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ABOUT IMPROVEMENT OF ENVIRONMENTAL PROTECTION MEASURES SYSTEM IN LANDFILLS OF RUSSIA WITH TAKING INTO ACCOUNT THE POSSIBILITY OF BIOGAS UTILIZATION

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ABSTRACT

Continual growth of waste accumulation volumes, in particular, of solid domestic waste (SDW), causes a great many of environmental and economical problems such as, environmental (soil, groundwater and air) pollution, alienation of lands, alteration of landscape, growing expenses for construction of new waste processing plants and reconstruction of existing ones, etc. These are the actual problems in the cities and settlements of Russia and many other countries. The most part of SDW generated in Russia (97 %) is removed to the dumps and landfills and only 3 % is treated in waste processing plants.

So, main attention should be concentrated on all the reduction of waste amount removed to the landfills which may be reached by means of development of environmental friendly wasteless or little waste technologies, in particular recycling systems introduction (organization of separate waste collection in situ, subsequent utilization of each useful SDW morphological components) and new waste processing plants construction. It should also take care of unauthorized dumps elimination, improving environmental conditions around the landfills, and engineering infrastructure safety provision.

Besides, SDW consisting of organic materials for 50-80% may be considered as important additional source of energy. In particular, as to landfills, it is the power of biogas, which may be used for heating, electricity generation and several another purposes. The main expenses for biogas utilization are to extract, dry up and transport.

KEYWORDS
Biogas, collection, improvement, insulation, landfill, leachate, treatment, waste.

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CONTEMPORARY SITUATION WITH WASTE IN RUSSIA, IN ST-PETERSBURG AND ITS REGION. EVALUATION OF LANDFILLS AND DUMPS AS POTENTIAL BIOGAS SOURCES.

There are about 57 mill tons of SDW annually generated all round the Russia on analytical data, [3]. On analytical data of another original source, [2], it is about 130 mill m^3 of SDW per year, what equals approximately 26 mill tons (density of SDW in non-compacted state is about 0,2 ton/m^3).The data of original source [2] turned out later to be most reliable. As emphasized above, 97% of all waste amount are removed to the dumps and landfills and only 3% are treated in waste processing plants. At present, there are more than 15 thousands ha occupied by operating dumps and landfills and more than 40 thousands ha done by closed ones in our country. Besides, there is a great quantity of unauthorized dumps representing particular threat for environment.

There are about 4,5 mill m^3 (0,9 mill tons) of SDW annually generated in St-Petersburg and about 1 mill m^3 of building and industrial waste, [4]. Now, waste generated in St-Petersburg are being stored in three landfills ("Yoozhniy", "Novosiolky" and "Severnaya Samarka") occupying total area approximately 200 ha (there are stored more than half of total waste generated amount) and being treated in two waste processing plants. The first waste processing plant has been treating waste since 1970 by technologies of composting and pyrolysis. The second plant came into operation in December of 1994 by composting technology.

The landfill "Severnaya Samarka" receives only industrial waste. As capacity of the landfill "Yoozhniy" will be exhausted completely in nearest time, reception of SDW will be concentrated in the landfill "Novosiolky". It will cause new problems with waste removal such as: lengthening transport run, need in construction of new access roads etc.

The serious shortcoming of existing SDW collection system is absence of separation from the waste mass of secondary raw materials and, - what is of the most importance, - dangerous waste (exhausted galvanic elements, luminescent lamps, and so on).

Variation of waste accumulation volumes in last years is shown in diagram (fig. 1).

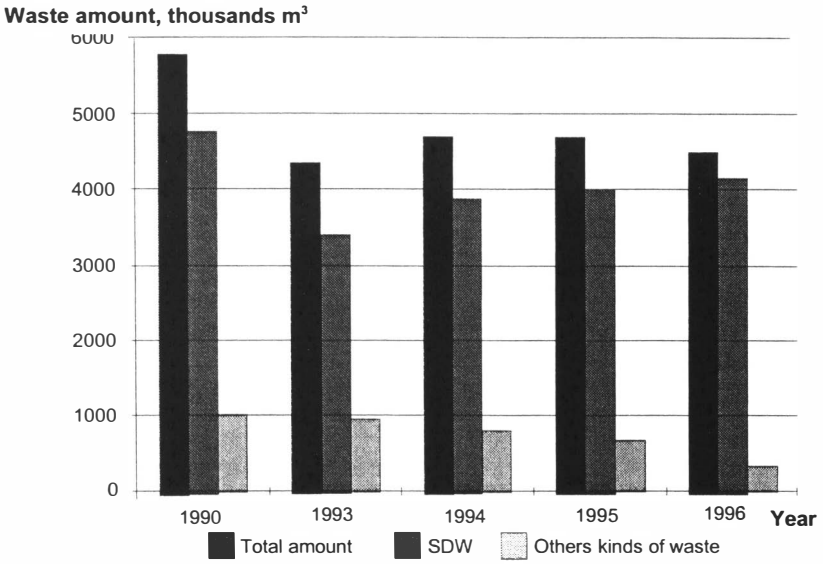

Fig. 1: Tendency of waste accumulation in St-Petersburg

In the field of waste treatment, it is necessary to take measures directed both to raising efficiency of waste treatment technological processes and to reduction of negative influence of waste processing plants and landfills on environment. Environmental aspect should be taken into account when choosing a waste treatment method. The most wide used methods are land-filling, incineration and composting. Influence of each manner on condition of atmosphere air is shown in the fig. 2.

