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Research on the Effects of Technical Parameters on the Molding of the Weld by A-TIG Welding

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Key words: TIG Welding, A-TIG Welding, Penetration, Weld Pool Width

The effects of welding parameters on the molding of weld by A-TIG welding of a 4mm thickness mild steel plate is studied in the present paper. The results obtained show that: as welding current increases, A-TIG welding penetration gets deeper than TIG welding; size and shape of HAZ has remarkable change; A-TIG welding has the narrower weld pool width than TIG welding.

1. Introduction

TIG technology is widely used in the modern welding as its high welding quality, high stability, and wide range of applications. However, because of shallow penetration depth, it is mainly used for sheet metal welding, and its production efficiency is low. A-TIG is the application of a reactive flux (Active-Flux) applied on the surface of the work piece for welding. It makes the welding arc contract, thus arc energy concentrate, thereby increased the weld penetration, and enhanced the production efficiency [1]. In present paper, the experimental method is used to study the effect of welding parameter on the molding of weld by A-TIG.

2. Main Text

2.1 Experimental

2.1.1 Materials and specimen

The sample is sized 250mm×150mm×4mm mild steel plate. The Active-Flux is developed by the research group. With acetone and Active-Flux in a 1:1 volume ratio mixture and stir evenly. Then special brush is used to evenly apply on the work pieces. It can only be welding after the acetone's evaporation. The way of coating is shown in figure 1^[2].

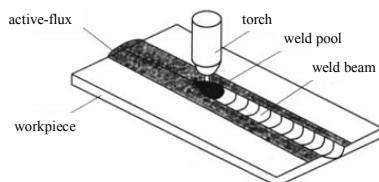


Figure 1 Method of the Active-Flux coating

2.1.2 Test equipment and processing parameters

WSE-315 AC-DC square wave welder and ZF-1000 automatic longitudinal seam welding machine are used in the test. Makes the torch fixed on the welding machine and wires to the negative terminal before welding. Then sets the work piece horizontally on the tool machine and packs down with the pressure plate. The arc voltage, weld speed and other parameters are fixed in this test and with the different welding current (60A~120A) to compare the appearance of weld of TIG and A-TIG weld. The specific welding conditions are shown in table 1.

Table 1 mainly welding conditions

Current A	60~120
Weld speed mm/min	285

Gas flow L/min	12
Arc length mm	3
Distance from nozzle to work piece mm	5
Voltage V	11

2.2 Results and analysis

2.2.1 Effect of welding current on weld morphology

With the welding conditions shown in table 1, the effect of welding current on weld morphology is shown in figure 2.

The welded joint can be divided into 3 parts: weld, HAZ, and base metal, as shown in Fig. 3. It can be seen from Fig. 2 that welding current has remarkable effect on the shape and dimension of HAZ. Weld penetration gets deeper with the welding current's increasing, and A-TIG has the deeper penetration than TIG with the same welding current.

