Landfill energy complex based on the renewable energy installations

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Abstract
The article presents the analysis of standard approaches to degassing of landfills. The need of comprehensive work on the degassing of the landfill body is identified. The author's task decomposition of the landfill degassing is formulated. The analysis of existing methods of work on degassing of landfills is presented. The author's approach is including implements of series of parallel studies in the framework of achieving a common goal to reduce the anthropogenic pressure on the ecosystem of the region due to the need for disposal of solid waste. An action plan for the development of the target problem-oriented management techniques of the landfill with the following development of the effective energy complex is formulated.

To the issue of landfill gas utilization has traditionally being paid great attention in Europe, Latin and North America. However, this issue is relevant for the landfills of the Russian Federation as well. The need for complex work of degassing of the landfill due to a number of factors: the withdrawal of the effective turnover of large areas in the area of the city; the effect of methane on global climate change is estimated to be 23-25 times higher than the potential impact of carbon dioxide; allocation of landfill gas creates the preconditions to spontaneous combustion of deep layers of the landfill; utilization of the landfill gas can generate additional electrical and thermal power and allow to reduce human pressure on the ecosystem of the region, and in some cases extend the life of landfill.

The severity and urgency of these problems are increasing day by day. The intensive development of the economy increases the human impact on the environment. Thus, research in the field of construction of a modern, efficient energy complex based on a closed or operated landfill is an urgent task.

After researching the task, the several areas of research are determined: the study of the morphological composition of the landfill; modeling of landfill internal processes lifecycle; analysis of the energy potential of the landfill; the development of problem-oriented methodology of the landfill degassing; system analysis of the process of processing, recycling and disposal of solid waste, development of effective management methodology of landfills and building an effective energy complex on the basis of alternative energy systems.

Analysis of the literature has showed that there are a number of developing and applying various technologies of degassing technologies have place today [4, 5, 6, 7]. However, conducted researches have very scattered narrowly focused work. The effective problem solving possible with a systematic approach. It is necessary to consider the landfill as a holistic energy complex such as power plex of industrial enterprises [9]. That will have the further attractiveness of the project to investors. [10] Due to the information above, we propose an approach that implements a series of parallel studies in the task of the work to achieve a common goal: reduce the anthropogenic load on the ecosystem of the region due to the need for disposal of solid waste.

The algorithm of research towards the study of the morphological composition of the landfill.

The most landfills of Russian Federation have formed without regard for the specific use as platforms deployment of alternative energy systems. Moreover morphological structure of exported waste has undergone significant changes and will change further. [11]

In such circumstances, it is important to define the boundary conditions of the functioning of the energy complex in conjunction with morphological composition and distribution of the landfill body. Analysis of the grounds revealed insufficient monitoring of the morphological composition of the waste is actually: a lack of strategic planning in the formation of the landfill; absence or chaotic actions of the administration of waste sorting and selection of commercially attractive materials.

It should be noted that in connection with the proceeding in the landfill process of natural decomposition of organic compounds in the morphological structure of its quantitative and qualitative indicators have variable numbers. The energy potential is directly related to the intensity and the concentration of the decomposition of organic compounds in the body of the landfill.

According to the statistics, solid waste consists of 55 - 70% organic compounds. The process of decomposition of this waste takes place in many ways identical to the process of fermentation of highly contaminated sewage sludge or sewage treatment facilities. As a result biogas is produced with combustion heat 18900 - 25100 kJ / m3 (4,500 - 6,000 kcal / m3). Average composition of biogas is the following: methane - 50-65%, carbon dioxide - 30 - 45%, hydrogen sulfide - 0.2-0.8%, nitrogen, oxygen, hydrogen, - 1-2% and aromatic hydrocarbons – up to 1% in the conditions of the average moisture content of biogas - 35 - 40%. By purification of the ballast, hydrogen sulfide and drying the heat of combustion of biogas can be increased to 27200 - 31400 kJ / m3 (6500 - 7500 kcal / m3), which is 80% of the calorific value of natural gas. Thus, landfill gas is a renewable resource suitable for use in conventional power plants.

In general, the scheme landfill gas has the form which is shown in Figure 1.

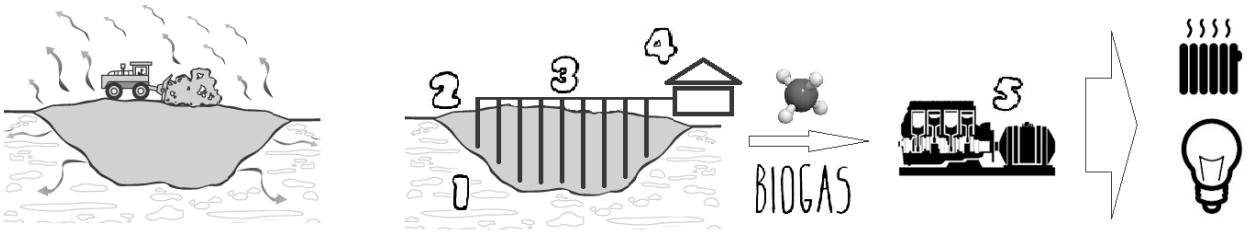

Fig. 1. Typical utilization of landfill gas, where

1 - waste storage area; 2 - landfill body; 3 – degassing system of landfill gas; 4 - section where landfill gas parameters are bringing to the required value; 5 - cogeneration facility

In most cases, systemic study of the morphological structure and the decomposition process of organic compounds has not been since the founding of polygons. In the absence of objective information on the current stage of the life cycle of organic compounds in the body of the landfill to give a qualitative assessment of the energy intensity of the landfill and the economic feasibility of the construction of the energy complex is not possible.

In analyzing the issue of construction of the energy complex we have formulated priorities which allow an objective assessment of the capacity of the landfill in the generation of the landfill gas: stratified analysis of the morphological structure of the landfill on the marker layers (time-projection installation waste); analysis of the current status of the life cycle of organic compounds in the body of the landfill; experimental determination and subsequent monitoring of the environmental parameters (temperature, moisture, pH of the environment, etc.) in the body of the polygon marker layers (the time of the projection 3, 5, 10, 15 or more years of laying waste); experimental determination of the debit layers of the landfill and mine as a whole.

By solving these problems the targeted problem-oriented method of management of solid waste landfill and development of the effective energy complex on it will be developed.

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