Modern problems of the waste recycling in small industrial cities

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Abstract. Creating an industry for the treatment, recycling and disposal of waste is an important task of the development of the Russian economy at the present stage. In accordance with the Decree of the President of the Russian Federation, the Ministry of Natural Resources and Ecology of the Russian Federation developed the national project “Ecology”. As part of this project, it is planned to implement the federal project “Construction of facilities for sorting and processing MSW” for the period from 2019 to 2024. In January 2018, the Government of the Russian Federation approved the Industry Development Strategy for the Treatment, Disposal and Disposal of Production and Consumption Wastes for the Period up to 2030. The authors propose a project to build the territory of the city district of Chapayevsk with waste recycling and recycling plants. Due to the already existing and erected high-tech industries, there will be an influx of highly qualified specialists. The city will receive substantial investment injections in innovative projects; it will be possible to participate in tenders for the execution of orders, grants for the development and development of high-tech areas.

1. Introduction
According to the United Nations, in 2025 the amount of garbage in the world will almost double. This conclusion was reached by experts at the Global Waste Management Partnership Conference. This conference is held every two years under the auspices of the United Nations Environment Program (UNEP). By 2025, the annual volume of municipal solid waste will reach 2.2 billion tons. This growth is due to population growth, urbanization and economic development of countries. Obviously, at the moment we cannot completely avoid waste, but we can strengthen the system of their collection and treatment.

World practice for recycling and disposal of waste shows that it is necessary, useful and profitable. Recycling of garbage in some countries of the world reaches the following indicators: Sweden - 51\%, Germany - 64\%, Netherlands - 51\%, Great Britain - 39\%, USA - 35\%, Japan - 21\%. Russia recycles only a small fraction of the waste (8–9\%). The annual increase in landfill sites in our country is almost 10\%. Each Russian has more than 400 kg of waste.

The main indicators of the quality of life of the population are: incomes, quality of food, quality of clothing, comfort of home, quality of health care, quality of social services, quality of education, quality of culture, quality of the service sector, quality of the environment, demographic trends, safety.

Deviation of environmental indicators from standards is one of the positions that affect the living standards of citizens.
Now, creating an industry for the treatment, recycling and disposal of waste is an urgent task of the Russian economy.

2. Results and Discussion
This area is regulated by the following fundamental legislative and other legal acts of the Russian Federation:

1. Federal Law "On Environmental Protection" dated January 10, 2002 № 7-FZ;
2. Federal Law “On Production and Consumption Wastes” of 06/24/1998 № 89-FZ;
3. Order of the Government of the Russian Federation of November 17, 2008 № 1662-p (as amended on September 28, 2017) “On the Concept of the long-term socio-economic development of the Russian Federation for the period up to 2020”;
4. The fundamentals of the state policy in the field of the environmental development of the Russian Federation for the period until 2030, approved by the President of the Russian Federation on April 30, 2012;
5. Decree of the Government of the Russian Federation of 31.03.2017 № 397 “On Amendments to the State Program of the Russian Federation “Environmental Protection” for 2012–2020”;
6. Decree of the President of the Russian Federation of April 19, 2017 № 176 “On the Environmental Security Strategy of the Russian Federation for the period up to 2025”;
7. The development strategy of the industry for the treatment, recycling and disposal of industrial and consumption waste for the period up to 2030, approved by order of the Government of the Russian Federation of January 25, 2018 № 84-r.

