation of waste, the formation of a network of waste sorting

complexes for collection, processing of municipal solid waste with extraction of secondary resources from them, as well as multifunctional sorting complexes for collecting all types of waste with a capacity of 100–300 thousand tons per year, is promising. According to expert estimates, the efficiency of extraction of valuable waste fractions – ferrous and non-ferrous metals, cardboard and paper, polymers (high and low pressure polyethylene, polypropylene, polyethylene terephthalate), glass – should be at least 30% of the total mass, with an optimal distance of waste transportation from 30 to 50 km [1, pp. 29–31; 2, pp. 95–110].

At disposal enterprises, as a rule, high-temperature decomposition of waste with significant (more than 75 %) reduction of their mass and volume (pyrolysis, high-temperature roasting, thermal destruction, plasma gasification, etc.) is used. Such objects should be placed in the areas of the chemical, petrochemical industry with a significant amount of hazardous waste (belonging to so called hazard classes 1–4 according to Russian standards). For a multifunctional complex, an uninterrupted optimal cyclical supply of a mass of waste for disposal in accordance with the design capacity of the enterprise due to non-utilized consumer waste and industrial waste from this region (district) should be ensured. In the process of comprehensive weighted socio-economic assessment, environmental justification for introduction of polymer, polymer-containing and other hazardous waste combustion technologies at the stage of selecting a land plot for construction of a facility, pre-design stage and during designing a system of restrictions, requirements and conditions in the field of environmental and sanitary epidemiological safety is created, which includes:

• optimal selection of a land plot for construction of a waste disposal facility taking into account all climatic, geological, landscape, hydrological and other features and factors: prevailing wind directions, groundwater level, soil cover properties, presence (absence) of water catchment basins, fishery reservoirs, rare species of flora and fauna;

• introduction of a standard indicator of a sanitary protection zone of a waste-burning plant not less than 20 km from the borders of settlements, specially protected natural territories, the 2nd zone of sanitary protection of drinking water sources, hunting grounds, agricultural objects (fields, orchards, pastures of cattle and birds);

• use of repeatedly tested best technologies for purification of emissions from all standardized types of dioxins and dioxin-like toxicants, extremely, highly and moderately toxic volatile compounds released during combustion, melting of polymeric and polymer-containing materials;

• organization of the subsequent use (isolation, neutralization) of residual toxic combustion products (fuel slag, fly ash) on specially equipped facilities in strict accordance with environmental and sanitary-epidemiological legislation;

• availability of modern systems for ensuring industrial safety, monitoring environmental safety of technological processes, monitoring the natural environment (atmosphere, water, soil, vegetation) in the sanitary protection zone of the facility;

• openness of environmental information on the activities of the waste disposal facility and its impact on the environment for the population, the public, local authorities and the media.

According to the authors, the basic principle of incineration in our country may be the residual principle, under which only waste that cannot be disposed of as a result of recycling, recovery, or regeneration because of thermal, technical, environmental considerations, should be incinerated.

Ecological technoparks are most efficiently used in cities with a developed scientific and technological infrastructure, with high-tech industries with a complex multi-faceted composition of waste, including waste materials, sludge and chemical compounds of various levels of environmental hazard.

The economic assessment of placement of the objects presented in the analysis of the industry for treatment, utilization and disposal of waste for the future was carried out on the basis of the following indicators:

• types and quantities of production and consumption waste generation, as well as the level of

their environmental hazard (according to the federal waste classification catalog);

• industrial specificity and concentration of production of industries of the economy on a territorial basis;

• output in the sectors of the Russian economy for the period up to 2030 under various scenario conditions;

• norms and standards of waste generation per unit of output;

• possibility of using waste as SMR and secondary raw materials;

• state and level of use of existing facilities for processing, recycling and disposal of waste;

• existing functions of enterprises of the industry for processing, recycling and disposal of waste;

• state and prospects of development of road and transport infrastructure facilities (throughput and carrying capacity of roads and railways, production parameters and performance indicators of the depot, stations, bus stations, bus terminals);

• environmental situation;

• rates of social and economic development and other factors.

Conclusions. *The state of the waste-processing industry should be assessed, as the article suggests, using mathematical modeling methods, comparative expert, qualimetric, factor analysis, forecast of the location of production facilities for treatment, utilization and disposal of waste in the territories of the Russian Federation. Within the framework of the methodological approach, a regulatory method for predicting waste generation by specific indicators, as well as an expert method for assessing indicators, could be applied.*

According to the authors, improving the system of monitoring, regulation, management, planning, improving the economic, organizational and technical activities in the field of waste and secondary material resources management will help to solve fundamental environmental problems, to ensure environmental safety, to maintain natural resources.

REFERENCES

1. Tskhovrebov, E. S., Sadov, A. V. Ways of solving the problem of waste management at the regional level [*Puti resheniya problem obrashcheniya s otkhodami na urovne regiona*]. *Vestnik RAEN*, 2011, Iss. 5, pp. 29–31.

