

The Effect of Parameters of the Pulsed Current GMA Welding on the Stability of Resistance of the Welding Arc

Process-integrated quality assurance of the weld is possible on the basis of more uniform pulse resistance area for each pulse cycle time

By

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ABSTRACT

Introduction

In this research paper, the results of investigation dealing with pulsed current gas metal arc welding (GMAW-P) with emphasis on process stability are presented. Selecting the parameters of GMAW-P is very important as melting phenomena of the filler metal, arc stability and quality of the weld mainly depends upon it. Selecting the most suitable GMAW-P parameter is highly complex due to interdependence of parameters. In order to simplify this selection procedure, a process control system has been designed.

According to this process-control system, an optimum GMAW-P parameter was selected on the basis of process-integrated quality assurance.

Experimental Procedure

The welding was carried out using a transistorized pulsed GMA welding power supply and solid filler metal ER 5356 Al-Mg alloy having a diameter of 1.2 mm (0.047 in.) and with the compatible AA 5083 Al-Mg alloy of 6.0 mm (0.236 in.) thick base metal.

The level of arc-stability was assessed from the regularity of pulse resistance area for each pulse cycle time and used as an important parameter or indicator for optimizing the welding conditions. The standard deviation and coefficient of variation of average resistance were taken as the best measure of the regularity of filler metal melting, during welding operation.

Results/Discussion

The pulse resistance area for each pulse cycle time was measured for all the welding experiments and the values of mean, standard deviation (S.D), and coefficient of variation (C.V) were calculated.

Pulsed resistance waveform was obtained by dividing pulsed current by pulsed voltage data for each welding experiment. Analysis of the fluctuations of these values as a function of various pulsing parameters was useful to understand arc's behavior with respect to resistance and this could be correlated to the various types of molten metal

droplet detachments. The optimum GMAW-P was selected by choosing the pulse parameter which resulted in the least S.D and C.V of pulse resistance area. This enables to produce cost-effective, spatter free, high quality welds.

The lowest standard deviation and the lowest C.V for the pulse resistance area were observed for the weld, which was made with one droplet detachment during peak duration. The smaller the standard deviation and the smaller the C.V, the more uniform the pulse resistance was. That means this type of droplet detachment provides a droplet from the filler metal tip regularly during background duration in order to produce spatter free, high quality, and stable weld. Hence, one droplet detachment during peak duration was considered to be the best for providing a more uniform pulse resistance area than the other types of droplet detachments.

The stability of the GMAW-P is directly related to the type of droplet detachment. Statistical analysis of pulse resistance area for each pulse cycle time from the pulsed resistance waveform using a computer provides a powerful means of assessing the arc stability directly. Thus process-integrated quality assurance of the weld can be possible on the basis of the regularity of pulse resistance area for each pulse cycle time.

Conclusions

1. This study is very helpful for monitoring and improving the GMAW-P process and for optimizing the parameters of the GMAW-P process.
2. The most uniform pulse resistance area was observed for the welds made with one droplet detachment during peak duration. Because, among the four types of droplet detachments, the lowest S.D and the lowest C.V were found for this weld. This parameter combination can be programmed to the computer so that whenever the operator wants to use the particular wire feed rate, this particular pulsed waveform is selected automatically, and the operator was able to get good quality weld.
3. This study can be very much useful for fabricators to derive the fullest benefits from GMAW-P in high quality or automatic or robotic welding.
4. This study can also be extended to monitor the manual skill of welding machine operators during their training or actual work, importantly during underwater welding.