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HOT ISOSTATIC PRESSING WITH INTEGRATED HEAT TREATMENT

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Content

Producing additive manufactured parts often includes post processing in a hot-isostatic press (HIP) and heat treatment. This process usually requires a long cooling and reheating time, which results in a long occupancy of the machinery with a high energy consumption. To reduce the required time and costs, a new process has been designed to reduce the process time and increase the operational capacity of the machinery. This is achieved by a new HIP design with increased cooling rates. The heat treatment of thermally thin components can be carried out within the HIP-vessel. For a successful heat treatment in the new HIP vessel, predefined cooling rates are necessary. Cooling inside the pressurized vessel with supercritical atmospheres increases heat transfer coefficients and temperature homogeneity. The newly designed process includes forced convection and heat exchange inside the pressurized vessel. Fluid flow and heat transfer were designed using Computational Fluid Dynamics analyses carried out by the Department of Industrial Furnaces and Heat Engineering. The numerical model is divided into sub models to reduce the requirements in computing capacity and to be able to investigate certain parts of the process in detail. For the overall flow conditions and interdependencies, the results of the sub models are incorporated into a comprehensive model, which is able to cover the mass and energy balances of the whole process. Resulting fluid flow and temperature distribution within the vessel are compared to the results of experimental measurements. The cooling rates necessary to enable heat treatment of exemplary parts within the pressure vessel were investigated at the Institute for Materials Applications in Mechanical Engineering, where the microstructure of the hot isostatically pressed samples was studied. Coupling the simulations of the heat transfer and the fluid flow with the simulations of changes in microstructure leads to a better understanding of the process. This aims to develop a new HIP plant with integrated heat treatment having a high predictability and precise plant control.

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