

Management of environmental problems of glass and plastic recycling

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Abstract. The article deals with the topical issue of getting glass and plastic into the garbage and its further burial in landfills. The authors propose to change the order of collection for the recycling of glass and plastic, make proposals to solve this problem, simultaneously bringing both environmental and economic benefits.

1 Introduction

Glass is a widely used material in the modern world, which is used in construction, in the manufacture of furniture, in the manufacture of tableware, in the automotive industry, in jewelry and other types of production. Glass is used in the decoration of exteriors and interiors of buildings. Thanks to the glass, buildings receive a lot of sunlight, while keeping the heat inside. Glass containers are generally considered to be environmentally friendly dishes.

The glass is externally a liquid in a frozen state. It is an amorphous substance that does not possess the properties of a crystalline substance in the solid state. The main components forming glass are: quartz sand (69-74%); soda (12-16%); limestone and dolomite (5-12%) and in small percentages some other components. In addition to the main raw materials, various additives are introduced to color the glass in the desired color or to impart special properties of the glass [1].

Glass has been known to mankind for several millennia. The first mention of it is associated with finds found in ancient Egypt in 7000 BC – glass beads and amulets. And the first glass factories began to appear only in the VIII century.

Glass production is a complex technological process that requires knowledge of modern types and varieties of materials.

Along with the popular glass containers for packaging liquids, bottles, cans, barrels and other containers made of chemical industry material, which did not exist in nature some fifty years ago, have become popular in recent decades. Vegetable oils, drinking water, carbonated drinks, dairy products, medicines, various building materials and other liquid goods are packed in them today. The material from which the listed items are made is popularly referred to by a simple word – plastic. Its more accurate name is polyethylene terephthalate. It has a number of positive qualities: good plasticity, hard, durable, non-poisonous, transparent (but can be painted in any colors if necessary), can be processed by

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drilling, sawing, milling, cheap in production. Polyethylene terephthalate has a high chemical resistance to gasoline, alcohols, oils, fats, ether, dilute acids and alkalis. Polyethylene terephthalate retains all its characteristics both at high temperatures, up to +75 degrees, and at low temperatures, up to -40 degrees. It is no coincidence that products made of polyethylene terephthalate in a dispute with similar products made of clay, cardboard, wood, metal or glass often come out victorious [2].

Polyethylene terephthalate is a thermoplastic polymer that is the most common among polyesters.

For the first time, polyethylene terephthalate was synthesized in 1941 by British scientists. In the USSR, polyethylene terephthalate was produced in the laboratories of the Institute of High Molecular Compounds of the USSR Academy of Sciences in 1949. At first, the new material was widely commercially used in the textile industry in the production of synthetic fibers and yarns for household purposes, then in the 60s it was used to produce a film for packaging, in 1973 a plastic bottle was patented in the USA, in subsequent years the range of packaging containers made of polyethylene terephthalate significantly expanded. Polyethylene terephthalate has become an indispensable material in rubber products, in mechanical engineering, electrical and radio engineering, construction, agriculture and other sectors of the economy. In fairness, it should be noted that today there are several dozen types of polyesters or analogues of polyethylene terephthalate and their additives are used in some products or the composition is a mixture in general [3].

Plastic bottles came to Russia in the late 1980s, they gained widespread popularity in the last decade of the XX century. The new century was marked only by an increase in the spread of plastic containers [4].

Polyethylene terephthalate is usually produced in the form of a granulate with a granule size of 2-4 millimeters. Russia has all the conditions to become a world leader in the production of polymers, because the polyethylene terephthalate industry in the country has a huge potential for growth, everything is there for this: the raw material base, the appropriate scientific and technical level, and the provision of specialists.