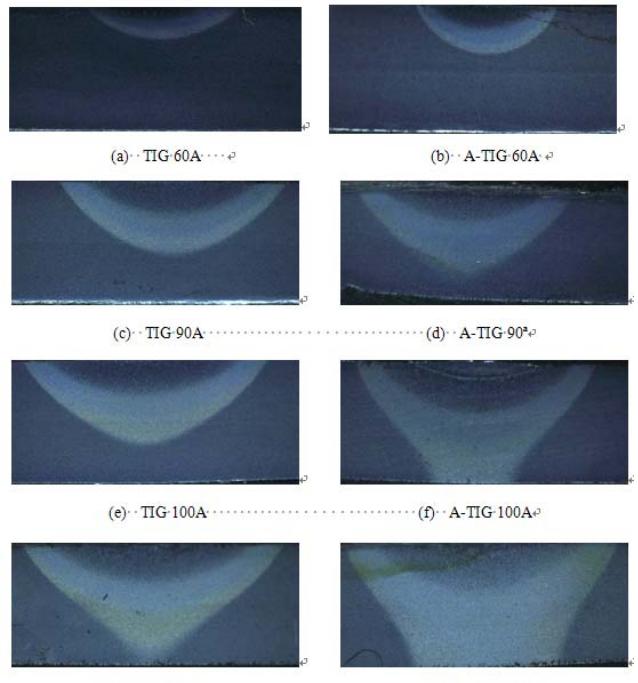


Figure 2 Macroscopic morphology of the weld cross-section diagram

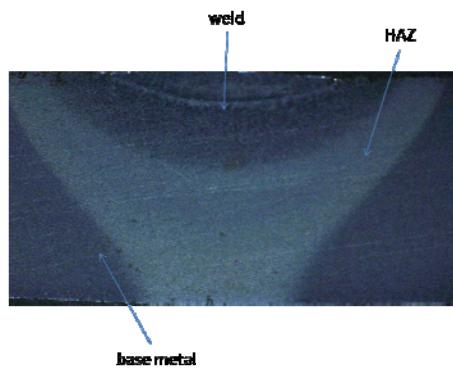


Figure 3 Section of weld joint

2.2.2 Effect of welding current on penetration

The effect of welding current on penetration is shown in figure 4. The weld penetration by A-TIG is always deeper than that by TIG on the same welding current. With the increase of welding current, the gap of weld penetration between A-TIG and TIG increases too. That is, the effect of the increasing of weld penetration becomes more and more evident as the Active-Flux added.

This effect can be explained with arc contraction theory. As the Active-Flux added, the surface activating flux evaporates and surrounded by outlying regions of the arc as atom form under the high temperature of the weld arc^[3]. The evaporated atoms seize electrons and shape into negative ion in the outlying regions because of the lower temperature of this region. This results in a decrease trend of the number of electrons in the weld arc. The arc conductivity decreased that automatic contraction and the heat and the arc force concentrated. Therefore, the weld penetration is increased. In the center of the arc, as the temperature is high enough to make the atomic ionization and the combination of particle and electron into negative ion is a exothermic reaction. As a result, negative ions can generally not form an arc in the region^[4]. With the current increases, the active agent in the volatile effect of halides and oxides increase, further increasing the weld penetration depth^[5].

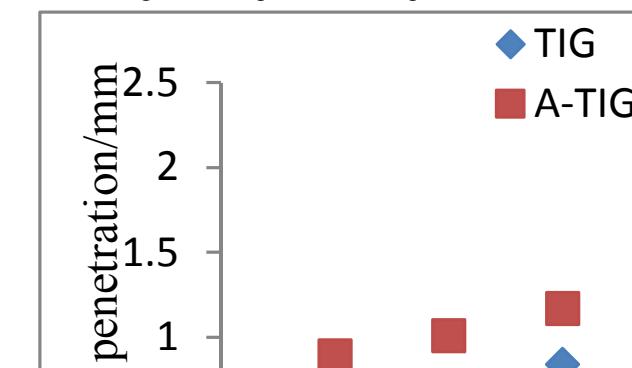


Figure 4 Comparison chart of weld penetration under different welding current

2.2.3 Effect of welding current on weld pool width

The effect of welding current on weld pool width is shown in figure 5. Weld pool width increases with the increased current; and A-TIG always has the narrower weld

pool width than TIG in the same welding current.

This effect can be explained by the theory of surface tension^[6]. There is a negative surface tension gradient in general welding metal melted. Metal on the surface of molten pool which flowing from center around causes weld penetration decreases and weld pool width increases. When there is some certain type of trace element in the molten pool or the arc contacts some activity atmosphere, the surface tension of the molten metal changed. Molten metal flows from around center making weld penetration deeper while weld pool width narrower.

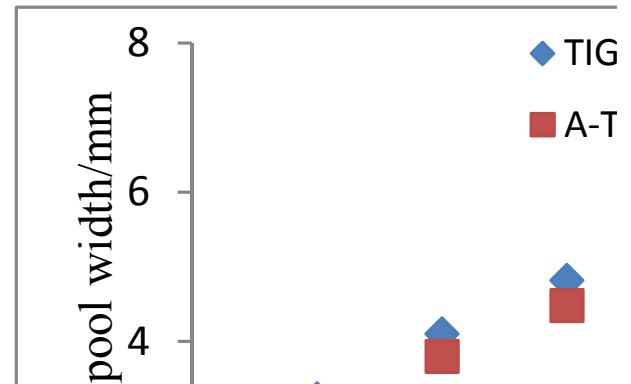


Figure 5 Comparison chart of weld pool width under different welding current

2.3 Conclusions

- (1) The welding current has remarkable effect on the shape and dimension of HAZ.
- (2) Penetration increases as the current grows, and A-TIG has the deeper penetration than TIG with the same current.
- (3) Weld pool width increases as the current increases, while A-TIG has the narrower weld pool width than TIG with the same current.

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Research on the Effects of Technical Parameters on the Molding of the Weld by A-TIG Welding

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