A heat treatment process optimization: coupling qobeo® and FORGE®

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This study explores the coupling of qobeo®, a 3D computational fluid dynamics simulation software, and Forge®, a software solution for simulating hot and cold forming processes, to optimize heat treatment processes. This study investigates the quenching process of Navy-C rings in an industrial gas quenching furnace, analyzing the impact of gas injection direction on the final opening at the rings' ends.

By coupling qobeo® and Forge®, it is possible to simulate the thermal behavior of parts while considering the initial stresses and deformations resulting from the forming process. Indeed, the process begins with a detailed CFD simulation with qobeo®, of several Navy-C rings positioned at different angles in the furnace to model the thermal and fluid dynamics in the furnace. The evolution of the gas flow and its uniformity is studied as well as the heat transfer coefficients obtained. These results provide more accurate boundary conditions for the rest of the study. Using Forge®, the dimensional evolution and phase transformation of the rings are simulated. The evolution of the variation of internal stresses and deformations, in particular the opening of the end of the Navy-C rings are studied. The simulation results will be compared to experimental measurements to validate the accuracy of the coupled approach and assess its ability to predict the thermal behavior and mechanical properties of Navy-C rings. This approach ensures a faithful representation of the quenching process.

This study acts as a proof of concept of the complementarity of the two-software workflow, showing the potential to better understand the process and to predict quenching or heating induced deformation.