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Multi-Objective Optimization and Effect of Surface Conditions on Fatigue Performance of Burnished Components Made of AISI 52100 Steel

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Abstract : The study deals with the burnishing effect of AISI 52100 steel and parameters influence (Py, i and f on surface integrity. The results show that the optimal effects are closely related to the treatment parameters. With a 92% improvement in roughness, SB can be defined as a finishing operation within the machining range. Due to 85% gain in consolidation rate, this treatment constitutes an efficient process for work-hardening of material. In addition, a statistical study based on regression and Taguchi's design has made it possible to develop mathematical models to predict output responses according to the studied burnishing parameters. Response Surface Methodology RSM showed a simultaneous influence of the burnishing parameters and to observe the optimal parameters of the treatment. ANOVA Analysis of results led to validate the prediction model with a determination coefficient R2=94.60% and R2=93.41% for surface roughness and micro-hardness, respectively. Furthermore, a multi-objective optimization allowed to identify a regime characterized by P=20 Kgf, i=5 passes and f=0.08 mm.rev-1, which favors minimum surface roughness and a maximum of micro-hardness. The result was validated by a composite desirability D_i=1 for both surface roughness and microhardness, respectively. Applying optimal parameters, burnishing showed its beneficial effects in fatigue resistance, especially for imposed loading in the low cycle fatigue of the material where the lifespan increased by 90%.

Keywords : AISI 52100 steel, burnishing, Taguchi, fatigue
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