For the last quarter of a century in Russia, and one can say more broadly in many countries of the world, the issue of disposal of solid household waste (MSW) produced by humans, which today have become the main pollutants of the environment, has become acute. The Ministry of Natural Resources of the country has estimated that about 350-400 kg of waste per year is accounted for every inhabitant of the country. In Russia, most of the garbage is stored in landfills (landfills), a significant part of which do not meet sanitary and hygienic and environmental requirements, despite the fact that much has been done in this direction in recent years. Solid waste ends up in landfills mostly without prior sorting. Non-standard and broken glass bottles and cans, mirrors, broken window panes, perfume and cologne bottles and other used glass products are also garbage and are sent to landfill. Plastic containers also make up a significant part of household waste: bottles, boxes, bags, cans ..., which, when they get into a dumpster, are mostly sent to landfill. And decomposing harmful substances pollute the earth and water, while burning also pollutes the air [5].

There are not enough waste processing plants with garbage sorting lines in the country, as a result: both glass and plastic, along with other discarded waste, capture more and more land areas allocated for landfills for solid household waste (MSW), clogging and disabling life-friendly ones for hundreds of years a man of the earth [6, 7].

Recycling of discarded glass involves its reuse, and it should be emphasized that the quality of recycled glass does not deteriorate at all. Processing 1 ton of glass waste saves 650 kg of sand, 150 kg of soda ash and 200 kg of limestone needed for the production of primary glass.

Table 1. Glass production in Russia in 2019.

Sub - branch	Millions of tons
Sheet glass	3.2
Tarn glass	6.7
Varietal glass	0.5
Continuous Glass Fiber	0.3
Special glass	0.4
Other	1.6

Table 1 shows that the total production of the glass industry in the Russian Federation is estimated at approximately 13 million tons per year. 2019 production is the average for two decades of the 21st century.

It is impossible to calculate the exact volume of glass and plastic thrown away. According to rough estimates, more than a million tons of glass and about 3 million tons of plastic are thrown out in Russia every year.

Existing landfill landfills (landfills) cannot be considered as a final solution to the problem. Industrial processing of solid household waste is the most important task facing the state, it requires huge material costs, constant improvement of existing developments for the processing of solid waste is the dictate of time. A network of waste processing plants that filters all the garbage of the country is an ideal solution. But, the ways of supplying raw materials to that should not be reduced only to filtering garbage brought from containers.

2 Materials and methods

The main research methods are observation, comparison and analysis.

The reform of production and consumption waste management in the Russian Federation, called the garbage reform, launched on January 1, 2019, caused a lot of talk and controversy in the country. It touched every citizen of the state, was widely discussed in the press, on radio and television, on the Internet. Each of us is an observer of its course. We compared the current situation with household waste in modern Russia with the situation during the Soviet Union, as well as with the situation with garbage waste in developed countries of the world and, after analyzing, came to the conclusion that it is necessary to adjust the garbage reform in our country, which consists in removing glass and plastic from garbage.

3 Results

For the recycling of glass waste, the following operations should be carried out: cleaning, grinding, remelting, filtration. With secondary remelting, a significant amount of energy is saved, and the melting furnaces at the same time operate at lower temperatures than those required by the glass manufacturing process. Also, used glass can be used without remelting for the production of glass wool, for this it is crushed into glass chips, from which a special fiber is obtained – the basis of glass wool. Glass wool is a universal insulation and sound insulation. It strengthens the external walls of buildings, floors and roofs. Glass wool insulation is not susceptible to destruction by rodents. Secondary glass can be used for the manufacture of tiles, countertops.

Existing technologies make it possible to recycle plastic waste and obtain secondary raw materials. There are also technologies for the use of plastic waste for the manufacture of

various products without converting waste into pellets: the production of paving slabs, manholes, snow holders and other goods in demand by the population. The market for secondary polyethylene terephthalate already exists in our country. However, its volume leaves much to be desired. We have huge opportunities for further growth, because recyclable waste in the country makes up no more than 10% of the plastic used, for comparison, in China the collection is 80%, in some European countries about 65%.

By organizing the processing of glass and plastic, we will save thousands of hectares of land for human life, we will preserve clean air, because the decomposition period of glass is, according to scientists, more than 1000 years, plastic up to 100 years, and at the same time, we will get raw materials ready for new production, with less energy consumption during processing, in comparison with primary production, while reducing emissions of nitrogen oxide and carbon dioxide – greenhouse gases, significant savings will be observed in the costs of natural primary raw materials. Success will be both in matters of environmental conservation and obtaining savings from the purchase of secondary raw materials.