The Ministry of Natural Resources and Ecology of the Russian Federation has developed a national project "Ecology" in accordance with the Decree of the President of the Russian Federation. This project plans to implement the federal project "Construction of facilities for sorting and processing of municipal solid waste" for the period from 2019 to 2024. In total, this project was planned to spend 277 billion rubles, of which 93 billion is the federal budget, 2 billion is the regional budget, 182 billion is extrabudgetary sources. The main directions of the federal project "Construction of facilities for sorting and processing of municipal solid waste" are: the creation of a public law company, the formation of an integrated system for the treatment of municipal solid waste, the creation of conditions for the recycling of all production and consumption wastes prohibited for disposal. The aim of the project is to increase the share of municipal solid waste sent for recycling in the total volume of waste transported from storage sites from 10% in 2018 to 80% in 2024. In January 2018, the Government of the Russian Federation approved the Industry Development Strategy for the Treatment and Disposal of Production and Consumption Wastes for the Period until 2030. The goal of the Strategy is to maximally involve waste in production, systematically reduce the amount of waste that cannot be recycled, and to provide this industry with modern high-tech equipment. The implementation of the Strategy is planned to be carried out in two stages: the first stage - 2018-2021, the second stage - 2022-2030. Among the proposed measures at the first stage is the creation of the necessary technological and production reserve, the development of an integrated territorial scheme for the development and placement of industrial facilities for processing, recycling and disposal of waste, the creation of a center for equipment certification. Also, at this stage it is planned to implement pilot projects for the creation and development of production and technical complexes for the treatment, recycling and neutralization of waste, multifunctional complexes for their industrial neutralization, multifunctional sorting complexes, as well as regional environmental technology parks. At the second stage, since 2022, the Russian scientific, technological and industrial infrastructure should start functioning, ensuring the release of high-tech types of equipment, machinery, machines and mechanisms for processing, recycling and disposal of waste and manufacturing products from secondary raw materials. The share of recycled and neutralized waste in the total amount of waste generated should increase by 26% by 2030. It is also planned to create 70 eco-technology parks and to increase the number of production and technical complexes for the treatment, recycling and disposal of waste more than 37 times. According to statistics, the share of
municipal solid waste sent for recycling in Russia is very low (compared to Western Europe, the USA, Japan) and amounted to 7.5% in 2014, 8% in 2015, and 2016 in 2016. - 9% of the total volume of municipal solid waste exported from the places of formation. And the share of neutralized ones is about 50%.

The structure of municipal solid waste includes: paper and cardboard - 40%, food waste - 30%, wood waste - 3%, ferrous metals - 3%, non-ferrous metals - 1.5%, textiles - 4.5%, bones - 1.5%, glass - 4.5%, leather and rubber - 2%, stones - 2%, polymers - 6%. In the process of burial, the annual loss of valuable fractions of municipal solid waste paper is more than 9 million tons, polymeric materials 2 million tons, glass 0.5 million tons. Modern technologies of processing solid municipal waste allow to process polymer waste and reuse resources for the production of polymer film, window and door blocks, facing slabs and wall paneling, water, sewer and insulating pipes, linoleum, packaging, fasteners, furniture and sewing accessories, etc. Recyclable plastics are mainly used for the production of packaging and packaging materials. From textile waste it is possible to produce yarn, non-woven materials, technical wool, batting, felted shoes, felt, viscose fiber, paper, cardboard, insulating materials. Business is weakly involved in the development of textile waste production. This is primarily due to the lack of infrastructure, lack of a collection system, poor quality of raw materials, low cost of secondary raw materials.

One of the most valuable secondary commodities is tire covers and tires, because they contain natural rubber, carbon black and metal. According to data for 2015, 70 thousand tons (77.7%) were recycled out of 90 thousand tons of waste of tires. A special feature in our country is the active use of this raw material by the population (in the improvement of yard territories, the construction of flower beds). Rubber crumb and other materials are made from tires and tubes to partially replace the raw materials from which roofing materials are produced, slate, tile, mastic, other waterproofing materials, paving tiles, rubber mats, used as filler in the mix during construction of roads. A promising area for business is the creation of technologies and the improvement of the production of a building complex for the recycling of crumb rubber as additives in the production of concrete, asphalt concrete and reinforced concrete.

Unfortunately, the collection of such a demanded type of municipal solid waste as waste paper continues to be low and lags behind the existing possibilities of harvesting, while the market demands for these raw materials are available. Waste paper is used for re-production of paper, cardboard, insulation materials. In Russia, 12 million tons of recyclable waste paper is generated, and only 30% of this value is collected, while in Europe this figure is twice as high.

Every year, not only in Russia, but also in the world, the list of waste electrical equipment and electronic equipment (computers, household appliances, phones, tablets, photo, video, audio systems) is expanding. The ability to extract various valuable components from these wastes makes it possible to use them as secondary resources.

Recycling glass is one of the most popular in the world practice used components of municipal solid waste. In Russia, 8% of the resulting waste from glass is recycled, and 92% is for disposal. Production facilities allow us to recycle and reuse up to 80% of this type of waste. Glass waste, heat-insulating materials, glass granite, glass blocks, foam glass, etc. are produced from glass waste.

