

Numerical simulation of induction hardening of ferromagnetic parts

TEINEXT

H2020 SOCIETAL CHALLENGES: Climate action, environment, resource efficiency and raw materials

PRODUCTIVE SECTOR: Mechanics and Mechatronics

PROBLEM DESCRIPTION

Mathematical modeling and numerical simulation of the thermo-electromagnetic-metallurgical behavior of an inductor-part system during the heating stage.

CHALLENGES AND GOALS

- To develop a simulation tool allowing to calculate the electromagnetic fields and the induced currents on the part, the temperature profile along the time and the evolution of the different material phases during the heating cycle.
- To determine the influence on the results of geometric and operation parameters.
- To Predict, from the previous results, the inductor geometry that best suits the shape of the part to be hardened.

MATHEMATICAL AND COMPUTATIONAL METHODS

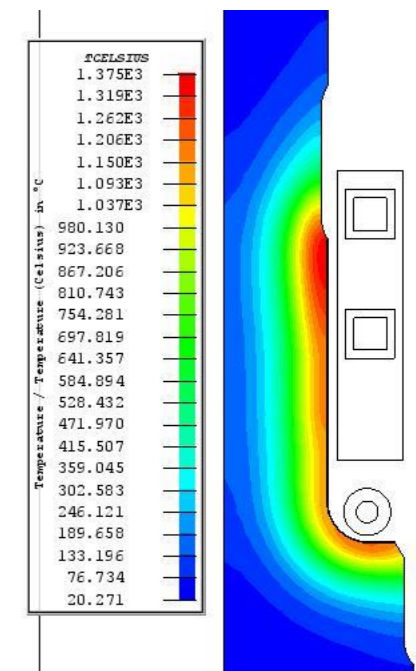
Mathematical modeling of coupled multiphysics phenomena

Partial differential equations, ordinary differential equations.

Computational methods: finite element method (FEM), Newton's method, implicit Euler's method, curve fitting.

Computer codes: Flux2D®, Code-Aster, FEniCS, Python.

Temperature of the piece in the area of interest at the end of the process.



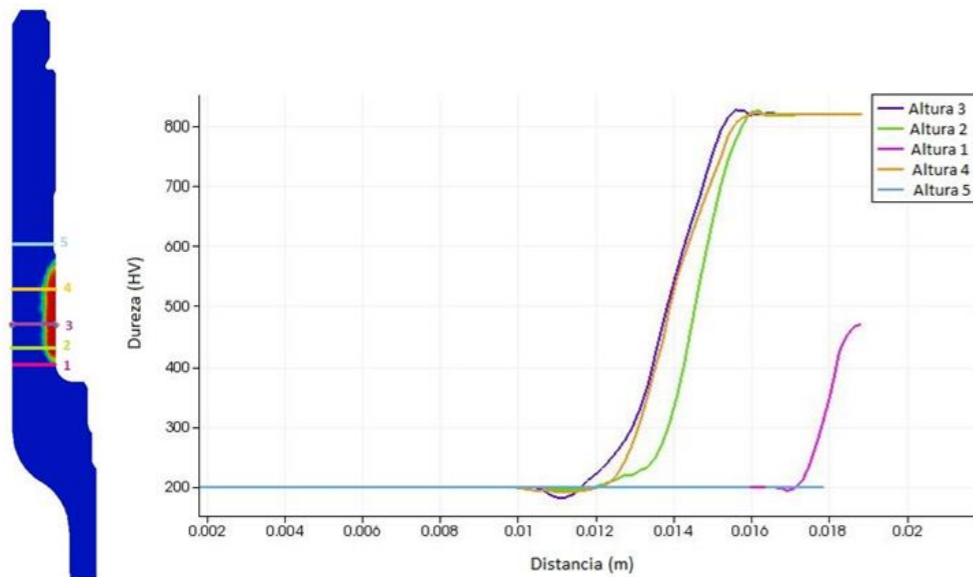
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Results and Benefits

The numerical simulation is used as an innovation tool in the design process of induction hardening of ferromagnetic parts.

Development of a free software tool that allows the numerical simulation of the process improving the performance and reliability of the system while reducing costs.



Hardness at different heights in the area of interest of the part

The numerical simulation will allow the company to improve the current design of the inductors and to evaluate new proposals with significant savings in costs and production time.

