Processing of solid waste for the improvement of the urban environment

*Vladimir Zotov*¹ and *Andrey Butyrin*^{2,*}

¹State University of Management, Ryazansky Avenue 99, 109542, Moscow, Russia

²Moscow State University of Civil Engineering, Yaroslavskoe shosse, 26, 129337, Moscow, Russia

Abstract. The article is devoted to the domestic waste recycling challenges in our country and possible ways to address them. Today, these issues are considered to be multifaceted and involve not only the enterprises but also the corresponding authorities and the population itself. The experience of the developed countries proves that the use of progressive innovative technologies in waste managing can solve a number of problems in the field of economy, ecology and public health. To implement such technologies a coherent action of all participants in the waste management process is required. The authorities and enterprises should be clearly coordinated in addressing the challenges of the development and implementation of low-waste technologies. Moreover, it is necessary to raise the level of environmental knowledge among the population.

1 Introduction

According to the Federal State Statistics Service (Rosstat), the increase in population in the cities of our country in the last decade constitutes a clear tendency. In this regard, the problem of increasing of solid domestic waste (SDW) concentration especially in large cities such as Moscow, St. Petersburg, Nizhny Novgorod, Novosibirsk, Samara, etc., is becoming increasingly urgent in the Russian Federation (RF). The growing increase in the amount of waste requires its timely removal from the territory of the population as well as effective and safe disposal. Effective and competent SDW recycling will solve a number of problems in the spheres of economy, public health and environmental protection of our state [1-10].

2 State-of-the-Art

Solving the problems of recycling of SDW and production waste as well as prevention of their negative impact on the environment is currently a priority for Russia. More than 94 billion tons of solid waste have accumulated in the dumps and storage areas on the territory of the country. According to official data, more than 3.5 billion tons of wastes per year, including 35-40 million tons of municipal SDW are produced in Russia. The Federal Service for Supervision in the realm of Environmental Management in Russia at the beginning of 2010 recorded 7518 polygons for waste disposal, of which: 1699 SDW landfills, 576

* Corresponding author: osun_kaf@mgsu.ru

industrial waste disposal sites, and 5,243 unauthorized dumps [4]. The recent wave of unauthorized dumps is a most acute problem today. Elimination of such landfills is very problematic since basically all of them are located on the land plots that in fact do not belong to anyone. Therefore, they are not controlled by any authorities. For instance, Moscow region state inspectors annually identify more than 600 unauthorized garbage dumps and about 2 thousand rubbish in bulk. At the same time, it should be noted that even a small-sized landfill can cause significant damage to the environment and public health as waste products decompose into the soil, water and are released into the air in the form of volatile compounds [7]. In the opinion of Sergei Ogorodnov, the chairman of the board of directors of Infra-Engineering Infrastructure Holding, the problem of waste accumulation as the civilization cost is not that important as the problem of ineffective waste treatment. According to the information of the largest participant of the SDW market state corporation Rostekhnologia at least 40% of all garbage accumulated in the country is a valuable secondary raw material. At the same time only a small part of the waste (7-8%) is recycled, and the rest is carried to the landfills. According to the Moscow department of nature management and environmental protection in 2011, about 2.9 million tons of solid domestic wastes were generated in Moscow, less than 1% of them fell into processing which is only 27.6 thousand tons. The fact is that in the Russian Federation garbage recycling industry is at the outset of its development. Currently in our country there are about 250 waste-processing and 50 waste-sorting complexes and 10 waste incineration factories. Such a number of technological facilities is clearly not enough to cope with the volume of SDW throughout the whole territory of Russia. In addition, in Russia there are no factories providing full cycle processing of garbage. The domestic projects have so far been limited to the purchase of industrial presses which compress garbage for further stowage on the landfill. The opportunity to receive profits from the sale of recyclable materials which foreign investors rely on as a priority is practically not realized. This is the key difference between the domestic economic model in the sphere of garbage processing and the European one. Rigid environmental requirements make the placement of solid waste on European landfills the most expensive way of waste recycling and its processing is a very profitable business. In our country, everything is exactly in reverse: it is cheaper to store garbage at landfills or burn them [8].