Solid municipal waste also includes organic components (up to 40%), from which it is possible to produce mixed feed, feed flour, biogas, bio-fertilizers, and even technical ethanol.

Recycling of municipal solid waste is an important problem that needs to be solved in our country, which will solve the problem of air pollution, water and soil. According to the Environmental Security Strategy of the Russian Federation for the period up to 2025, as a result of economic and other types of activity, 30 billion tons of waste has already accumulated. Creating a new system to reduce the proportion of disposed waste, to ensure the largest possible amount of waste involved in recycling as raw materials or materials, production of new products from raw waste, energy generation - these are the primary tasks that need to be addressed at both the federal and regional levels. Whole polygons of waste threaten the life and health of millions of people, cause significant harm to the environment.
reduce the area of productive agricultural land. This leads to a decrease in the quality of life of our citizens.

In world practice, great experience has been accumulated in creating an effective waste-processing industry. In the countries of the European Union, the USA, and Japan, environmental policy is based on the principles of illegitimacy of actions that threaten the quality of life of future generations. The main effect in solving the problem of growing waste is associated with their involvement in reuse. The reasons for the backlog of the Russian Federation in the process of creating an industry for processing, recycling and disposal of waste include the lack of an organized system of separate waste collection (and this applies to households and enterprises) and the subsequent processing of waste on an industrial scale, the use of waste fractions again in economic circulation.

What is produced from garbage in other countries? The United States built a plant that processes waste into liquefied gas, which, in turn, is used as fuel for cars. In Germany, 14% of raw materials for industrial enterprises are obtained from waste, and when burning garbage, the energy released is used for space heating and hot water systems.

Norway processes more than 95% plastic. If you buy a drink in a plastic container, then pay on top of the bottle, and when you hand over this bottle to a special machine, the money will be returned to you. Plastic containers are processed up to 12 times.

The Japanese use waste for the production of new things, office furniture, packaging and packaging. For example, they learned how to make new and high-quality cameras from old and broken cameras. At the same time, they also came up as the first in the world in creation of artificial islands from waste.

3. Conclusion
Thinking about the importance of recycling waste and the production of products from it, we analyzed the main development trends and the possibility of building processing plants in small urban settlements to meet the needs of the region and the region for cleaning and recycling. The authors propose to consider the territory of the city district of Chapayevsk for the construction of factories for the disposal and recycling of garbage. To do this, we consider the reasons why we selected Chapaevsk as the territory of development.

Table 1. The main factors influencing the development of the urban district of Chapayevsk

| Economic forces                                      | Socio-demographic factors                                      | Environmental factors                                      |
|-----------------------------------------------------|----------------------------------------------------------------|------------------------------------------------------------|
| 1. City budget:                                     | 1. Population:                                                  | 1. Air pollution:                                           |
| - economic and political instability;               | - insignificant population growth;                              | - within normal limits                                      |
| - budget surplus, alternating deficit               | - high mortality rate                                           |                                                             |
| 2. City-forming enterprises:                        | 2. Age structure of the population:                             | 2. Soil pollution                                           |
| - dependence on government orders;                  | - 45.5% - people of retirement age and minors (32500 people)    | - indicators are kept in the upper maximum permissible limits|
| - The slow pace of transition to civil proceedings; |                                                               |                                                             |
| - work on insufficient power                        |                                                               |                                                             |
| 3. Employment:                                     | 3. Education:                                                  | 3. Pollution of water resources:                            |
| - the share of the working-age population is only 55.5%; | - good preschool and school education;                         | - since 2011 there has been an increasing deterioration;    |
| - about 18-20% of the working-age population are involved in the main activity | - limited and insufficient number of secondary vocational education and higher educational institutions | - impossibility to clean the Chapayevka river from contaminated sludge; |
|                                                     |                                                               | - over the past 5 years, 11 underground drinking water sources have been recognized as unsafe |
We examined the three most important integrated groups of indicators that maximally influence the development trends of the urban district of Chapayevsk. These include economic, demographic and environmental factors, the main characteristics of which are presented in Table 1.

