

D. The Effect Of Fluid On The Percussive Welding Process*

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Introduction

Percussive arc welding is a process where an arc is drawn between two parts that are subsequently impacted together to achieve coalescence. Manufacturers of percussive arc welders often recommend that a droplet of water be placed at the impact point between the parts being welded. It is claimed that this improves the weld, or at least improves the weld cosmetic appearance. In past studies where we developed techniques to evaluate this extremely brief form of arc spot welding we did not employ this technique. Some recent applications led us to examine this technique and how it affects the process.

Technical Approach

Measurements of the effect of fluid presence on the voltage and current vs time diagnostics applied to the process will be discussed. We will track how the fluid changes the energy dissipation and part displacement during the weld. We will also document how the fluid presence changes the solidification morphology and porosity of the resulting weld and variability in the resulting weld strength vs welding parameters. We will also compare these results with previously presented models of the process.

Results and Discussion

Previous work has shown that the process begins with a resistive-heating driven explosion of a arc-initiation nib, followed by an arcing regime, followed by the final impact and a final resistive heating regime. The most obvious effect of the presence of fluid is to lengthen the arc time. Relative to equivalent no-fluid welding conditions, this slows the impact velocity and constrains the arc and molten zone by virtue of the requirement that momentum be transferred to the surrounding fluid during the explosive event that displaces molten metal, allowing for the final coalescence of two fresh molten surfaces. The fluid also acts to extract heat, localizing the arc plasma, much as the orifice in a plasma arc torch. Similarly to the PAW process, the arc voltage is increased and the arc current reduced. By virtue of the fact that the fluid makes the process slightly less violent, i.e. slows down the velocity of metal ejection, it makes it somewhat easier to control and opens up the processing window. Finally, we shall also discuss how the volume and mass of the fluid affect the process

Conclusions

Experience has shown that the prior presence of a fluid (typically water) in percussive arc welding leads to cosmetically improved welds and sometimes to improved strength welds as well. In light of recently-presented models we will discuss how this factor affects the overall process evolution, particularly how the dynamics of the arcing and molten metal flow are affected.

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