ENVIRONMENTAL CHALLENGES IN THE PROCESS
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A REGIONALLY SUSTAINABLE SYSTEM OF WASTE GLASS HANDLING

1. Introduction to the problem of solid municipal wastes. The situation in St. Petersburg

One of the most crucial modern problems is utilizing, using and burying municipal solid wastes (MSW). Every year this problem is more and more topical because MSW levels increase. So far, humanity has no common solution to this problem. MSW consist of paper, plastic, rubber, glass (scrap glass, glass waste), metals, textile, etc. According to different sources, scrap glass content is about 5–10% of the general waste flow, so its contribution to the overall problem is significant. Despite this glass waste, used as an example of waste management in this paper, is not harmful, toxic or dangerous. The example is used to put fundamental requirements of law in the light of the main barriers to the implementation of a sustainable waste management system. In this paper we address legal and organisational aspects of a sustainable waste glass management system.

Scrap glass is an integral component of the general household waste flow, so it is impossible to talk about glass waste management and selective scrap glass collection without reference to other waste components.

We could analyze the experience of developed countries, where the waste utilization problem appeared much earlier than in Russia. The main lessons we can learn from their experience are, firstly, that there is no super technology which could effectively utilize the general waste flow, because each component must be utilized separately by different methods. Secondly, only a complex waste management approach has a chance of success. So, MSW utilization is not only a technological task, but also an economic and social one.

Presently in Saint Petersburg there is no effective waste management program, in particular, MSW are not separated at source. The waste problem is one of city's the most crucial problems. The fees for waste removal do not depend on the amount of waste and are very low. This money is barely enough for waste removal from the housing estates. Waste removal from containers is not regular or completely lacking, and we face the problem of illegal dust heaps. Dust heaps are often burned, which leads to harmful emissions including dioxins.

The city's two incinerators cannot meet the city's growing needs. The two main landfills are nearly full of waste. Their fees are relatively high, so the city's authorities are often not able to pay for MSW dumping, and the landfills operate mainly with industrial wastes. As a result, MSW are transported from Saint Petersburg to the Leningrad Region where there is a lot of illegal landfills.

To a elaborate sustainable waste management program for the city, we need to investigate the existing flow of wastes. But, to complicate the situation, the statistics are often not available and rarely reliable. According to various estimates, every year Saint Petersburg produces from 5 to 9 million cubic meters of MSW [Cherp, Vinichenko, 1998], so the amount of scrap glass is 250–900 thousand cubic meters per year. About 30% of waste by weight and 50% of waste by volume are packaging materials [Minko, Bolotin, Zhernovaya, 1999]. Every year the composition of waste changes and the main tendency is of an increasing variety of wastes.

Nowadays in Russia, particularly in Saint Petersburg, homeless people have to adopt to living outside, the main sources of their revenue is dust-heaps. They select paper, aluminium and glass bottles from the general waste flow and then hand them to point of utility material acceptance. Homeless people change the composition of dust heaps to a great extent. So it is impossible to estimate the content of some waste. It is necessary to say they help to solve the MSW problem, but, of course, there are such components, which cannot be used even by them, because of the waste's non-recyclable character. In Saint Petersburg not only homeless people select waste, but some pensioners also do it because of a lack of money.

2. An integrated waste management approach to the solution of the MSW problem

According to the integrated waste management approach, selected waste is to be regarded as industrial products, and the best option is to separate waste at the stage of its formation. The solution of the waste

problem is not only utilization, but also reducing the general waste flow and decreasing its toxicity. These could be achieved via the transition of producers and consumers to less harmful and waste minimizing products and packaging. In this context, glass packaging has a lot of advantages compared to plastic. Firstly, scrap glass recycling technology is already developed and, secondly, glass bottles can be reused, while plastic package is not recycled or reused in Russia.

To create a selective system of scrap glass collection, it is very important to know its major sources. Nevertheless, a program managing waste collection should be prepared taking into account special features, such as local enterprises and waste sources.

The problem of municipal solid waste could be successfully solved, only if all stakeholders are involved, because the decision is not only to choose and purchase some technology. A sustainable method includes a social dimension, as well as economic and environmental ones. Representative and executive powers, municipalities, the local population and social organizations, departments of the state supervision, the largest enterprises-sources of MSW, utility waste enterprises, etc. could be interested actors in selective waste collection. A sustainable program is to define roles, rights and responsibilities of all stakeholders.

