

## Instrumental research method of qualitative composition of landfill gas in the surface layer of landfills

I R Gilmanshin<sup>1</sup>, N F Kashapov<sup>1</sup>, S I Gilmanshina<sup>1</sup>, A I Galeeva<sup>2</sup>

<sup>1</sup>Kazan Federal University, 18 Kremlyovskaya street, Kazan, 420008, Russian Federation

<sup>2</sup>Kazan State Power Engineering University, Kazan, 420066, Russian Federation

[Is-er@yandex.ru](mailto:Is-er@yandex.ru)

**Abstract.** The article analyzes the practice of waste management in Russia. The system of target indicators of the efficient landfills functioning is formalized. The method of instrumental analysis of concentration and qualitative composition of landfill gas in the surface layer of the Samosyovo landfill is presented.

As of 2014, in the Russian Federation there are 5 168.3 million tones of . wastes have been generated.[1] Out of the total volume of annually generated waste about 60 million tons are SDW, from which the result of the life activity of the population is about 50 million tons and 10 million tons of industrial waste. The annual increase in waste volumes is 3-4%. [2]. In addition, according to statistics, specific volumes of waste generation in Russia are 350 kg / person in a year that is significantly lower than the average for Europe (503 kg / person per year), and even than in the EU-12 (420 kg / person), whose income level is close to Russian. [3]

According to the established practice, almost all the volume of solid waste is stored on landfills and dumps, and only 4-5% of the waste is involved in recycling. A low percentage of SDW involvement in processing is due to the lack of a sufficient number of enterprises for recycling of waste and waste disposal facilities. In total, 1092 specially arranged places for waste disposal (solid waste landfills) are registered in Russia, which is several times less than even authorized landfills, which are about 10 thousand. According to Rosprirodnadzor data, in 45% of the constituent entities of the Russian Federation the project capacity of landfills is lower than the established annual waste accumulation rate . All above it determines the prerequisites for reforming the industry of handling, processing, utilization and disposal of waste in the Russian Federation. The existing system of waste management needs to be promptly adjusted taking into account the global world trends.

Along with systematical upgrade of the waste management system, it is necessary to establish the following targets:

- percentage of waste to the disposal from the total volume of generated waste,
- damage to the environment associated with the removal of land from use, pollution of the environment,
- energy intensity of the burial process and subsequent reclamation of the landfill.

The condition for optimizing these criteria comprehensively determines the effectiveness of the waste management system.



Consider the selected criteria.

1. The proportion of waste to the disposal in the total volume of waste generated. The formation of waste is inextricably linked with the process of human life. Moreover, the growth of welfare and economic development only increase the volume of waste generated. Therefore, a system of total disposal of waste with full volume inevitably leads to increased costs associated with organizations of landfills, their content and reclamation. At the same time, land plots are withdrawn from circulation directly by landfills and the scope of use of adjacent sites is limited. The existing optimization mechanisms presuppose preliminary segmentation (including separate collection), mechanical modification of the state and form of waste (pressing), and problem-oriented methods of influence that determine the reduction in the volumes and degree of aggressiveness of wastes sent for disposal (thermal, chemical, microbiological, etc.).

2. Damage to the environment. Morphological composition of waste along with the burial system determines the intensive, continuous negative impact on the environment. Filtrates, the emission of harmful substances and gases into the soil and the atmosphere require monitoring and a set of compensatory measures. Moreover, the high effectiveness of protective measures can be achieved only when environmental safety requirements are taken into account at all stages of the life cycle of the landfill.

3. Energy intensity of the burial process and subsequent reclamation of the landfill. High material and energy costs associated with the implementation of comprehensive measures for the effective management of landfills are holding back their (measures) full implementation. At the same time, these activities are costly only to the first sight.

Certainly, a separate evaluation of the effectiveness of individual measures as a rule does not reveal their investment attractiveness. However, in the complex, systemic consideration of the effect, taking into account indirect positive factors, the economic efficiency of the project is fundamentally changing.

