Multi-objective optimization of manual metal arc welding process parameters for nano-structured hardfacing material using hybrid approach

Abhijit Saha, Subhas Chandra Mondal

PII: S0263-2241(17)30073-8
DOI: http://dx.doi.org/10.1016/j.measurement.2017.01.048
Reference: MEASUR 4571

To appear in: *Measurement*

Received Date: 13 May 2016
Revised Date: 23 January 2017
Accepted Date: 26 January 2017

Please cite this article as: A. Saha, S.C. Mondal, Multi-objective optimization of manual metal arc welding process parameters for nano-structured hardfacing material using hybrid approach, *Measurement* (2017), doi: http://dx.doi.org/10.1016/j.measurement.2017.01.048

Multi-objective optimization of manual metal arc welding process parameters for nano-structured hardfacing material using hybrid approach

Abhijit Saha[a]*, Subhas Chandra Mondal[b]

[a] Production Engineering Department, Haldia Institute of Technology, Haldia 721657, India

[b] Mechanical Engineering Department, Indian Institute of Engineering Science and Technology, Shibpur 711103, India

* Corresponding author. *E-mail addresses: alfa.nita2010@gmail.com*

Abstract- In the manufacturing industries, welding assisted hardfacing attracted increasing attention for its effective protection against corrosion, thermal shock, and abrasion. The presence of nano-particles in hard confronting materials fundamentally upgraded surface to volume proportion appropriately. Moreover, it enhances conductivity, hardness, and wear resistant properties. This paper introduces the multi-objective optimization of manual metal arc welding (MMAW) process parameters. The paramount process variables such as welding current, arc voltage and welding speed have been considered to undergo experiments. The response parameters consider weld bead width, reinforcement and bead hardness. Taguchi's (L25) orthogonal array has been utilized to perform the trial runs. The S/N ratio of Taguchi design is applied to identify optimal parameter settings for the lower bead width which corresponds to welding current of 160 A, arc voltage of 17 V and welding speed of 40 mm/min. Similarly, for the higher reinforcement, it corresponds to welding current of 150 A, arc voltage of 25 V and welding speed of 30 mm/min and for bead hardness, welding current of 140 A, arc voltage of 19 V and welding speed of 40 mm/min. Moreover, multi-objective optimization was performed using a hybrid approach combining TOPSIS (Technique for order preference by similarity to ideal solution) with PCA (principal component analysis) to identify optimal process parameters. Moreover, TOPSIS-AHP (Analytical hierarchy process) methodologies were used to compare the results with the TOPSIS-PCA. Finally, optimal settings of the input welding parameters correspond to A5V2S1 namely; welding current 160 A (level 5), arc voltage 19 V (level 2) and welding speed 20 mm/min (level 1).

Keywords: Hardfacing; Multi-objective optimization; Manual metal arc welding; Principal component analysis; TOPSIS