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## **EQUIPMENT FOR RECYCLING CRUSHED POLYETHYLENE TEREPHTHALATE INTO CONSUMABLES FOR 3D PRINTING**

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.

Today, a global problem can become a global source of income and a real salvation for all living things. When mountains of plastic waste occupy entire landfills, there are more and more people who make money recycling it. It is important to understand that if you do not establish a timely process of collecting, sorting and processing plastic waste, very soon it will go far beyond landfills.

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.

Moreover, as a result of processing by various methods, additional products are created for other industries, nature is polluted to a much lesser extent, and the use of secondary waste allows you to significantly reduce the use of primary non-renewable raw materials - oil and gas, reduce electricity consumption and reduce carbon dioxide emissions. Thus, the secondary processing of polymeric materials makes its contribution to combating global warming.

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.

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.

Polyethylene terephthalate (PET) is a thermoplastic polyester used in the production of synthetic fibers, film and plastic packaging. With a market share of 18% of all manufactured plastic materials, it ranks third after polyethylene (33,5%) and polypropylene (19,5%). PET is known to the world under other names - mylar, thermoplastic or polyester.

The need to process plastic waste is caused not only by a large amount of garbage, but also by the need of many modern enterprises for secondary raw materials. Thus, the business built on the processing of plastic waste and the production of secondary raw materials is one of the most promising today.

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.

One way to recycle plastics is to use recycled polyethylene terephthalate waste into consumables for 3D printers [1, 2]. The use of additive technologies is one of the most striking examples of how new developments and equipment can significantly improve traditional production.

In order to conduct an exploratory experiment to confirm that the crushed waste of polymer materials can be remelted, the extrusion machine shown in Fig. 6 was used.

Extrusion machine consists of the following parts: a housing with a heating system to the required melting temperature of the polymer; loading unit through which pre-prepared crushed polymer enters the body cavity ; housing cavity with an auger for moving raw materials from the loading unit to the forming nozzle; screw drive; extrusion head (Fig. 1); filament cooling and winding systems (Fig. 2); a control and management system that supports the necessary technological mode.

An auger design was developed and manufactured for feeding crushed polyethylene terephthalate in the form of small pieces.



Fig. 1 – Extrusion head



Fig. 2 – Systems of cooling and winding of polymer thread

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.

### References

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