UDC 621.452.3.
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APPLICATION OF ADDITIVE TECHNOLOGY IN THE PRODUCTION OF AVIATION GAS TURBINE ENGINES COMBUSTION CHAMBER WHEELS

One of the most urgent problems of the modern aviation industry that needs to be solved is the labor intensity of production, the modernization of already existing processes and the creation of new technological processes.

It is additive technologies that have the greatest importance in the development of the technological process of manufacturing complex technical systems in aircraft construction. The essence of such technologies consists in the creation of a computer model of the part and its manufacture with the help of layer-by-layer addition of metal on special equipment using various methods, such as the method of selective laser sintering (selective laser sintering - SLS).

Using the example of manufacturing a combustion chamber swirler using the SLS method, it is shown the possibility of a sharp reduction in the working time of the structure and its geometric parameters in order to obtain the necessary cost characteristics of the product without additional production preparation. Let's consider the application of this method on the example of the manufacture of a monolithic swirler of the combustion chamber, in the basic version it consists of three parts obtained by the method of casting according to the models that are melted. To do this, we change the design by combining the input parts into a single whole, while excluding welded and soldered seams. This change in design elements made it possible to reduce the number of parts and the cost of one swirler by more than half, as well as to significantly reduce production time and minimize defect. After the release of the design documentation, which includes 3-D models (taking into account the specifics of the presence of the "support" material, sintering conditions, etc.), we select a material that satisfies both in terms of strength and temperature characteristics. After printing, in order to increase the density of the material, the parts and samples undergo hot isostatic pressing (HIP) followed by heat treatment. The density depends on the development of pores during the printing process, as well as the presence of non-metallic (in particular, gas) inclusions. The higher density and homogeneity of the blanks after HIP improves mechanical properties with corresponding increases in tensile strength and yield strength, ductility and fracture resistance. Carrying out the HIP process also reduces the spread of these characteristics along the cross-section and length of the workpiece. According to the work, the mechanical properties of compact samples from powder materials of fraction 20-45 μm based on mono aluminum nickel are able to provide the following record level due to the hot isostatic pressing cycle: compressive strength of the order of 3200 MPa, yield strength of 100, relative compression only at the level of 17%. After the HIP process and heat treatment, the parts are checked by non-destructive control and geometry for compliance with the drawing. This is followed by a check of air flow along the contours. The results of blowing along both contours showed a difference in air consumption of less than 5%, in contrast to the results of blowing swirlers manufactured according to the current technology (casting method according to molten models) - 12%. The use of the SLS technological process in the production of the swirler ensured high stability of air flow along the contours of the swirler and reduced the stage of production preparation in the serial production of such parts.

Thus, the SLS method has significant advantages, including reducing the number of necessary post-processing stages, controlling the spatial distribution of the composition and microstructure by printing with optimized parameters, as well as designing complex structural elements in combination with a computer system, increasing reliability and reducing labor intensity, the mass of the certificate is reduced by more than 15%.

From the above, it follows that the use of additive technologies mainly has a positive effect on the technological aspects of the production of parts, and the use of this technology for the production of parts in aircraft construction will increase every year.