2. Tskhovrebov, E. S., Velichko, E. G. Scientific and methodological approaches to creating a model of an integrated system for managing construction waste flows [*Nauchno-metodologicheskie podkhody k sozdaniyu sistemy upravleniya potokami stroitelnykh otkhodov*]. *Vestnik MGSU*, 2015, Iss. 9, pp. 95–110.

3. Tskhovrebov, E. S. Legal aspects of ensuring environmental safety [*Pravovie aspekty obespeccheniya ekologicheskoi bezopasnoti*]. *ECOS*, 2008, Iss. 3, pp. 13–19.

4. Barishevsky, E. V., Velichko, E. G., Tskhovrebov, E. S., Niyazgulov, U. D. Issues of environmental and economic assessment of investment projects with regard to recycling waste into building products [*Voprosy ekologo-ekonomicheskoi otsenki investitsionnykh proektov po pererabotke otkhodov v stroitelnuyu produktsiyu*]. *Vestnik MGSU*, 2017, Iss. 3, pp. 260–272.

5. Shevchenko, A. S., Niyazgulov, U. D., Tskhovrebov, E. S. The use of resource-saving technologies and renewable energy sources in construction [*Ispolzovanie resursosberegayushchikh tekhnologii i vozobnovlyaemykh istochnikov energii v stroitelstve*]. *Kachestvo. Innovatsii. Obrazovanie*, 2017, Iss. 12, pp. 34–40.

6. Alekseev, A. A., Karlik, A. E., Makhatadze, L. P. Development of a regional management system for secondary material resources management: the experience of SE500 project [*Razvitie regionalnoi sistemy upravleniya vtorichnymi materialnymi resursami: opyt proekta SE500*]. *Ekonomika i upravlenie*, 2013, Iss. 4, pp. 12–18.

7. Sagitov, R. F. Ways of a rational solution of the problem of processing industrial secondary material resources in the Russian Federation [*Puti ratsionalnogo resheniya problemy pererabotki promyshlennykh vtorichnykh materialnykh resursov v RF*]. *Izvestiya OGAU*, 2015, Iss. 2, pp. 246–248.

8. Chepiga, P. N. Improving the management of the system of handling of solid secondary material resources in the Russian Federation [*Sovershenstvovanie upravleniya sistemoi obrashcheniya s tverdymi vtorichnymi materialnymi resursami v Rossiiskoi Federatsii*]. *Problemy sovremennoi ekonomiki*, 2010, Iss. 4, pp. 45.

9. Zvyagina, A. I. Secondary raw materials and technologies for their use for production of building materials [*Vtorichnie syr'evie resursy i tekhnologii ikh ispolzovaniya dlya proizvodstva stroitelnykh materialov*]. *Tekhnologiya mashinostroeniya*, 2007, Iss. 4, pp. 50–51.

10. The development strategy of the industry for treatment, utilization and disposal of industrial and consumption waste for the period up to 2030, approved by Decree of the Government of the Russian Federation of January 25, 2017 No. 84-r [*Strategiya razvitiya promyshlennosti po obrabotke, utilizatsii i obezvrezhivaniyu otkhofov proizvodstva i potrebleniya na period do 2030 goda, utv. Rasporyazheniem Pravitelstva Rossiiskoi Federatsii ot 25.01.2018 № 84-r*].

11. Shevchenko, A., Konon, N., Tskhovrebov, E., Velichko, E. Innovative technologies of liquid media treatment in the system of ecological and sanitary-hygienic control of waste landfills. In.: *Matec Web of Conferences «International Science Conference SPbWosce-2016 «Smart City»*, 2017, p. 07005.

12. Murray, R. Zero waste. London, Greenpeace Environmental Trust, 2002, 213 p.

13. Hazardous waste and solid waste. Ed. David H. F. Liu, Béla G. Lipták. Lewis publishers, Boca Raton, London, N.Y., Washington, 2000, 273 p.

14. Rao, S. R. Resource recovery and recycling from metallurgical wastes. Volume 7. Elsevier, 2006, 558 p.

15. Antrekowitsch, J., Steinlechner, S. The recycling of heavy-metal-containing wastes: mass balances and economical estimations. *JOM 63 (1)*, 2011, pp. 68–72.

16. Measuring the environmental impact of waste management system. Integrated solid waste management tools. University of Waterloo, Canada. April, 2004, 45 p.

17. Pistoia, G., Wiaux, J-P., Wolsky, S. P. Used Battery Collection and Recycling. Industrial chemistry library. Elsevier Science, 2001, Vol. 10, 372 p.

18. Seadon, J. K. Integrated waste management-looking beyond the solid waste horizon. *Waste management*, 2006, Vol. 26 (12), pp. 1327–1336.

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