Секция 1 «Новые материалы и технологии»

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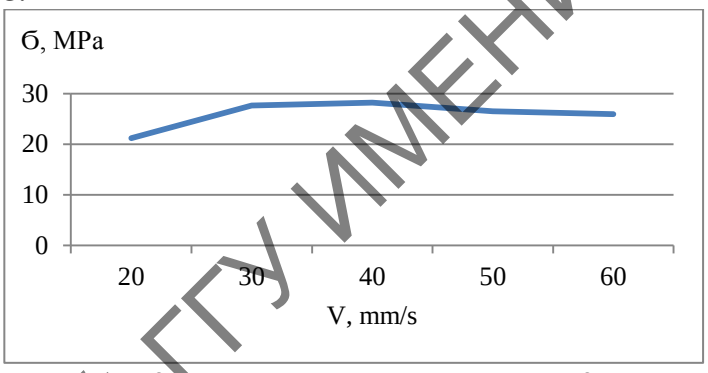
INFLUENCE OF TECHNOLOGICAL PARAMETERS OF FDM-PRINT ON THE STRENGTH CHARACTERISTICS OF SAMPLES OF POLYAMIDE

It is known that one of the main factors determining the deformation-strength characteristics of polymer products obtained by the FDM technology of 3-dimensional printing is the nature of the interlayer auto-adhesion of the polymer. Interlayer autohesion is a type of adhesion that characterizes the interlayer interaction of surfaces of polymers homogeneous in chemical composition [1]. Autohesion determines the basic properties of a product, its strength and durability. Issues of autohesion are especially relevant in the manufacture of large-sized products and serial printing due to the significant temperature difference between successively applied polymer layers. Low autohesion combined with high shrink stresses cause warping, deformation and premature failure of 3D products. This is appeared when the temperature and speed parameters of printing are incorrectly selected most clearly [2]. The problems of autohesion of polymer layers in products obtained by FDM printing are currently poorly understood and consumers of polymer filament for 3D printing rely on the recommendations of manufacturers of equipment and supplies for printing. In [3], the authors found out the effect of 3D printing technological parameters on the interlayer interaction in semi-finished products based on ABS plastic and polylactide (PLA) and established an increase in autohesion interaction with an increase in the contact temperature of polymer layers.

Polyamide 6 (PA6) from the manufacturer SANVIGOJ (China) in the state of delivery of the filament with a diameter of 1.75 mm was used as an object of study. Printing standard samples in the form of blades type 1 according to GOST 11262-80 in various settings of the 3D printer Flash-Forge Dreamer was performed for research. The deformation-strength characteristics of the test samples were evaluated on a tensile testing machine RM-500 in the uniaxial tension mode at a speed of 50 mm / min with

fixation of the strain and the corresponding tensile force. Printing of polymer blades in the established test modes was carried out in an amount of at least 5 sets for the reliability of the research results.

It is generally accepted among users of FDM printing technology that the minimum print speed (less than 20 mm/s) combined with the minimum print layer thickness (less than 100 microns) allows to achieve high accuracy in the dimensions and geometry of the product. However, it was shown in [4] that the strength characteristics of various grades of polyamides reach their maximum values when the thickness of the printed layer increases to a value corresponding to the diameter of the nozzle of the printing extruder. In addition, the influence of the extrusion rate on the autohesion processes of interlayer interaction in the process of FDM printing should be taken into account. Thus, a study of the effect of print speed on the strength characteristics of standard samples based on PA6 (Figure 1) indicates the need for additional studies to explain the nature of the established dependence.



Figrue 1 – Dependence of the uniaxial tensile strength of samples based on PA6 obtained by FDM printing technology, on the print speed

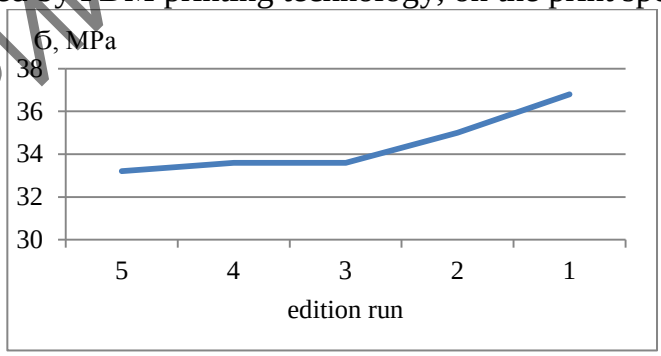


Figure 2 – Dependence of uniaxial tensile strength of samples based on PA6 obtained by FDM printing technology on the number of simultaneously printed products

It can be assumed that the strength characteristics of polymer products based on PA6 obtained by FDM technology are also dependent on their size (the area of the printed layers).

To evaluate this assumption, standard samples were printed in the form of Type 1 blades with a circulation of 1 to 5 products printed simultaneously in layers. It should be noted that an increase in the time of subsequent overlapping of the printed layer with PA6 melt at a printing speed of 40 mm / s over 200 s (Figure 2, circulation of 3 products or more) leads to a noticeable decrease in the tensile strength of the samples. This, in turn, also requires a detailed examination of the identified dependence.

Thus, when determining the technological parameters of 3D printing of polymer products using FDM technology, it should be taken into account that engineering products based on PA6 along with accuracy criteria also require taking into account the manifestation of interlayer autohesion, the nature of which is determined by various printing parameters, the main of which are print temperature, print layer thickness and printable area.

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ИССЛЕДОВАНИЕ ОПТИЧЕСКИХ ХАРАКТЕРИСТИК ФОТОХРОМНЫХ ПОКРЫТИЙ, ПОЛУЧЕННЫХ ЗОЛЬ-ГЕЛЬ МЕТОДОМ

Фотохромные материалы применяются в качестве светофильтров переменной оптической плотности в средствах защиты глаз и приборов от светового излучения, светочувствительных регистрирующих