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A new multi-objective optimization approach for process parameters optimization during numerical simulation of quenching steel parts

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A B S T R A C T

The paper presents the numerical simulation of quenching cylindrical steel sample immersed in three different quenchants: water, 5 % aquatensid solution, and isorapid oil. The quenching process starts from the initial temperature of the cylinder at 850 °C and moves through the air until it reaches the quenching bath. The quenchant is held at constant temperature of 40 °C. The cylinder is made of carefully selected steel which does not change its structure during quenching and heating. Cylindrical samples were manufactured in three different dimensions (R, H), (mm): (12.5 × 100), (25 × 150) and (37.5 × 225), so that four measuring points were installed in each sample. Each measuring point consists of thermocouple installed beneath the cylinder surface, capable of measuring the temperature every half second. Based on the experiment, the numerical simulation is recognized as transient and nonlinear two-dimensional heat conduction problem consisting of the two main tasks: direct heat transfer problem (DHTP) and inverse heat transfer problem (IHTP). The paper proposes a new multi-objective optimization approach for the estimation of heat transfer coefficients during the numerical simulation of quenching cylindrical steel sample. The proposed approach gained better results and less convergence time compared to the results from the literature. The paper includes methods, algorithms and the source code for the calculation of the temperature fields in time and heat transfer coefficient estimation of the IHTP. The simulation software has been implemented in C# programming language and can be found at *http://github.com/bhrnjica/quenching_simulation*.

A R T I C L E   I N F O

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