To be precise, regarding our city, a sustainable waste management plan is to answer the following questions:

- **Who is responsible for waste collection**? It may be municipalities or the city government.
- **How to organize selective waste collection**? A range of measures is needed, including installation of special big containers for separate waste collection, giving out home waste containers to the population, etc.
- **How to educate local the population?** It is important to raise people's awareness of this problem's acuteness. I do believe that people's willingness to change is the best engine of transition. So, general educational measures are the first step necessary. All mass-media are to be involved. The social advantages of selective waste collection, such as the improvement of environmental conditions are to be defined. School is to become an important mediator between the program and society, because children are more susceptible to new ideas and they are able to involve their parents.
- **What is the role of the municipalities**? Programs of sustainable waste handling ought to be elaborated with the active participation of municipal powers. They also could control the realization of the program.
- **What is the role of the city authorities**? They are not only to execute overall control, but also to help municipalities to organize a separate waste collection system in Saint Petersburg. Authorities are to

adopt legislation managing the municipal programs. Their crucial task is also to ensure the economic solidity of the market support measures of the waste collection program.

- **What economic measures are needed?** Differentiation of payment for waste removing depending on waste quantity may be a stimulus to separate waste collection. But the existing housing system in Saint Petersburg does not allow estimation of the amount of waste, which every householder throws away.
- **What is the role of Non-Governmental Organisations (NGOs)?** Any society needs "activists" who can demonstrate the principle of sustainable waste handling and involving other people. Often, the stakeholders, including the city authorities, do not possess modern technologies for sustainable waste management. Consequently, one of the main roles of a waste management program should be the accumulation of local experience. Through the realization of small-scale projects, society will have an opportunity of gaining the necessary experience. NGOs can play a crucial role in initiating such pilot projects, as well as in public education.

3. Ways of effective waste glass handling

From a chemical point of view, glass is inert, hence, it is not harmful to the environment. But, because of its inertness, glass waste does not decompose in natural conditions. There are two main ways of efficiently handling scrap glass, namely reuse and recycling. Reuse is the system of gathering glass bottles for repeated use in packaging.

In the former Soviet Union almost all types of glass bottles the glass industry produced were reused. After disintegration of the Soviet Union, due to economic crisis and increasing globalization, the Russian market is full of foreign products. Each firm tries to produce originally packed products, which could attract customers' attention. So now there are a lot of non-standard glass bottles, which cannot be involved in a reuse-system in Russia because of their variety. Presently, limited amounts of glass bottles are collected for reuse; mainly they are soft drinks and beer bottles, which are used by the Saint Petersburg breweries.

Recycling is the use of scrap glass and non-standard glass bottles as a basic material component for some industries, especially for the glass industry. Scrap glass can also be successfully used in building, road construction, heat insulator producing, etc. The use of cullet in technological cycles has numerous environmental and economic advantages [Environmental protection, 1996]. First, it reduces consumption of raw materials. Second, it decreases energy consumption and, consequently, reduces

harmful emissions per unit of production. Third, it diminishes the production prime cost, etc. (Table 1).

Table 1. Resource savings and waste/emissions reduction from glass recycling (%)

Resource or waste/emissions	Observed reduction
Energy used	4–32%
Atmospheric emissions	20%
Liquid waste	—
Mine tailings	80%
Water consumption	50%

Source: Québec Action Plan for Waste Management

Despite the fact that many cullet recycling technologies exist, they have not been used in Russian glass plants, some of them use limited amounts of cullet. The main reason for this is an absence of separate waste collection systems. It is important for scrap glass to be free from incidental admixtures and, beside that, to be separated by colour. The second barrier for glass recycling is the difficulty of transition from classic technology to recycling, to do this it is necessary to re-equip the plant. So, glass plants need some incentives to shift to recycling technology.

4. Russian legislation related to waste handling

One of the major mechanisms which could support the elaboration and implementation of a sustainable waste management system, including waste glass management, is adopting relevant legislation. First, we analyze the existing legislation in the field. The basic Russian legal act regarding waste management is the Federal Law on Industrial Wastes.

According to this law, the main principles of state politics in the sphere of waste handling are, firstly, the balancing of the environmental and economic interests of society for the creation of sustainable development; secondly, the usage of the best available technologies, which produce the minimum waste; thirdly, the application of economic regulation measures to reduce and recycle wastes. The fundamental economic regulation measures prescribed by the law are economic incentives to reduce and recycle waste and, on the other hand; payment for waste dumping. Economic incentives should be realized through establishing special rates of payments for waste dumping, credit privileges for the enterprises, etc.

The Federal Act also defines the plenary powers of the Russian Federation and its subjects, including a general policy of waste handling; the organization and realization of state control and supervision; the elaboration and implementation of the state's general program and ensuring the economic, social and legal conditions for reducing and recycling wastes.

