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Strategy of screening and optimization of process parameters using experimental design: Application to a layer of aluminum 1050A by vibratory grinding treatment

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A full factorial design (FFD) 2^3 was used as screening technique to verify the influence of the three factors on the response variable (thickness of the oxide layer: T_{ol}) by vibratory grinding treatment on an aluminum alloy 1050A. Factors studied are the amplitude oscillation of the working chamber (A = 2.0 - 5.0 mm), treatment Time (t = 30-60 min), treatment frequency (f = 25-33,3 Hz). The values of these parameters were selected from a preliminary study on formation of the oxide layer at the material surface. As a result of FFD evaluation, the main influent factors are the amplitude of oscillations (A) and treatment Time (t). The fitted quadratic regression model, including these parameters was developed using the central composite design (CCD) as the response surface methodology. Analysis of variance (ANOVA) was validated with a confidence level > 90%. The final model is established on the basis of additional statistical analysis using other statistical criteria (Mallow's Cp statistic), the convenient results obtained, ensuring a satisfactory quadratic regression model, including all main parameters and their quadratic terms. Optimal conditions were determined using an analytic method, stationary point of model was determined, and the values of Hessian matrix determinant showed that the response (thickness of the surface layer: T_{ol}) agrees a maximum solution corresponding to optimal conditions, A = 2,32 mm and t = 35,12 min, at which the predictive value of the response is T_{ol} = 4,99µm.

Biography

Hamouda Khaled is a Professor in University of Sciences and Technology Houari Boumediene, Algeria, his research interest includes Strategy of screening and optimisation of process parameters using experimental design.

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