Fig 2. Relative indicators of atmosphere air contamination when processing SDW by next manners: 1 - composting; 2 - incineration by efficient cleaning smoke gasses; 3 - storing in the landfill (in all the time of storage); 4 - incineration without cleaning smoke gasses.

Besides, both operating landfills of St-Petersburg and already closed may be considerable biogas sources. Now there are situated 4 closed (recultivated) SDW landfills with area occupied about 300 ha in St-Petersburg, which may represent interest as the sources of biogas [4].

Unauthorized waste dumping goes on in many districts and places of our city, especially to the badly organized territories. By present time, there has been revealed more than 300 unauthorized dumps occupied the area 256 ha. The part of rubbish is being burried or thrown to the ponds. These dumps can't be industrial biogas sources because they have small volumes and inert substances prevail in composition of rubbish there.

In addition, over 4 mill m^3 of waste are being stored in the 55 authorized dumps. They have been approved by administrations of districts. Despite the comparatively small volumes of waste burial places, biogas extraction in a number of the dumps can prove to be profitable because of high fuel costs and irregularity of fuel delivery.

Biogas output may increase in 1,5-2 times, if municipal sewage sludge will be added to SDW. By this, the extremely actual issue of sewage sludge utilization may be solved, because high concentrations of pollutants don't allow sludge to be used as fertilizer. There are situated 16 sludge grounds in our city occupying total area 161 ha, where the weight of sludge stored is about 3 mill tons. By such amount of sludge, approximately 500-600 mill m^3 of biogas may be received. There are nearly 100 such objects in St-Petersburg region, [2].

Now, we pass on to considering the main topic of the paper.

PROVISION AND IMPROVEMENT OF ENVIRONMENTAL PROTECTION MEASURES IN LANDFILLS. LANDFILL AS BIOGAS SOURCE.

As removal of SDW to the landfills and dumps has up till now remained the main method of handling with the given kind of waste and quality of landfilling does not always correspond to the Normative Basis of handling with SDW, a number of problems arises in this field. The main of them are search of efficient ways: 1) to reduce environmental load, and along with that, 2) to utilize waste as supplementary source of energy and several useful secondary raw materials. In particular, the possibilities of biogas receiving at landfills estimated in this paper. The analysis of the main measures to minimize negative effect on environment from landfills is performed.

Inappropriate landfilling causes environmental (soil, groundwater and air) pollution. In particular, educing landfill gas (biogas) has negative influence on root systems of plants growing in the vicinity of landfills or on surfaces of those landfills, which have been closed (recultivated) by this time. The influence consists chiefly in ousting air from root systems. Surface water filtering through landfill dissolves many components of SDW and when mixing with direct concentrated liquid product of waste biochemical decomposition (alcaline solution or lye) causes formation ofdiquid substance (leachate). It has no less suppressive effect on plants and environment at all when landfilling inappropriate. Emissions of biogas and leachate, besides, lead to dangerous and damage situations in engineering constructions and buildings bordering with landfill sites. Biogas penetrating into basements and lower floors may set off explosions and fires. Leachate may cause corrosion of metallic parts of constructions and equipment. So, main attention should be concentrated on improving environmental conditions around the landfills, and engineering infrastructure safety provision. To attain two last objectives there is the complex of environmental protection measures, including careful gas and

water insulation of landfills, as well as obligatory installation of leachate collection system. Similar system is desirable in respect of biogas. It is desirable also, that monitoring for soil, groundwater and air qualities be being performed not only while operating landfills, but even during 20-30 years (in single cases even up to 40 years) after their recultivation, that is in the term of active SDW biological decomposition.

A shortcoming of many landfills in our country is absence of leachate purification systems in situ. Usually, there operates the systems of leachate re-circulation: leachate is collected into the perforated pipe, then it flows to the collecting well. From well it is driven up by pump through pressure pipeline to the surface of storing waste layers. One part of leachate evaporates, another part leaks into the landfill again. It occurs in some cases, that only one leachate collection pipe is projected in landfill. If it becomes obstructed landfill will convert into mire, as it happened, for instance, with landfill of town Tosno (St-Petersburg region), where bulldozer got stuck in the mass of sodden waste.

The main operations on exploitation of landfills with involving biogas collection system into technological scheme are shown in fig. 3. Observance of this succession provides environmental protection requirements and allows the waste to be utilized as complementary energy source.

