SPB6. Pulse Parameter Development For GMAW Of Aluminum.

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Introduction

Benefits of pulsed GMAW over conventional GMAW include reduced heat input, less distortion, and spray transfer. To obtain pulse parameters, statistical methods (including the Box-Behnken design model) have been used. This results in a reduction of the required number of experiments needed to accurately predict bead profiles as a function of pulsed parameters. One objective of the work was to investigate the effects of five pulsing parameters on depth and width of 5052-Aluminum weld beads. A second objective was to use statistical analysis to develop machine settings for a desired bead characteristic (depth & width).

Technical Approach & Results

A series of screening experiments were conducted using a high speed camera to observe droplet transfer characteristics of 5052-Aluminum. After acceptable droplet characteristics were determined, the machine settings were recorded, set as nominal operating values and entered into the Box-Behnken matrix created by Minitab 13. Welds made according to the matrix were sectioned, etched and scanned and the depth and width of each cross section were measured. Regression analysis of the data yielded two quadratic regression model equations, one for depth and one for width. Pulse parameters examined as equation inputs were pulse peak width (Tpk), peak current (Ipk), background current (Ibk), background voltage (Vbk), and pulse frequency (frequency). A Minitab DOE Response Optimizer then generated a list of pulse parameter settings that, when used, would yield the selected depth and width. Experimentally, the group did not achieve a depth greater than 0.2 inch and the largest width value was slightly greater than 0.5 inch. These points were selected because they were our maximum achieved D/W and placed into the Response Optimizer yielding machine settings: pulse frequency, 270 Hz; peak width, 3.0 ms; peak current, 185 Amps; background voltage, 16.8 Volts; and a background current of 34.0 Amps.

Conclusions

* For a desired depth and width, a regression model and the response optimizer can be used to determine pulse parameters.
* R2 values indicate some error in the regression model.
* The collected data contained some noise created by unknown variables. The effects of this noise may be reduced by repeating the experiment with a wider parameter variance.

Future Work:

* Change lead/lag angle to see effect on model.
* Include other pulse parameters (rise & fall rate) in model to improve droplet transfer.
* Increase variance range of parameters in an attempt to increase R2 values