B. Response Surface Model for Predicting Dilution in Universal Gas Metal Arc Cladding

by A.S. Shahi, Saint Longowal Institute of Engineering and Technology; Sunil Pandey, India Institute Of Technology

This paper describes the use of a new variant of GMAW process named as UGMAW -Universal gas metal arc welding process, for cladding of low carbon steel with austenitic stainless steel. UGMAW process employs two contact tips and a secondary power source to preheat the tiller wire prior to its emergence from the welding torch, thereby providing an additional and independent power source. In this arrangement, the major role of welding current is dissipation of sufficient heat to support the arc, to melt the surface of the base plate and to fuse the hot incoming wire. The main difference between GMAW and UGMAW, in terms of heating is that the preheated filler wire further experiences FR heating after it leaves the lower contact tip. Weld-deposited cladding in one layer with 316L filler wire on 12 mm thick low carbon steel (which is used as general structural steel) was carried out in order to develop mathematical models for predicting dilution in conventional GMAW and UGMAW process, since dilution has a major influence on weld metal quality, such as mechanical properties and corrosion resistance Four factor five level and one factor two level central composite rotatable design was used to study the influence of four numeric factors viz, wire feed rate, welding voltage, welding speed, nozzle-to-plate distance and one categorical factor preheat current, on dilution. Results are presented in the form of response surfaces along with their contours. The findings of this study not only establish the technical superiority of the new process but also justify its use for low cost surfacing applications.

Conclusions summary

1. The new concept of hot filler GMAW has been investigated for stainless steel cladding.
2. The working ranges of primary and secondary parameters for 1.14mm diameter stainless steel wire 3 16L using UGMAW process were established based on bead appearance
3. Minimum dilution conditions were found to be at lower levels of wire feed rate, arc voltage and welding speed and higher levels of NPD in UGMAW process.
4. Preheating of the filler wire reduces base metal penetration, apart from relatively smaller variations in other bead geometry parameters, due to significant drop in the main welding current, which is the main reason for reduced dilution obtained in UGMAW process
5. Significant reductions (30 to 45% approximately) in dilution were achieved by using UGMAW process.
6. The study undertaken gives qualitative and quantitative comparisons of UGMAW and conventional GMAW process as regards cladding dilution and it is shown that UGMAW process promises to hold a good potential in meeting the needs of low cost surfacing applications-