The first group of factors is economic. Considering the economic situation in Chapayevsk, we cannot regard it as an area with a financially stable position. In the city budget there is a constant change of economic results, the surplus is constantly replaced by a deficit, which is graphically presented in Figure 1.

The well-being of the city depends on the profitability of city-forming enterprises. Industrial plants have a slow pace in transition from production of the defense industry to civilian, as a result of which it is highly dependent on government orders. The absence of such orders leads to the work of enterprises at low capacities.

One of the important problems is the pendulum migration of most of the working resources. About half of the population of Chapayevsk (45.5%) belong to the disabled population. In view of the fact that two thirds of the working-age population go to work in other cities, then, as a result, only 18–20% of the total population of the urban district’s workers are employed at urban enterprises.

The second group of factors is demographic. After 1989, in Chapayevsk, there was no significant population growth due to natural growth or migration processes, which is clearly shown in Figure 3.

Among the negative factors, it is worth noting the growth of the elderly population in the general age structure. As of the end of 2016, its share was more than 1/3 of the total number and there is a steady increase.
Next, we consider the possibility of the population to receive educational services from preschool educational institutions to higher educational institutions. The city has a relatively well-developed network of pre-school and school educational organizations, as well as additional education. However, citizens are concerned about the issue of vocational and higher education of young people, since in the territory of the urban district there are practically no major higher and professional educational institutions.

Last, but not least, a group of environmental indicators. On the basis of the state report on the state of the environment and natural resources of the Samara region from 2016, conclusions were drawn regarding the state of the atmosphere, as well as the state of the land and water resources of Chapaevsk.

Currently in the territory of the Samara province there are no cities with “elevated”, “high” and “very high” levels of air pollution. It should be noted that the level of air pollution in Chapaevsk is estimated as low. The presence and concentration of harmful substances in the air samples was not exceeded.

When assessing the level of water contamination, it should be noted that the Chapayevka River is characterized as “very dirty” and in 2016, 13 cases of its “high pollution” with manganese compounds, Biochemical Oxygen Demand (BOD5) and alpha-hexachlorane were recorded, as well as 5 cases of “extremely high pollution” alpha-hexachlorane.

According to the pollution of the atmosphere of the city ranks fifth in the area. The results of the soil study revealed a more negative state - almost all indicators reached critical limits within acceptable limits. The most deplorable trends are outlined in the state of the water resources of the urban district. The bottom of the Chapayevka River is saturated with dioxides and furans, and it cannot be cleaned anytime soon. Which in turn puts at risk the health of citizens. 11 underground drinking water sources for 5 years were declared unfit for use. We conducted a sociological survey of citizens, regarding the degree of their satisfaction with life in Chapaevsk. The survey was conducted by means of a questionnaire, in which more than 180 respondents from various age groups participated. After processing the data, we obtained the following results.

![Survey Results](image)

**Figure 3.** The results of the survey respondents
The first question faced by citizens is “would you like to move to another city?”. The results showed that most would like to change their place of residence, but do not have such an opportunity. This issue is most relevant among students and young workers. Further, respondents were asked to assess the ecological state of their hometown on a five-point scale. Most of the citizens gave their preference to the "satisfies the request" indicator. The overwhelming proportion of votes cast in the direction of a negative environmental situation suggests that the majority of citizens feel vulnerable in the current situation, express concern about their health and the health of their relatives. The last question that was posed to residents was “is it possible to change the economic situation in Chapayevsk?” Most people think that there is no such possibility today.

Summing up, we would like to note that the results obtained during the survey and personal communication with citizens revealed a desire to change their place of residence due to lack of jobs, low wages, negative environmental conditions, which adversely affects the economic situation. Often were the statements of elderly citizens about the desire for their children and grandchildren to grow and work in a more prosperous area. Citizens believe that this situation can only be changed by taking drastic measures. In the course of the research, we identified the main reasons that prevent Chapayevsk from realizing its full potential. One of the important reasons is the lack of jobs, since the city-forming enterprises work only for 20-30% of the possible capacity, they do not have the need for workers, although they must be the largest employers in the urban district. As a result, the able-bodied population has to go to work in neighboring settlements on a rotational basis. The next reason is the lack of jobs for potential employees, current students and graduates of universities and colleges, as well as the migration of young people due to the lack of such higher and secondary vocational schools.

