

Sensitivity of austempering heat treatment of ductile irons to changes in process parameters

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Abstract

Austempered ductile iron (ADI) is frequently obtained by means of a three-step austempering heat treatment. The parameters of this process play a crucial role on the microstructure of the final product. This paper considers the influence of some process parameters (i.e., the initial microstructure of ductile iron and the thermal cycle) on key features of the heat treatment (such as minimum required time for austenitization and austempering and microstructure of the final product). A computational simulation of the austempering heat treatment is reported in this work, which accounts for a coupled thermo-metallurgical behavior in terms of the evolution of temperature at the scale of the part being investigated (the macroscale) and the evolution of phases at the scale of microconstituents (the microscale). The paper focuses on the sensitivity of the process by looking at a sensitivity index and scatter plots. The sensitivity indices are determined by using a technique based on the variance of the output. The results of this study indicate that both the initial microstructure and the thermal cycle parameters play a key role in the production of ADI. This work also provides a guideline to help selecting values of the appropriate process parameters to obtain parts with a required microstructural characteristic.