Another challenge in the field of waste management in the Russian Federation is the inability of the empowered authorities to manage garbage properly. The fact is that currently all the hardships of ensuring environmental safety in waste production and consumption have become the responsibilities of the corresponding enterprises and local governments. As practice has shown, local self-government bodies are not able to ensure proper execution of the assigned responsibilities for domestic waste managing which caused an uncontrolled growth of unauthorized landfills almost in each locality [4].

3 Results

The following factors were identified as problems of solid waste processing.

Poor Resource Utilization.

Lack of skill man power most of the enterprise produce products wit out any engineeringspecification (drawings, mock-ups, material requirements of the product, were not available) causing Waste generations in the enterprises.

Waste Storage Problems.

In these enterprises solid wastes, which cannot be accommodated in the normal storage containers and need a special collection mechanism? The waste simply found in the working area and it is reduce production capacity of the enterprises.

Poor Awareness, Training and Capacity Building.

There is lack of awareness, training, and education coupled with the negative attitude and lack of cooperation from government organizations. Therefore, awareness is crucial problem for sustainable solid waste management of the enterprises.

Waste Prevention.

Waste prevention also called source reduction seeks to prevent waste from being generated. Waste prevention strategies include using less packaging, designing products to last longer, and reusing products and materials. Waste prevention helps reduce handling, treatment, and disposal costs and ultimately reduces the generation of methane. From the analysis observed that the waste prevention of the enterprises are very poor. From the total respondents, 86% did not consider the Waste Prevention mechanisms. Due to this the problems controlled only 14% of the total of solid waste.

Recycling.

Recycling is a process that involves collecting, reprocessing, and/or recovering certain waste materials (e.g., paint plastic& glass, metal scraps, concrete waste and plastics) to make new materials or products. Recycling generate many environmental and economic benefits. But the enterprises have not recycling mechanisms of solid waste because of shortage of facility, lack of knowledge and financial problems.

Reuse of Solid Waste.

Waste reuse means to find a new use for components that would be part of the Municipal solid waste, without the need for reprocessing them. These products can be either is reused for their original purpose, or for a different one. Examples of reuse are selling or donating used clothes, using empty glass containers for candy storage, turn empty jars into containers for leftover food, use of refillable pens, among others. But the enterprises have little knowledge for reusing of most solid wastes. Only small amount of plastic wastes use for secondary purpose.

Collection Systems.

The proportion of solid waste generated to that collected is very low in the enterprises. The collection efficiency is also hampered by the inappropriate waste container. The solid waste is not collect properly to control problems of the enterprises production process. The enterprise has not appropriate storage containers to store and collect wastes together. In general before the action is taken pre assessment result shows that (lack of training, capacity building, implementation of kaizen, poor collecting systems, lack of waste storage facility) the following problems were seen. Poor mobilization of resources. There are no viable economic incentives to encourage waste recycling, waste reduction to the employer Insufficient financial resources for recycling of wastes Lack of government and institutional support. Poor employer attitudes towards environmental cleanliness shifting responsibility Lack of general awareness of solid waste management Inadequate solid waste management (SWM) mechanisms at generation points including collection, storage. Over-reliance on imported and inappropriate technology and equipment at the enterprises.

Some concrete recommendations can be done to improve the effectiveness of the enterprises solid waste management was proposed, covering the following are as.

Action from the enterprise:

- a) Increase the amount of waste containers (in side and outside the work shop);
- b) Encourage the employer by giving incentives;
- c) Conduct workshops for stakeholders;
- d) The enterprises should consider training the workers to upgrade their skills;
- e) Conduct continuous trainings on solid and waste management technologies.

Action from government:

- a) Increase the enterprises awareness, education and participation in the waste management program;
- b) Conduct continuous trainings on solid and waste management technologies;

- c) Promote /crate recycling departments in educational institutions;
- d) The government/town and urban administrator) should design the waste collection sites of the enterprises.

4 Discussion

In the world practice there is a number of the most commonly used ways of solid domestic and industrial waste processing. At present the methods of preliminary sorting with subsequent processing of waste fractions (recyclable materials), sanitary earth filling and burning are widely applied [1].

