Development of territorial scheme of municipal solid wastes treatment in Tyumen region

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Abstract. At the present time the majority of wastes have negative influence on the environment. At the same time, about 70% of wastes can be used repeatedly, as raw material, transforming them into new products and materials. Russia possesses the existing and commissioned waste recycling and waste burning plants. But only 3-15% of municipal solid waste are utilized. Moreover, many of these plants are not loaded at full capacity or have to buy the wastes abroad. This is due to the fact that Russia still doesn’t have effective system of wastes treatment – separate collection and following utilization or waste neutralization. To prevent the increase of areas of used municipal solid waste fields and unauthorized dumps, it’s required to track the full chain of wastes movement from the place of their formation to the place of their dumping.

1. Introduction

Industrial and consumption wastes (hereinafter - wastes) are the substances or subjects which are formed in the process of production, works and services or in the process of consumption which are removed, are intended for removal or subjected to removal according to current Federal law [1].

Depending on the degree of negative influence on the environment, the wastes are divided according to the criterion established by federal body of legislative authority, carrying out state regulation in the sphere of environment protection. They are divided into five classes of hazards [1,2].

Storage of industrial and consumption wastes is allowed on: the production territory of the main producers (manufacturers) of wastes; reception centers for collection of secondary raw materials; territory and in the buildings of socialized plants on recycling and neutralization of toxic wastes on open specially equipped platforms [2].

Collection of wastes on the production territory is intended for selective collection and accumulation of separate types of wastes; using of wastes in the following technological process with a purpose of neutralization, partial or full, and utilization on the auxiliary productions [1,3].

Collection of wastes is carried out according to the requirements of Sanitary Rules and Norms 2.1.7.1322 "Hygienic requirements to the placement and neutralization of industrial and consumption wastes" [4]. For the waste collection it’s provided the installation of container-type waste bins with covers mounted on specially equipped site with solid artificial waterproof coating (reinforced-concrete slabs) and efficient protection from wind and atmospheric precipitations with the observance of unhindered vehicular access for their loading and removal to the object of placement and utilization. Storage of wastes on the unprotected ground is not allowed [5,6,7].

Processes of waste treatment (wastes life cycle) include the following stages: formation, accumulation and storage, primary processing (sorting, dehydration, neutralization, pressing, calibration
etc.), transportation, secondary recycling (neutralization, modification, utilization, using as secondary raw material), storage, burial and burning [8,9,10].

Waste burial is applied to noncombustible refuse and such wastes which evolve toxic substances during the burning process.

Wastes field (municipal solid waste) is not an ordinary dump. Modern fields for utilization are complex engineering structures equipped with systems of fight with underground waters pollution and atmospheric air [11,12,13]. Some fields can process the gas formed in the process of wastes decomposition into electric energy and heat. Unfortunately, today this mostly refers to European countries, since in Russia very small percentage of fields corresponds to these characteristics [14,15,16].

The main minus of traditional wastes burial consists in that even using numerous systems of cleaning and filtration, this utilization type doesn't give possibility to get rid of such negative effects of wastes decomposition as putrefaction and fermentation which pollute air and water [17,18].

Seriousness of influence of waste processing and burial on the environment depends on the volume of produced wastes, their composition, amount of illegally buried wastes, number of wastes placed on the dump and standards on the plants of wastes processing. Future influence of waste management process will depend on how the indicated factors change. The final processing of wastes means the burial on the dump or burning. And these two types of final processing have an influence but it's negative in both cases [19].

Placement of wastes on the dumps leads to the methane emanation – one of the greenhouse gases and dangerous chemical substances which have harmful influence on the environment.

With the course of time, while the wastes decompose, they sag. At the same time shallow cavities appear. The water accumulates in them and the whole plot turns into marsh with poisonous water. For the periodic control for the quality of ground waters, monitoring wells are made along the dump perimeter [21].

2. Methods and conditions
For the development of territorial scheme there were taken into account the volumes of municipal solid wastes formation for 26 municipal regions and urban districts of Tyumen region, presented in the Figure 1.

![Figure 1. Map of municipal districts and urban districts of Tyumen region](image-url)
To study the dynamics of change of recycled wastes volumes, there were used actual data about the volumes of municipal solid wastes formation, appeared as the result of daily activities of the population for the following types of wastes: wastes from houses with joint collection; unsorted wastes from houses (except large-scale ones); rubbish and street sweeping; wastes (rubbish) from building and repair works; wastes of paper and cardboard from office activity and paper work; large-scale wastes from houses; wastes of unpolluted polypropylene package [22,23].

Places of disposal of municipal solid wastes in Tyumen region were presented by the following objects: MSW fields; authorized dumps; unauthorized dumps.

In the studied municipal regions there were observed unauthorized dumps, except Abatskiy, Vikulovskiy, Isentsiy and Yalutorovskiy municipal districts and Tyumen.

To determine the dynamics of municipal solid wastes formation in every residential area of municipal regions and urban districts there was calculated demographic population forecast on which the required index depends, it's determined by the formula 1:

\[ P_t = P_0 \times \Delta t \] (1)

where \( P_t \) – forecasted level of population number; \( P_0 \) – basic level of population number; \( \Delta \) – average annual increase of population; \( t \) – forecasting period.