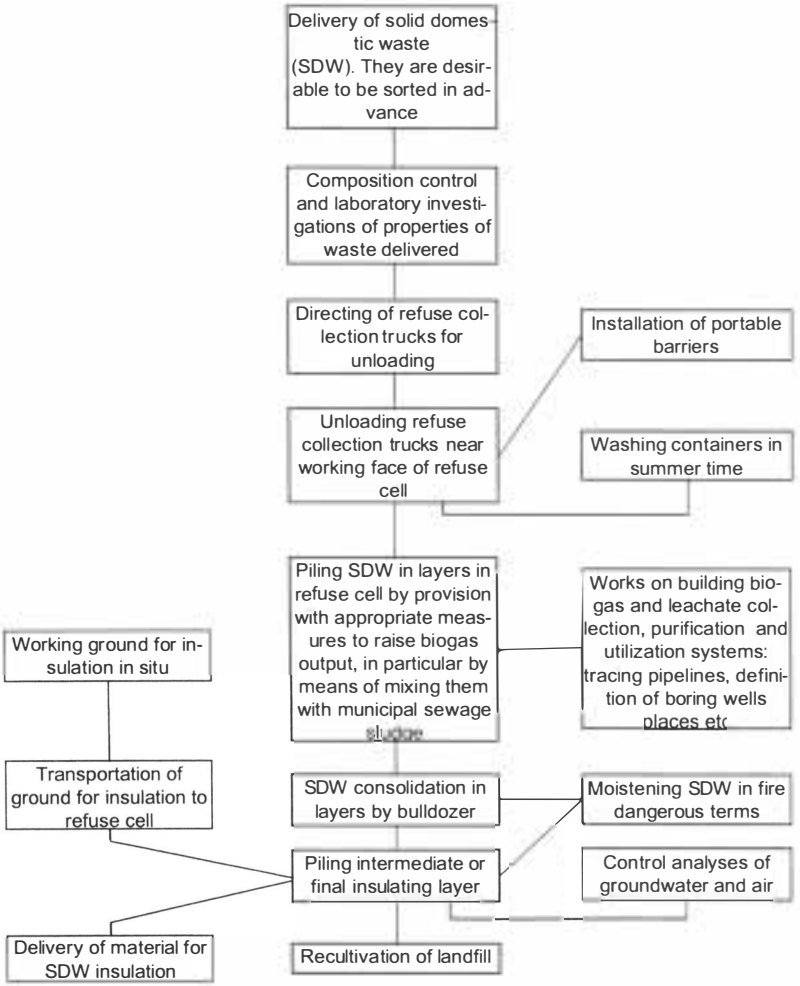

Fig. 3 The main technological operations in landfill site with involving biogas collection system into technological scheme.

In order leachate and biogas collection systems to be an effective parts of landfill technological scheme, it is necessary to provide the system of control and laboratory investigations of delivered waste composition. Special attention should be paid to content of great amount of easy decomposable organic substances to reach maximal biogas output. If the composition of SDW delivered and storage conditions are not optimal for industrial biogas receiving in

amount required (needed biogas output is about 200 m^3/ton SDW and higher), then, to increase educing biogas amount may be used such measures as:

- rise of content of organic materials able to biochemical decomposition (and therefore rise of active carbon) for example by means of addition of municipal sewage sludge (i. e. by combined storing with SDW) in proportion 2:1 on weight with receiving mixture with humidity not more 60 %;
- air supply;
- water supply for provision SDW humidity required;
- artificial consolidation of storing waste up to density not less 600 m^3/ton SDW;
- application of reliable gas and water insulation in landfills.

With the inclusion of biogas collection system into landfill technological scheme when carrying out waste monitoring, investigation measures and optimization of waste composition, solutions of some problems will be facilitated. In particular, they are: expected biogas and leachate amount calculation as well as basing efficiency of investment project on building appropriate constructions.

Optimization of waste composition, should be carried out by means of preliminary separation before waste removal to the landfills and dumps. This measure is widely applied in landfills of many European countries, in particular, in Sweden. There performs division of landfill site for different types of waste. Division of waste input to a landfill site between a number of sub-sites implies that there is greater possibility to treat the waste correctly. The sub-sites are in turn divided into cells. The waste are divided as follows: inert landfill; coarse waste landfill, bio-cells, ash cells, special waste cells [1]. Unfortunately, preliminary separation of waste has not been performed up till now in overwhelming majority of Russian cities and settlements. This is a one of the most considerable shortcomings in the field of waste handling in Russia. It causes a great quantity of complementary economical and environmental problems both while processing waste and while landfilling. So we should adopt progressive experience of Sweden and other European countries to develop and improve the system of handling with waste products and their treatment. It will allow to eliminate existing negative environmental and economical consequences of inappropriate waste handling, and to avoid possible mistakes in this field.

SUMMARY

To sum up, development, improvement and introduction of waste processing and landfilling technologies in the directions considered in the paper, introduction of equipment for landfill gas (biogas) collection and carrying out its effective utilization included, are to provide environmental load reduction, as well as to make a valuable contribution to solution of additional energy sources problem.

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