The measures mentioned, including economic ones, have no mechanisms of implementation, neither is selective waste collection mentioned in the act. The second major pitfall of the act considered is that there is no direct responsibility for the different aspects of the problem. So, the main reason for the fact that the law does not contribute to solution of the problem of waste is its framework character. Furthermore, there is no regional legislation regulating waste-related issues. Hence, there is a need for a regional law regulating selective collection, as well as the utilizing and recycling of municipal and industrial wastes. This law is to cover the gaps in federal legislation, the most important being the absence of mechanisms and direct responsibilities.

The major legal act in Russia in the environmental field is the Federal Act on Environmental Protection. The law defines the main tasks of the state authorities, local authorities and citizens. The law does not contain any reference to selective waste collection, but we can conclude that as far as waste management is one of the requirement for sustainable development, the poor state of the state waste management policy contradicts the main responsibilities of the people and state.

5. The regional waste glass market

Before analyzing the main demands on the regional law, it is necessary to investigate the regional scrap glass market, demands, supplies and prices.

It was elucidated on the Internet that there is demand for wholesale of scrap glass. Presumably, most of the enterprises interested in scrap glass deal with construction, because scrap glass usage for these purposes is the most popular and construction is developing very rapidly in Saint Petersburg. There is also one glass plant in the suburbs of Saint Petersburg. Presently, the plant's management intends to increase the quantity of glass bottles produced to provide the consumers with glass packaging. Still, the plant uses scrap glass in limited quantities due to the reasons enumerated.

Large amounts of scrap glass on the regional market will be an incentive for the industry to use it in their production cycles, so the assistance

of trade companies is necessary to organize an effective system of municipal scrap glass collection.

6. The requirements of the regional legislation. A complex scheme of municipal waste glass collection

In order to promote effective waste management in Saint Petersburg, there is a need for regional law. This law should be precise, its main function is to support the city's waste programs. The main goal is to contribute to the organization of a sustainable waste system. For that purpose some measures have been analyzed. The measures which are necessary for developing sustainable waste handling are enumerated below.

The first group of measures regards industry. These include an obligatory environmental audit of all the regional industrial enterprises. This audit is to be regular and, depending on the scale of the enterprise, to be conducted every 5–10 years. This procedure is aimed at the registration of all actual waste sources and revealing possibilities of reusing and recycling. Concrete tax privileges are to be given to those enterprises, which demonstrate compliance with auditors' requirements. The regular obligatory environmental audit is to be paid for from the regional budget, namely, from environment taxes. If new industrial activity is planned, an environmental impact assessment (EIA) is necessary. The regional "waste" law should require the inclusion of a waste management plan in EIA documentation.

Another group of measures considers numerous trade enterprises. They are to be obliged to take back for refund all glass bottles produced in the country. This refund is possibly to be included in the price of goods. So consumers get their money back, if they ensure bottle reuse. In the case of non-fulfillment of the demands, the trade point must be denied the license.

Thirdly, the law is to contain measures enabling the collection of scrap glass on housing estates. In many western countries the most effective way of waste glass collection is by containers. Three containers of different colour are installed on an estate. One of them is white, another is green and the third is brown. So scrap glass selection by colour already takes place at source. People collect their rubbish selectively and throw it away selectively as well. In the countries considered active "waste" legislation has contributed to the success achieved. In our region, I think it is reasonable to begin with a single container for glass, because the system of selective waste collection needs to be established and people

ought to get used to it, while the system discussed should address all other waste components.

In Saint Petersburg, this group of measures should be realized under the supervision of the municipal powers. Container purchase and installation should be the task of the municipal powers, as well as removing the wastes. To do this they are to hire some transport firm. For these purposes, it is necessary to raise the existing tariff payment for waste hauling. This money should go to the municipal budget, but not to city's one. So, special legal measures are needed to empower municipalities to coordinate this process and to make them responsible for the result. Responsible people should be delegated within each municipality of Saint Petersburg. The responsibilities of the city authorities should also be included in the regional law, for example, control measures would be realized by the city authorities. Public control is also necessary, for this purpose, a hot line should be organised to enable people to report any waste handling infringements.

Fourthly, scrap glass collection may be realized through the organisation of special collecting outlets. This measure is proposed only in certain places, where large amounts of glass waste are encountered, for example, in the city centre and within the city's recreation zones, where lots of people spend free time. These collecting outlets are quite expensive to create and keep because of rent, salaries and other payments.

Fifthly, involving school-children into the selective waste collection system is a crucial education measure. People's awareness is a necessary component of any social activity. Raising awareness about the MSW problem is supposed to be realized mainly at schools (see Section 2). So the proposed law is to include obligatory school classes devoted to sustainable waste handling and sustainable development of society in general.

To conclude, I would like to emphasize that no program could manage waste flows effectively without a complex of legal, economic, social, educational, and environmental measures.

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