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**Proceedings
of
2nd International Conference
on
Manufacturing Excellence
(ICMAX-2019)**

15th and 16th February 2019

**Organised By
Department of Production Engineering
K. K. Wagh Institute of Engineering
Education & Research, Nashik**

**Sponsored By
Savitribai Phule Pune University, Pune**

ICMAX - 2019



International Conference On Manufacturing Excellence

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Multi-response Optimization of Burnishing of Friction Welded AA6082-T6 using Taguchi, Gray Relation Analysis and Principle Component Analysis

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Abstract

Ball burnishing is employed as post-welding treatment for AA 6082-T6 friction welded part to enhance surface and surface properties. In this paper Taguchi method, Gray Relation Analysis (GRA) and Principal Component Analysis (PCA) were employed as a tool of single and multi-response optimization, to investigate the effect of control parameters on multiple responses of burnishing process. Four controllable factors such as burnishing speed, burnishing feed, burnishing force and number of passes at five levels each and three responses such as surface roughness, surface hardness and tensile strength were studied. The optimum combination of control parameters and their levels for single and multiple responses based on the Taguchi, GRA and PCA were determined. The significance of the factors on individual quality and overall quality characteristics of the burnishing process has also been evaluated quantitatively with the variance method (ANOVA). Optimal results of all three methods were verified through confirmation experiments. The overall performance indexes of optimal level of parameters obtained in all above optimization methods were evaluated. PCA has highest value of 0.9562 among all methods.

Keywords: Friction welding, Ball burnishing, Taguchi method, Gray relation analysis, Principal component analysis, Analysis of variance.

1. Introduction

Nonferrous material like Aluminum and Aluminum alloys has wide range of applications in the industry such as aircraft fittings, truck wheels, brake disc, hinge pins, couplings, brake pistons and hydraulic pistons. Aluminum alloys are particularly well suited for parts and structures requiring high strength-to-weight ratio and are probably the best known materials used extensively in aircraft space research etc. However most of the aluminum and aluminum alloy have poor machinability and weldability. Aluminum difficult to weld can be welded with friction welding. Researchers have made an attempt to optimize the friction welding process to enhance the quality of weld. Vill, Kinley and Fomichev[1][2][3] studied the friction welding set-up and the strength of the joints. Murti et al. [4] directed a study about parameter optimization in friction welding of dissimilar materials. Sahin, M. studied the joining of

stainless-steel and aluminum materials and aluminum and copper materials with friction welding[5][6]. Although friction welding produces minimal distortion, residual tensile stresses are created that impact fatigue and stress corrosion performance. Post weld surface enhancement processing can be used to place the friction welded region in compression to improve fatigue performance[7][8]. Shot peening, laser peening laser shock peening can be used to relieve residual tensile stress by inducing residual compressive stress. Shot peening (SP) that produces a shallow layer of compressive residual stress on the surface of components to improve fatigue life. The repeated random impact of shot subjects the treated surface to poor surface finish and high level of plastic deformation, or cold working. The high level of cold working reduces the thermal and mechanical stability of the beneficial compressive layer and