Preliminary sorting of waste is of great economic importance: the recycling of secondary raw materials (petroleum products, ferrous and non-ferrous metals, and plastics) reduces the consumption of irreplaceable minerals. Sorting makes it possible to reduce the demand of the pulp industry in wood raw materials and it is the direct ecological effect of the conservation of forest lands. As a result of waste sorting and secondary use of sorting products, the volume of waste falling on landfills for disposal is reduced. Besides, the service life of the landfills increases. However, in our country waste as a secondary raw material characterized by a high level of liquidity under the prevailing market conditions such as waste of ferrous and non-ferrous metals, scrap and glass is being collected and disposed most frequently. Paper, cardboard, plastic and aluminum cans, which, according to specialists, account for more than 40% of solid waste, are located on landfills polluting the environment. The use of recyclable materials makes it possible for the enterprises that produce packaging to significantly reduce their costs. For example, savings from the recycled materials use in the production of packaging is on average 20% of the cost. And decrease in costs when using cullet for glass production can reach 50% [4].

The European practice on SDW management has proved that separate waste collection is beneficial to the citizens themselves reducing their payment for export and recycling of a household waste. To implement such practice in Russia it is necessary to raise the level of environmental culture of the population. The best way is to use a comprehensive way covering all age categories from schoolchildren to retirees [8-11].

It should also be noted that a decrease in the volume of waste to be disposed of leads to a reduction in the area allocated for disposal which can then be used, for instance, as farmlands [4,5].

Sanitary earth filling refers to the technologies of waste neutralization spread in Europe. According to this method waste is covered in a certain way with a layer of soil 0.6-0.8m thick in the compressed form. This method of waste recycling is associated with the production of biogas which can be subsequently used as fuel [2]. Since the burial of waste at landfills is widely spread in Russia with the help of sanitary earth filling it will be possible to obtain a large amount of energy. The disadvantage of the waste processing method is the contamination of groundwater and soil by the formed filtrates up to 20m deep. It was revealed that the water of filtrates is a source of contamination of surface waters over nitrates, ammonium, Fe, Cr, Ba, Ti, P, Ni, and Cl from 2 to 100 MPC. Water with such pollution becomes highly toxic to most living organisms. In addition, artesian water wells can be situated near the SDW landfills [3].

Now the technology of incineration of solid domestic waste is applied in some European countries and in the USA. Incineration provides the minimum content of decomposable substances in slag and ash and allows reducing considerably the growing amount of waste. However, it is a source of harmful substances emissions into the atmosphere and an expensive and complex technological process [4].

A valuable alternative to SDW incineration is its pyrolysis. It is a process of thermal decomposition of waste that occurs without access to oxygen. As a result of this process solid

carbon residue and pyrolysis gas are formed. Pyrolysis is environmentally much cleaner than conventional waste incineration since it allows building a continuous closed process and the final products are relatively clean due to the absence of resinifying. Another advantage of pyrolysis is the production in the process of highly liquid products: secondary hydrocarbons and fuel. Thus, pyrolysis of SDW solves two most important tasks: introduction of modern waste-free technologies for recycling of garbage and conservation of dwindling natural resources [6].

An important aspect in solving SDW recycling problem in Russia is the competent distribution of responsibilities of the authorities in the sphere of waste management. In the opinion of V.V. Kirillov, the head of the Federal Service for Supervision in the Sphere of Nature Management, it is expedient to assign to the constituent entities of the Russian Federation the responsibilities currently exercised by the local self-government bodies and to restore the right of the entities of the Russian Federation to design and construct facilities for the recycling and disposal of waste; to leave the current authority to organize the collection and export of solid domestic waste in the competence of local governments of municipal districts, settlements and urban districts, and assign to them the rights to establish norms for the formation of solid domestic waste [4].

5 Conclusion

Summarizing the foregoing, it can be concluded that the problem of domestic waste recycling in our country is very acute. The ubiquity of landfills for solid domestic waste disposal in Russia is likely to remain for a long time. Therefore now first of all it is necessary to equip them in such a way as to minimize the harmful impact of waste on the environment. In addition, I believe that the problem of SDW recycling is multifaceted and it can be solved only through the concerted actions of the authorities, enterprises – waste owners and the population. At the same time it is necessary to create a well-coordinated infrastructure in the SDW processing industry which requires large amounts of material resources. However, the experience of developed countries has revealed that the introduction of advanced technologies for waste processing allows solving a number of problems in the sphere of economy, ecology and public health.

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