According to the forecast of municipal solid wastes formation by residential areas for the period from 2016 to 2026, some municipal districts observe decrease of population that leads to the decrease of municipal solid wastes formation. Graphical data is given in the figure 2.

Maximal decrease of population by 2016 will take place in Sladkovskiy municipal district – by 14.90% with regard to the data of 2016. Insignificant decrease of population size and formation of municipal solid wastes will be observed in Tobolsk by 0.05%.

Significant dynamics of population growth and formation of municipal solid wastes in municipal districts of Tyumen region by 2026 is observed in Tyumen municipal district and makes up 18.36% regarding the same indices of 2016. The lowest growth is observed in Ishim town and it will be 1.61% by 2026. Maximal value 31.80% is forecasted in Tyumen.

For the collection, accumulation and further operations on treatment with municipal solid wastes, there will be built 19 waste transfer stations and 10 sites for accumulation with solid waste compactor by the end of 2026 in Tyumen region.

At the present time, territory of Tyumen region possesses 21 objects of municipal solid wastes disposal which correspond to the requirements of effective legislation and are included in SRWDS.

During 2018:
1) complete transfer of municipal wastes to the waste recycling plants is planned in the following regions:
   - Abatsky municipal district;
   - Ishimsky municipal district;
   - Ishim town;
   - Nizhnetavdinsky municipal district;

Figure 2. Dynamics of population decrease and formation of municipal solid wastes in municipal districts of Tyumen region
• Tobolsk municipal district;
• Tobolsk;
• Tyumen Municipal District;
• Tyumen;
• Yarkovsky municipal district;
• Yalutorovsk;
• Yalutorovsk municipal district
2) partial transfer of municipal solid plants and fields of MSW is planned in the following regions:
• Vagayskiy municipal district;
• Zavodoukovskiy urban district.
3) total transfer of municipal solid wastes to the MSW fields will be continued in the following regions:
• Armizonsky municipal district;
• Aromashevsky municipal district;
• Berdyuzhsky municipal district;
• Vikulovsky municipal district;
• Golyshmanovsky municipal district;
• Isetsky municipal district;
• Kazan municipal district;
• Omutinsky municipal district;
• Sladkovsky municipal district;
• Sorokinsky municipal district;
• Uvatsky municipal district;
• Uporovsky municipal district;
• Yuginsky municipal district.

In Uvatskiy municipal district transfer of wastes will be carried out to three WSM fields in Uvat village, Demyanskoe village and Pershino. Percentage ratio of residential areas transferring MSW to the fields.

33 villages transfer their wastes to the MSW fields of Uvatskiy municipal region. Among them: 21 residential areas transfer MSW to the field of the village Uvat, 5 village settlements transfer wastes to the village Demyanskoe, 7 village settlements – to Pershino. This dynamics of distribution of the wastes transfer by the residential areas to MSW fields is determined by the geographical location relative to each other, that contributed to the transportation of wastes.

In Yarkovskiy municipal district transfer of wastes will be carried out to 3 waste recycling plants. Percentage ratio of residential areas transferring MSW to the waste recycling plants is given in figure 3.

To the waste recycling plant in Ylutorovsk there will be transferred MSW from 8 village settlements; to Tyumen – from 20 village settlements; to the plant in Tobolsk – from 45 residential areas. This
gradation of distribution of MSW transfer by residential areas to the waste recycling plants is stipulated by more rational transportation depending on their geographical location relative to each other.

In Vagayskiy municipal district the transfer of wastes by residential areas is carried out to the field of MSW located in Vagay village and waste recycling plant in Tobolsk. Percentage ratio is given in the figure 4.

![Figure 4. Percentage ratio of residential areas carried out wastes transfer to MSW field and to the waste recycling plants in Vagayskiy municipal district](image)

Wastes from 84 residential areas are transferred to MSW field, and to the waste recycling plant – from 30 residential areas.

Analogous situation is observed in Zavodoukovskiy municipal district that is given in the figure 5.

![Figure 5. Percentage ratio of residential areas carrying out transfer of wastes to the MSW field and to the waste recycling plants in Zavodoukovskiy urban district](image)

3. Conclusions

From 47 settlements, 7 settlements transfer waste to the waste recycling plant, the remaining settlements - to the MSW field. Waste transportation to the waste recycling plant from village settlements is stipulated by their favorable geographic location relative to the plant, a small figure may indicate that the waste recycling plant has not been put into full operational capacity and cannot accept more waste for recycling.

When calculating the population for the period from 2016-2026, the number of generated MSW will be 499865.54 tons.

The objects of accumulation and disposal of municipal solid waste are identified:

- fields of MSW (14 municipal districts);
- waste recycling plants (Ishim, Yalutorovsk; Tyumen, Tobolsk);
- waste transfer stations (19 municipalities);
- sites with the presence of a press packer (7 municipal districts).

The developed territorial scheme will allow timely collection of transportation and processing of MSW, in order to improve the quality of the environment.

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