$$\xi_i(1) = \frac{0.00 + 0.5}{0.376274 + 0.5} = 0.570598$$

$$\xi_i(2) = \frac{0.00 + 0.5}{0.768116 + 0.5} = 0.394286$$

$$\xi_i(3) = \frac{0.00 + 0.5}{0.889577 + 0.5} = 0.359822$$

Grey relation grade

$$\zeta = \frac{0.570598 + 0.394286 + 0.359822}{3} = 0.441568$$

5. Conclusion

This paper has presented an application of the parameter design of the Taguchi method in the optimization in the SAW parameters. A Four -factor four level Taguchi experimental design was used to study the relationships between the weld dilution and the four controllable input welding parameters such as feed rate, welding voltage, nozzle-to-plate distance, Current. The following conclusions can be drawn based on the experimental results of this research work:

1. Taguchi's robust orthogonal array design method is suitable to analyze this problem as described in this paper.
2. It is found that the parameter design of Taguchi method provides a simple, systematic and efficient methodology for the optimization of the SAW parameters.
3. For main effects feed rate, welding voltage, welding speed, nozzle-to-plate distance; have significant effect on the weld dilution. This is consistent with the conclusions from the study of other investigators.
4. The feed rate has the most significant effect on the weld dilution found by S/N ratio
5. Statistical results shows the voltage , current, feed rate and electrode distance affects the Dilution of weld by 8%, 24.7%, 29% and 22.46% in the Gas metal Arc welding process.
6. The Reinforced Area, Penetration Area and % dilution predicted by the result of regression analysis as follows

Reinforcement area = 51 + 0.10 Voltage + 0.087 Current - 0.038 speed

Penetration area = -56.4 + 0.54 Voltage + 0.234 Current + 0.231 speed

Dilution = 35.5 + 0.05 Voltage + 0.0137 Current + 0.063 speed

7. According to grey relational theory the experiment with Voltage of 26V, Current of 350A and speed of 285mm/min are optimum.

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