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## **DEVELOPMENT OF TECHNOLOGY FOR PROCESSING POLYMER WASTE INTO FINISHED PRODUCTS BY 3D PRINTING**

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### **Abstract**

*The technology of processing polymer waste into finished products by the 3D printing method is proposed*

**Keywords:** polymer, polymer waste, shredding, extrusion, 3D printing

### **Introduction**

Polymers are the most popular materials in the production of containers, packaging, tape, packaging film, clothes, shoes and other products. The widespread use of plastic has created the problem of its accumulation, which can be dealt with only by establishing its secondary processing, which is the main, rather even the only, way to solve the problem of environmental pollution.

Accumulation of polymer waste is the main negative impact of humans on the environment. Trying to make modern life simple and comfortable, people think about harm to nature last. The problem of the accumulation of polymer waste is particularly acute today, as it has a deadly effect on the environment and its inhabitants, including people themselves.

Without solving the problem of recycling polymer materials, it is impossible to solve the environmental problems of any country, moreover, other methods of disposal of such waste can only worsen the situation. Combustion of plastic in primitive low-temperature plants and simply in landfills leads to the release of substances extremely dangerous to health, primarily dioxins. Modern waste incineration plants using pyrolysis partially solve this problem, but only recycling is a cardinal and, moreover, economically beneficial solution.

According to statistical data, the use of secondary raw materials in the world is steadily increasing. This is not surprising - according to some indicators, stocks of secondary raw materials already exceed the amount of available primary materials. Therefore, scientists of all countries are making significant efforts to create, develop and improve technologies for processing various types of waste.

The purpose of the work is to development of a technology for the processing of products containing of plastic waste into consumables for 3D printing [1, 2].

### **Results of the research**

Plastic is a material that is easily recycled and can be used in the second cycle without losing its basic properties. Many objects necessary in everyday life are made from secondary plastic. They are used to make: building materials (tiles, paving slabs, etc.); bags, suitcases and backpacks, which are in no way inferior to products made from primary raw materials; sports equipment, bicycles, etc.; packages, packaging materials; clothes (suits, jackets, t-shirts), shoes (sports sneakers); furniture (tables, chairs, benches); road surfaces and others.

Modern light industry uses various types of raw materials for the manufacture of clothing and household items. Among synthetic polymers, the leading positions in the world are occupied by polyester (polyester) and nylon (nylon).

Polyester - fibers that appeared thanks to the active evolution of the oil refining industry. This is a type of synthetic material. Outwardly, it resembles fine wool, but in terms of consumer properties, it is closer to cotton. It is made from a melt of polyethylene terephthalate - a strong, wear-resistant thermo-

plastic, which is a good dielectric.

One of the varieties of polyester fiber.

A wide range of finished products made of polyester and nylon raises the question of their further disposal after the period of operation or processing into finished products.

Most light industrial products are still thrown away and burned in incinerators or end up in landfills. Among them are products containing polyester (mylar) and nylon fibers.

Recycling also faces a number of challenges, meaning that globally only less than one percent of all materials used in clothing are recycled back into clothing. This reflects the lack of technologies for their further processing. In addition, the existing technologies that allow the processing of clothing into virgin fibers are still imperfect.

One of the advantages is that when heated, polyester and nylon melt, and if they are passed through small holes, thin skeins are obtained. When cooled, they harden and form threads.

Due to its physical and chemical properties, plastic, as already mentioned above, can go through an infinite number of cycles of production and processing. The development of new technologies and equipment for processing will help to solve the problem of excess plastic waste, and in the future eliminate the need for new plastic production.

A new technology for processing polymer waste into finished products by 3D printing is proposed, which includes:

1. Sorting.
2. Crushing.
3. Cleaning and washing.
4. Drying.

Some milled materials may not require steps 3 and 4.

5. Heating the crushed material in the extruder of the 3D printer and extrusion of the molten polymer.

6. Formation of the finished product. The mass is squeezed out through the nozzle of the extruder and the finished product is formed layer by layer.

Thus, the number of operations to obtain the finished product is reduced.

An experimental installation was used to grind polymer waste from light industry, which allows to implement the process of grinding textile materials with the possibility of taking into account all factors that have an impact on this process. The design of the installation allows you to change within certain limits the technological and structural parameters, which allows you to study their influence on the grinding process and carry out the necessary measurements. But the main thing is that it allows you to adjust the size of the fiber that will be obtained after the grinding process. This issue is relevant when used as an initial value for 3D printing.

As samples during experimental studies of the process of shredding fibrous polymer waste, waste from textile materials, which were formed by the method of cutting parts of flooring products, were used. Samples of the following materials were used for grinding: polyester and nylon.

In order to conduct a research experiment to confirm that the crushed waste of polymeric materials can be remelted, an extrusion machine was used.

The conducted experimental studies confirmed the possibility of re-processing the crushed waste of polymer materials into finished products using 3D printers, which use granules or crushed polymer waste as raw materials.

### **Conclusions**

In the future, it is necessary to develop the design of a 3D printer, carry out the process of printing finished products on it and investigate their properties.

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### ***Розробка технології переробки полімерних відходів у готові вироби методом 3D-друку***

#### ***Анотація***

*Запропоновано технологію переробки полімерних відходів у готові вироби методом 3D-друку*

**Ключові слова:** полімер, полімерні відходи, подрібнення, екструзія, 3D-друк.

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