The Samosyovo solid waste landfill was selected as the object of research. The polygon consists of 4 burial maps. The first map is an experimental site - the burial site is full and is subject to reclamation and degassing. The estimated timeframe for filling the first waste storage card is 6 years. Years of the beginning and end of operation of the first card - 2004 - 2009. Design capacity of the first card: 937 872 tons. (5 345 780 m<sup>3</sup>) The area of the first polygon map is 4.44 ha. The height of the polygon (m), the height of the prism of the burial of the first card is 26 meters from the surface of the earth. Method of disposal of waste: clay sandy quarry - fill with uniform stowage, quarry fill - fill. Morphological composition of wastes on the first map: consumption waste of 562 713.68 m<sup>3</sup> (98 721.7 tons), industrial waste 2 138 349 m<sup>3</sup> (375 149 tons). The hazard class of the stored waste: mainly 3 to 4 hazard classes. Conditions and method of waste disposal degree - fill with uniform waste disposal, compaction, layer-by-layer repopulation of soil with a layer pitch of 2 meters in height. The thickness of the layer is 250 mm.

Based on the analysis of the initial data on the landfill, a preliminary plan was drawn up for the assessment of the energy potential of the first SDW landfill map:

1 Instrumental study of qualitative composition of landfill gas in the surface layer 1 of the SDW landfill map

2 Determination of quantitative parameters of landfill gas emissions from the surface of the landfill

3 Investigation of quantitative and qualitative characteristics of the landfill gas withdrawn through the arrangement of wells. The study of the actual morphological composition of waste in the body of the test site at the reference points.

4 Modeling the process of methanogenesis in the body of the test site and assessing the energy potential of the first SDW landfill map

Instrumental study of qualitative composition of landfill gas in the surface layer 1 of the SDW landfill map.

Instrumental investigation of the qualitative composition of the landfill gas in the surface layer 1 of the SDW landfill map was carried out using an analytical sampling probe for sampling the qualitative composition of the landfill gas in the surface layer of the polygon body from a depth of 500 mm.

As a gas analyzer, a complex analysis instrument for the qualitative composition of Geotech GA2000 gaseous from Keison Products, England was used.

Based on the set radius of the sampling point coverage of 20 meters, 23 samples were analyzed.

The results of the analysis are presented in Tables 1-4.

Table 1 Methane content in the landfill, in%

Row 6	Row 5	Row 4	Row 3	Row 2	Row 1
-	3,8	2,5	12,4	20	16,8
0,9	1,3	0,6	19,3	2,1	0,3
0,7	0,6	0,4	0,3	0,6	0,3
0,4	1,5	1,4	0,3	0,7	0,3

Table 2 Carbon dioxide content at the landfill, in%

Row 6	Row 5	Row 4	Row 3	Row 2	Row 1
-	21,5	0,4	18	30,8	25,2
4,4	0,8	1,4	30,5	2,3	5,9
4,8	0,4	0,2	13,9	10,4	3
10,7	0,8	15,1	10	7,2	21,3

Table 3 Oxygen content in the landfill, in%

Row 6	Row 5	Row 4	Row 3	Row 2	Row 1
-	2,6	12,3	7,1	2	1,8
12,4	13,9	14,4	1,7	12,8	10,5
12,1	15	15	5,8	8,4	12,5
8,7	13,6	5,7	8,2	10,8	1,9

Table 4 Carbon dioxide content in the landfill, in ppm

Row 6	Row 5	Row 4	Row 3	Row 2	Row 1
-	31	55	96	134	52
23	24	40	112	60	21
29	25	33	19	34	22
21	31	75	16	27	27

During the analysis of the results of the study of the qualitative composition of the landfill gas in the surface layer 1 of the SDW landfill map, the increase (up to 20%) of methane concentration in the northeastern part of the map of the 1 landfill is established; significant uneven distribution of methane concentration in the surface layer of the top area of the first polygon map; presence of local areas (bubbles / cavities) of increased (up to 60%) concentration of methane in the body of the first map of the landfill; the surface layer of the first polygon map has an uneven layer of overspill, at a number of sites the thickness of the overpacking layer exceeds 500 mm; the actual stage of the life cycle of organic inclusions in the body of the first polygon map allows us to continue the studies of quantitative emission of landfill gas into the atmosphere; the actual stage of the life cycle of organic inclusions in the body of the first map of the landfill allows us to positively consider the feasibility of building an energy complex for landfill gas, but the data obtained are not sufficient for a comprehensive assessment of the energy potential.

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