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DEVELOPMENT OF 3D PRINTING EQUIPMENT USING A MIXTURE OF POLYMER MATERIAL AND METAL POWDER

In engineering practice, there is a tendency to gradually replace metals and other traditional structural materials with composite materials. However, the correct choice of composite materials for each specific case is complicated by the very strong difference in properties between traditional and composite materials.

In connection with the need to provide new technology with structural materials, in recent decades special attention has been paid to the study of the physical and mechanical properties of composite materials. The creation of various composite materials based on metal and polymer fibers makes it possible to obtain materials with high strength characteristics. The advantage of any composite material is that it can be given the necessary structural properties, as well as the ability to create materials with such indicators as high values of strength, deformability , and fracture toughness. The reliability of the structure depends primarily on the safety margin of the structural material, and even on such a characteristic as fracture toughness, that is, the ability of the material to prevent the propagation of a crack.

The use of composite materials instead of traditional materials allows you to significantly reduce the weight of the product, while not changing the strength characteristics of this material, which is especially important for the aviation and aerospace industry. In most cases, polymer materials very often do not have sufficient stiffness and strength to meet the requirements for structures. The introduction of a wide variety of reinforcing fillers is the most traditional way to improve the properties of composite materials sufficient for the composite polymer materials to be used as structural materials.

To date, the most promising for use as structural materials are polymer composite materials based on metal powders, high-strength organic (aramid) and carbon fiber fillers with a polymer matrix. The most promising direction for the use of metal, aramid and modern carbon materials is the direction associated with the creation of very high-strength composite materials for their use in various branches of industry and technology [1-3].

An extruder that prints with granules or composite mixtures of polymer materials was developed for experimental research. Using the SolidWorks software , the model of the extruder presented in Fig. 1 was developed [4].

The initial mixture of the composite material is poured into the loading hopper located outside. In the future, the mixture is fed through the nozzle 1, which is placed on the wall of the intermediate chamber 2. The rotating screw 4 is directly driven by the motor-reducer 3. Its main function is to transport the mixture from the intermediate chamber 2 to the heating chamber 5. A fan 6 is used to supply a flow of cold air to the intermediate chamber in order to maintain a constant temperature lower than that in the heating chamber. The chamber for heating the mixture 5 consists of an aluminum housing on which a radiator 8 is placed on the outside. It is used to dissipate the heat that flows from the heating element into the intermediate chamber.

The heat from the heater 9, which is placed in the lower part of the extruder, is transmitted up the aluminum cylinder and the screw, heats them to the set temperature and melts the connecting polymer (matrix). When rotating, the screw of the extruder increases the pressure on the molten

mixture, pushing it through the hole in the nozzle.

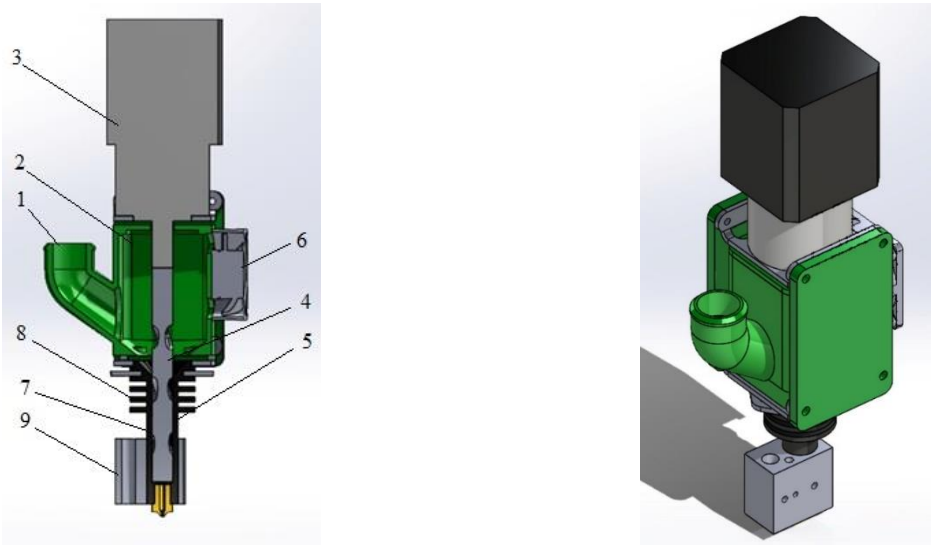

Fig.1 – Extruder modelin SolidWorks software environment

Developed extruder was installed on the Anycubic 3D printer Mega S. The general view of the experimental setup is shown in Fig. 2.

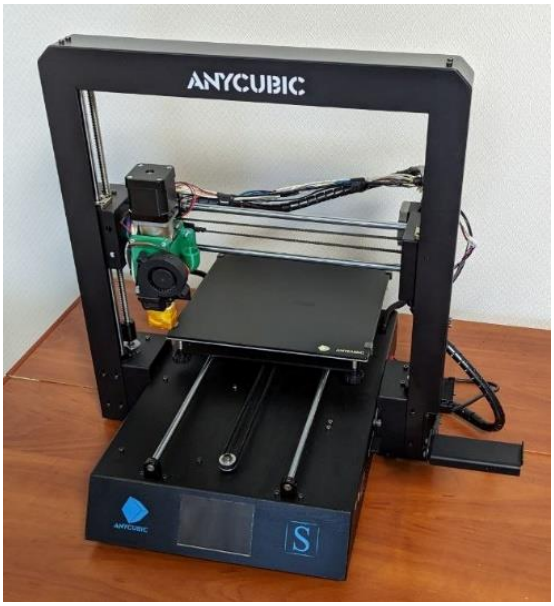

Fig.2 – General view of the Anycubic 3D printer Mega S with installed extruder for printing with a mixture of composite material

In the future, experimental studies will be conducted to confirm the functionality of the device for printing experimental samples and finished products with a mixture of composite materials, namely: plastic PLA + copper; PLA+ bronze; PLA+ stainless steel (nickel).

References

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