Chapayevsk at the moment has not attracted enough large investors. In the urban district there is a low birth rate and a rapid increase in the elderly population.

Thus, to apply existing successful projects of resuscitation of single-industry towns in relation to Chapayevsk is not consistent, for a number of distinctive causal. The development of small and medium-sized businesses will not bring significant injections into the city budget. While more than 50% of the population - disabled citizens, need social support. A good solution would be to give the city district the status of a territory of advanced social and economic development, which in turn would attract the attention of investors, but in view of environmental, economic problems, low social living conditions and a number of other reasons, we do not consider this area.

On this regard, we consider it expedient to propose a unique project for the development of social and economic development of Chapayevsk for 2018-2030. The project will be implemented through co-financing from the federal, regional budget and private investors, that is, on the basis of modern and relevant public-private partnerships. The estimated cost of the project is estimated at 70 billion rubles, and the share of attracting budget and private funds will be the same.

The project is based on the expansion of the industrial and scientific potential of the urban district. In the process of its implementation, it is planned to resettle part of citizens to neighboring regions of the region, reconstruct part of the city, build two important industrial facilities and give the city district the status of a “closed city”.

The city will be inhabited only by urban workers and their families, as well as citizens who refuse to move, for particularly important reasons, as well as a small proportion of the elderly population.

In Samara, construction of territories adjacent to the city is proceeding at a fast pace. The Government of the Samara region is invited to hold a competition among companies for the construction of the next village with the infrastructure it assumes, which will then be offered to move the residents of Chapayevsk. Also, this project provides for a program to provide a mortgage for the purchase of new housing at a low rate of 2-3% per annum. According to the project, it is necessary to carry out the reconstruction and cleaning of the site in the south-west of the city from the housing buildings for the subsequent placement of two large industrial enterprises there. In this case there will be a clear separation of the industrial and "residential” zone of the city - the railway.
The two main enterprises that we are invited to place in the city district are a plant for processing solid household waste and an aeromechanical plant.

The first thing that is proposed to be built on the territory of Chapaevsk is a domestic waste recycling plant. The advantages of industrial complexes of this type are their undoubted demand; continuity of the process regardless of the season and continuous supply of raw materials. Processed products will subsequently be used in local businesses. The construction of this plant will provide the city with 900 jobs, and such a complex will pay off within 9-10 years.

The second object is a tire and car tire recycling plant. This plant will undoubtedly bring a significant plus to the city district. For example, plants of this type can produce spare parts not only for local AvtoVAZ and KAMAZ, but also for aircraft, to produce parts for space objects and the local aviation industry. At the same time, students of Samara University can become potential employees and trainees of the plant. The company has a huge high-tech potential, which in turn will lead to an infusion of investment in the development of innovative technologies based on it. According to preliminary estimates, about 1.800 jobs will be able to offer an enterprise of this magnitude.

Also, the most non-standard solution is to appeal to state structures with a request to grant the city district the status of a “closed city”.

In the urban district there are significant defense, chemical and industrial enterprises. After the construction of plants for processing household waste and aeromechanical, the importance and attractiveness of the city will increase. Chapaevsk has a favorable strategic location, is located quite remotely from the borders of the country, and has a railway junction in all directions.

One of the advantages of acquiring such a status is a salary increase of 20% regardless of the sphere of employment. This will attract labor, increase competition for jobs, create demand for them.

Figure 4. Draft of geographical changes in Chapaevsk
In conclusion, as a result of the project, the population of Chapaevsk will be about 27,000 people, more than 80% of whom are able-bodied people. Due to the already existing and erected high-tech industries, there will be an influx of highly qualified specialists. The city will receive substantial investment injections in innovative projects; it will be possible to participate in tenders for the execution of orders, grants for the development of high-tech areas.

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[1] Federal Law "On Environmental Protection" dated January 10, 2002 № 7-FZ;
[2] Federal Law “On Production and Consumption Wastes” of 06/24/1998 № 89-FZ;
[3] Order of the Government of the Russian Federation of November 17, 2008 № 1662-p (as amended on September 28, 2017) “On the Concept of the long-term socio-economic development of the Russian Federation for the period up to 2020”;
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