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IMPROVEMENT OF THE STRUCTURE AND PROPERTIES OF THE RESPONSIBLE CASTINGS FROM HEAT-RESISTANT NICKEL ALLOYS USING THE HOT ISOSTATIC PRESSING METHOD

Responsible cast parts of aviation and power engineering power units are made of heat-resistant nickel alloys by methods of equiaxial and directional crystallization. As is known, all types of casting are characterized by the presence of such defects as the micropores and other structural imperfections, liquation, inconsistency of the phase composition, which significantly affects the reliability, physical-mechanical, heat-resistant and operational properties of the finished products.

One of the effective methods of correcting casting defects in responsible castings, and therefore improving the structure and increasing the level of properties, is hot isostatic pressing (HIP). The essence of this process is the comprehensive compression of castings in a special liquid or gas environment at high temperatures. For the process the highest possible temperature of the castings is chosen in order to prevent melting of the material structure.

In the process of HIP, the cavities internal surfaces are first brought into contact by the mechanisms of creep and plastic deformation, and then

connect by diffusion welding. At the same time, barometric processing does not remove defects connected to the surface of the casting.

A number of studies were conducted on the basis of JSC "Motor Sich", which revealed the peculiarities of the structure and properties of turbine blades made of highly alloyed foundry heat-resistant alloys, obtained in the process of both equiaxial and directional crystallization, after conducting HIP.

We studied the material quality of working blades and samples cast from the heat-resistant nickel alloy ZhS3DK-VI of various experimental variants that underwent the HIP operation and heat treatment according to the standard regime. Thus, the structure and properties of castings obtained with 50% returns in the charge (after preliminary remelting) as well as alloy modified with nickel-yttrium ligature and ultradispersed titanium carbonitride powders were studied.

It was established that in the process of hot isostatic pressing of the experimental castings at a temperature of 1210 °C and a pressure of 160 MPa, micropores and loose particles that do not reach the surface of the parts (located in the internal volumes of the metal) heal. Micropores are practically absent in the structure of the studied turbines working blades and cast samples after HIP, which contributes to the stabilization of the structure and properties of the material. The size of the single micropores detected after HIP is more than 40 times smaller compared to the pores found in the castings before the HIP operation.

Thus, the conducted research shows the positive influence of hot isostatic pressing (HIP) and standard heat treatment on the structure, physical-mechanical and operational properties of responsible cast products from heat-resistant nickel alloys for aviation and energy power plants.