Our proposals relate to improving the collection of the main environmental pollutants of the most long-decaying types of solid waste - glass and plastic. The State should take a number of measures aimed at removing these materials from garbage:

- Legislatively increase the collateral value of empty glass and plastic bottles and cans, as well as other plastic containers that are part of the goods being sold.
- Organize public reception points in three directions for delivery for money: 1) not damaged glass bottles and cans, 2) plastic containers, 3) cullet (glass debris). By doing this, we will achieve the removal of glass containers and plastic containers from the delivered garbage, which means that it will no longer fall into landfills for burial. The creation of a network of reception points for glass and plastic containers will enable the population to collect and hand over glass and plastic, receiving a monetary reward for this.
- Develop sanitary requirements for the above-mentioned point of reception of glass and plastic from the public.
- To exempt individuals from personal income tax on the amount of money received from the delivery of glass and plastic to procurement centers.
- Exempt individuals from paying income tax on the amount of money received from the delivery of glass and plastic to procurement points.
- In each region of Russia, build (or consolidate an existing) class factory specializing in the melting of trash glass.
- Create conditions for the emergence of plastic packaging processing plants in every region of Russia.
- To develop a regulation on grant support by the state for plants under construction and mini plants for melting waste glass and recycling waste plastic. With an insufficient number of such enterprises, the procurement of reception points will be meaningless.
- Attract senior schoolchildren to the collection of glass containers and plastic garbage by developing a special youth program.

4 Discussion

Solid waste, which includes glass and plastic, are the main pollutants of the environment. [8, 9] Today, humanity faces the task of turning them into a product suitable for processing and further use. In economically developed countries, this task is being successfully solved. In Russia, for many years, they did not pay attention to it.

According to the garbage reform, it is planned to create high-tech waste disposal complexes in the regions, i.e. the state intends to create a network of waste processing plants. At the same time, it is planned to introduce separate garbage collection. This, in our opinion, can create permanent problems. The population is forced to pay for garbage collection and, plus, sort it themselves for separate collection. There is no financial interest for deliverers here. Not everyone may like it. Provocations are also quite possible, consisting in laziness to sort, in mixing up containers, it is possible that the deliverer may get confused out of harmfulness, that someone will receive income for this, as a result, additional sorting will be required at the factories. We are unlikely to achieve a positive effect only by explanatory work among the depositors of garbage, workers of processing plants will be in constant tension from the quality of the imported recyclables. Separate waste collection does not guarantee that glass or plastic containers will not be thrown past the container, because it does not represent any value for the owners. We see our proposed way of removing glass and plastic from garbage as more reliable by creating paid points for their reception. The procurement points will receive the ideal recyclables for further processing, because the point receiver will be directly responsible for the quality [10, 11].

The monetary reward for the glass and plastic handed over will become an indirect support for a part of the poorest segment of the population.

In the Soviet years, the prices of glass bottles and cans were significantly higher than the current ones, and the network of their reception was also widely developed, so only broken dishes fell into the trash. Now, due to its meager price and insufficient number of reception points, the bulk of the population does not burden themselves with the delivery of glass vessels, therefore, an absolutely whole glass container goes to the garbage together with the defective one. At the end of the 1980s in the USSR, the turnover of packaging in total consumption was 85%. Now these figures are negligible. The purchase price should be favorable for the deliverers and the reception points should be within walking distance.

The removal of glass and plastic from the composition of garbage will reduce the amount of solid waste to be delivered, which means that it will also entail a reduction in the utility fee for garbage collection.

5 Conclusion

Metal practically does not get into the garbage today and is not lying around uncontrollably, you will not see it under a tree in a park, in a forest or thrown into an urn. An unattended metal product will quickly find its new owner. Why? Because scrap metal collection points are organized, where they pay good money for it. Unfortunately, this cannot be said about glass and plastic containers yet. By organizing reception points and further processing of currently discarded glass and plastic, we will save our lands from pollution, reduce the area of landfills and at the same time we will save energy and natural reserves: sand, soda, limestone, dolomite, transportation costs and operation of melting furnaces.

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