МІНІСТЕРСТВО ОСВІТИ І НАУКИ УКРАЇНИ

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IX Міжнародна науково-практична конференція
«Теоретичні і експериментальні дослідження в сучасних технологіях матеріалознавство та машинобудування

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SHREDDING OF POLYMER WASTE OF LIGHT INDUSTRY

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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 thermoplastic , which is a good dielectric.

One of the varieties of polyester fiber.

Polyester is one of the most common and modern materials used to create various types of synthetic fabrics. This material began to be actively used in light industry only in the early 60s of the 20th century.

It is used when sewing everyday clothes and accessories: pants; skirts; dresses; raincoats; coat; a jacket; sports suits; t-shirts; shorts; patch; tie

Polyester is used to make home textiles, including bed linen, curtains, and tablecloths. The fabric is also suitable for dragging furniture. It is economically beneficial, as polyester is inexpensive – cheaper than other upholstery materials.

Many items of tourist and fishing equipment, starting with protective covers and ending with sunbeds, are made of this material. Awnings, tents and sleeping bags are made from it.

From the same fabric, only of a different density, medical films and covering materials for gardeners are made. In the food industry, it is used as a filter material for filtering solutions. This synthetic material is also in demand in the shoe industry, as well as in the production of workwear.

Nylon is a trivial name for a synthetic fiber made from polyamide (PA). This is the general name of a family of synthetic polymers consisting of polyamide , which are repeating units connected by amide bonds. It is a thermoplastic material that is usually made from petroleum. It can be processed in a molten form into fibers, films or molded into the necessary products. Nylon polymers can be mixed with various additives to obtain materials with specified properties.

There are many types of nylon polymers, among which the most common are: nylon 1.6; nylon 4.6; nylon 510; nylon 6; nylon 6.6 and others.

Nylon type PA6 and PA66 is most often used for plastic injection molding. Nylon has excellent strength, stiffness, heat resistance, wear resistance and lubricating properties, as well as chemical resistance to hydrocarbons.

In addition, nylon has a relatively low cost compared to the characteristics of engineering polymers, is easy to process, and can be reinforced with glass fiber or carbon fiber to improve mechanical and thermal properties.

In connection with a wide range of properties, this material has found use in various industries.

In light industry, due to different density, stiffness and purpose, different grades of nylon are used.

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.

Polyester fibers are not biodegradable. For example, in clothes, their number is about 16%. One of the advantages of such fibers is that they can be processed into primary (new) fibers. Recycled polyester fibers, made mainly from plastic bottles, increased their market share from 8% in 2007 to 14% in 2017.

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. Therefore, the creation of a technology for the processing of products containing polyester or nylon fibers into new finished products is an urgent task.

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.

Today there are 5 ways of processing polymer materials: pyrolysis, hydrolysis, glycolysis, methanolysis, mechanical recycling.

Mechanical recycling is a method, the essence of which is the mechanical grinding of plastic waste for the purpose of further heat treatment.

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.

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.

The schematic diagram of the experimental setup is presented in Fig. 1.

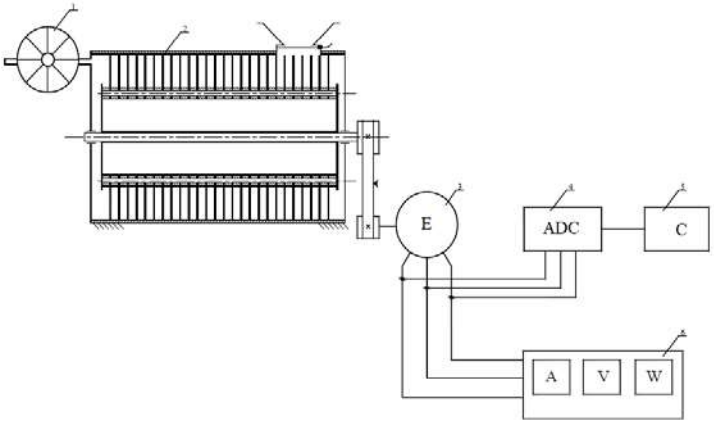

Fig. 1 – Schematic diagram of an experimental installation for grinding textile materials: 1 – centrifugal fan; 2 – hammer grinder; 3 – electric motor; 4 – analog-digital converter; 5 – computer; 6 – block (ammeter, voltmeter and wattmeter)

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: Mylar and nylon.