

FEATURES OF OBTAINING MATERIALS FROM PET WASTE FOR PROTOTYPING ON A 3D PRINTER

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Abstract: *The article deals with the use of recycled materials from PET (polyethylene terephthalate) waste for the manufacture of plastic for 3d printing at minimal labor costs, with the aim of its further use in layouts - models in which the user is not interested in the appearance and high quality characteristics inherent in some types of purchased plastic, and is only interested in the correspondence of the dimensions of the printed part to the necessary ones. The possibility of using previously printed parts and the use of PET containers was analyzed.*

Key words: *PET plastic, recycling, 3D printing, available materials.*

PET plastic is one of the most popular materials for 3D printing and has high strength, transparency, wear resistance and heat resistance.

This material is used when it is necessary to produce durable, wear-resistant products. 3D PET plastic is crystal clear and highly wear resistant. It is shock-resistant and heat-resistant, maintains temperatures in the range from - 40 °C to 75 °C. In addition to this, 3D PET plastic is resistant to abrasion and is also known as a good dielectric. It is resistant to oils, alcohols, acids, alkalis and paraffins. Good for post-processing. Products made of PET plastic can be sanded, primed, painted and varnished without much effort.

PET plastic is used in many different products. The properties of PET make it ideal for many different applications and these advantages make it one of the most common plastics available today. Understanding the history of PET as well as its chemical properties will allow you to further appreciate this plastic. In addition, most communities recycle this type of plastic, allowing it to be used over and over again.

PET is a highly flexible, colorless and semi-crystalline resin in its natural state. Depending on how it is processed, it can range from semi-hard to hard. Shows good dimensional stability, resistance to impact, moisture, alcohols and solvents.

As you know, plastic pollution is a serious environmental problem on a global scale. Every day, millions and millions of tons are dumped all over the world. These plastics end up in the sea and rivers and pollute the environment. It also leads to the death of thousands of animals that swallow them or accidentally get trapped. Depending on the origin and material from which they are made, there are different types of plastics. Among them are PET plastics. They are considered friendlier plastics, but we should be aware that they are not completely harmless.

Therefore, we are going to dedicate this article to tell you about all the characteristics, uses and problems of polyethylene terephthalate.

This type of plastic is made up of polyethylene terephthalate. Hence its abbreviation in English. They are well known throughout the world as they are among the most widely used recyclables on the planet. More and more products are being packaged with these materials due to their qualities. These are unbreakable, inexpensive, lightweight, waterproof and recyclable plastics. The last point is very interesting from an ecological point of view. We must remember that plastics must be recyclable so as not to use more raw materials.

As you know, recycling in the world is much lower than the export of these wastes. Today it is easier to produce new plastics than to recycle old ones. All of these advantages that PET plastic has make it the best recyclable plastic according to Greenpeace.

3D printers are increasingly being used to perform various technological, design, and everyday tasks. A few years ago, they were something far from us, but now, thanks to the development of technology and its popularization among people interested in the production of their own products, 3D printers have become an integral part of their arsenal of tools in the manufacture of plastic products. Since this paper will deal only with plastic printers, other types of 3D printers will not be mentioned.

For many users of 3D printers, the problem of a large amount of plastic spent on trial products is an urgent problem. Since the key parameters of a test product are precisely its correct geometric shape and dimensions [1], there is accordingly no need for high quality characteristics, such as wear resistance, strength and durability, inherent in expensive purchased plastic [2]. Based on this, there is a need to find a new way to obtain material for printing.

For example, 3D printers are convenient for creating many technical devices, which include gears, wheels, housings, or other complex products that require high compliance with a computer model [3]. At the moment, for all these purposes, high-quality purchased plastic is used, which has suitable characteristics, for which the user of the printer pays. Due to the fact that a product that meets the requirements of the user can be obtained only after the manufacture of several prototypes [4], there is a problem of economic irrationality of using such plastic in test models, since its properties will not be used if the dimensions of the test part do not match the required ones.

During the analysis of the identified problem, several possible ways to obtain economic benefits were found. Moreover, in the course of solving the problem [5], there will also be a positive impact on the environmental situation. Among the methods identified are the following:

- reuse of plastic obtained from manufactured, but for some reason, not relevant or no longer needed products obtained using a 3D printer.
- processing of previously used plastic raw materials, which are containers for liquids, as well as for bulk substances, that is, PET bottles, as well as packaging plastic bags.

Determining the advantages and disadvantages of each of the proposed methods allows you to objectively choose the best option for further consideration and possible implementation in life [6].

One of the main tasks of this work was to determine a method that allows to provide the user with a sufficient amount of plastic in a timely manner, while, when processing previously manufactured models, obtaining a volume sufficient for processing requires a long accumulation of test parts, which contradicts the task set [7].

The advantage of reusing previously printed models is that the plastic obtained with this method of processing differs little in its properties from the purchased one from which the recycled

parts were printed. Considering the option of recycling PET plastic, one can single out its obvious advantages.

Ease of access. PET is a plastic used to make containers for a wide range of consumer products. Bottles, containers, films and many other packages are made from it. Accordingly, this type of raw material is widespread and its production is practically not difficult.

Easy processing. The melting point of this material is 260 degrees Celsius, the softening point is 245. Knowing the characteristics of PET plastic, one can imagine that the energy consumption for the recycling process is low. You can also draw an analogy with the extruder of the 3D printer itself. The heater installed in it consumes about 40 watts of power.

Environmental friendliness. Thanks to this method, users of 3D printers will not only be able to provide themselves with the necessary amount of available material, but also have a positive impact on the environment. If we assume that 100% of plastic waste will end up in processing plants, it will still not work to get rid of the negative impact of plastic. The main methods for the disposal of plastic waste remain:

- incineration;
- granulation;
- disposal by chemical means;
- pyrolysis.

Unfortunately, none of the above methods can ensure the recycling of plastic without harmful emissions into the atmosphere, or without residual material, which one way or another will be buried in landfills.

Among the disadvantages of this method, it is worth noting that plastic containers have a different shape, size, color and characteristics. It is quite difficult to predict what they will be in a given batch of finished plastic. The color in one bar can change from one to another when changing the tape: from transparent to brown. The plastic itself used by bottle manufacturers can also have different properties for different bottles. Given this, the conclusion suggests itself: it is possible to print with such plastic only parts that will later be painted, due to the color difference in the bar. Or the part will be sent for recycling at all, after the user checks all the print settings and the dimensions of his product on it before printing with high-quality plastic.

Having studied both the positive and negative aspects of the affected methods, one should also pay attention to the disadvantages of using purchased plastic, based on which, it will be possible to come to a more correct conclusion about the rationality of using a different method of obtaining printing material. Of course, the main disadvantage is, as already mentioned, its price, but there are other problems. A situation may arise in which it will be necessary to manufacture volumetric products of complex geometry, which requires a large amount of material. In such a situation, the available amount of plastic may run out, and the need to complete the work that has begun will remain. The problem is that not all localities and not all stores may have the necessary plastic. In this case, you will have to spend a significant amount of time waiting when ordering in an online store, but that's not all.

As already mentioned, the number of people using 3D printing is rapidly increasing, and, consequently, there are many beginners who need the printing practice necessary to understand the principles of the printer, various parameters and settings. Sometimes this initial period can drag on for quite a long time until a person gets comfortable with all the subtleties. During this time, he will

need a large amount of cheap material, which would not be a pity to use for trial models and training. This further expands the range of possibilities for using a recycled counterpart made from PET bottles.

After conducting this analysis, the preference was given to the method of melting plastic obtained from PET bottles, since it is its high prevalence that allows the user of a 3D printer to be sure that the material will not run out at the last moment, and also allows beginners not to be limited in experiments and test prints, since cheap and affordable material will always be at hand. In addition to everything, the positive impact on the environment is a significant plus in favor of this method, because recently serious environmental issues have been raised more and more often.

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