MIG Arc Welding of Magnesium Alloy†

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Abstract

AZ31 magnesium alloy sheet of 1.6mm in the thickness was successfully welded at the high speed of 300cm/min using AZ61 filler wire and DC pulse MIG arc welding. The range of the appropriate welding condition was determined from bead appearance and macrostructure by changing the parameters of the welding current and welding speed. The welded bead was grouped by three-grades; a burn-through bead, a sufficient penetration and an insufficient penetration bead. The tensile strength of the butt-joint was 250MPa, which was 98% of that of the base metal. The elongation was 6%, much lower than that of base metal of 13%.

KEY WORDS: (Magnesium Alloy), (MIG Arc Welding), (Mechanical Property)

1. Introduction

Magnesium alloy is the most lightweight of all useful alloys. Therefore it is attractive as a lightweight structural material. However, the welding methods for magnesium alloy are not well established. In the actual process, the welding method almost applied for magnesium alloy is TIG arc welding. On the contrary, the welding of magnesium alloy with MIG arc welding, which is at higher efficiency, has hardly been investigated[1-3].

The purpose of this research is to evaluate the weldability of magnesium alloy by DC pulse MIG arc welding and the bead mechanical property of the welded joint.

2. Experimental

AZ31 magnesium alloy sheet of 1.6mm thickness and AZ61 filler wire of 1.2mm diameter were used. Bead-on-plate welding by DC pulsed MIG arc was curried out at the different welding conditions, 52-120A welding current and 80-300cm/min welding speed Ar gas shielding of 20l/min. The range of appropriate welding condition was evaluated from the bead appearance and the macrostructure. The mechanical property of the joint welded at the appropriate welding condition was evaluated by the transverse tensile test.

3. Results and Discussion

3.1 Decision of the appropriate welding range

Figure 1 shows differences in the bead appearance and macrostructure of the welded bead at the welding current of 80A and different welding speeds. At the welding speed of 120cm/min(heat input:13.3J/cm), an intermittent burn-through bead was observed due to excess heat input. At higher welding speed, 200cm/min(8.16J/cm), a smooth bead was observed from the surface appearance. However, the weld bead possessed excess weld reinforcement and insufficient penetration, because of the insufficient heat input. At the middle welding speed of 150cm/min(9.8J/cm), a sound bead with excellent bead appearance and good shape in cross section was obtained. Therefore, welding at this condition leads to the sufficient

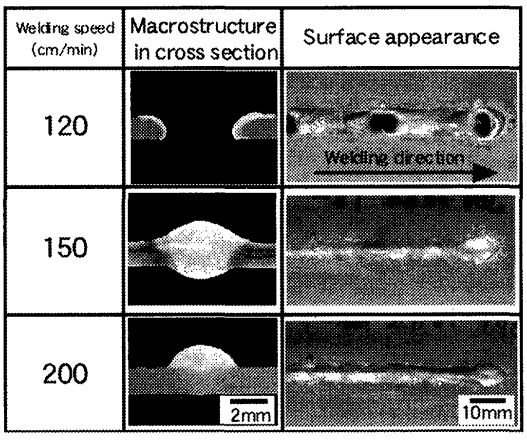

Fig.1 Bead appearance and macrostructure in cross section of weld bead at welding current of 80A.

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heat input to obtain the sound bead.

Figure 2 shows the range of appropriate welding conditions of the bead-on-plate welding at different currents and speeds. The range of appropriate welding shifted to high current with increasing speed, which indicated that it was controlled by the heat input. In the appropriate welding condition, the range of appropriate heat inputs was from 8.1 to 10.7J/cm.

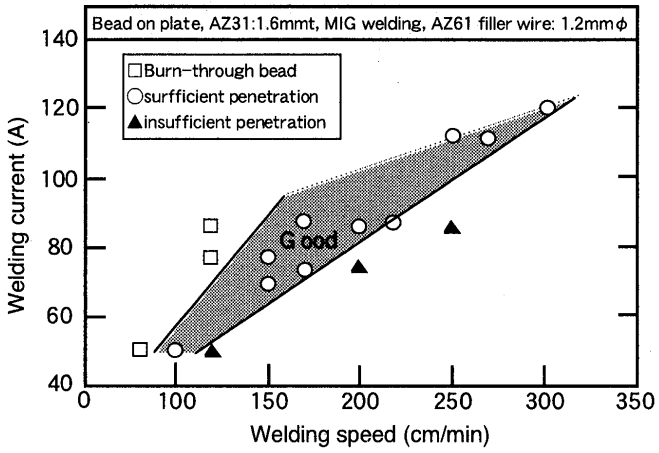

Fig.2 Combined effect of welding speed and welding current on the formation of weld bead in bead -on-plate welding by DC pulsed MIG arc.

3.2 Mechanical property

A transverse tensile test of the welded joint at the welding current of 70A and the welding speed of 150cm/min was carried out. The tensile strength was 250MPa, which was 98% of that of the base metal(256MPa). The elongation of the welded joint was 6%, much lower than that of the base metal of 13%. The fractured position is in the HAZ near the fusion boundary. This result may be caused by stress concentration on a narrow heat affected zone.

4.Conclusions

The conclusions in present paper are summarized as follows,

(1) A sound weld bead of AZ31 magnesium alloy sheet can be obtained by DC pulsed MIG arc welding at high speed up to 300cm/min. A range of appropriate welding conditions for welding current and welding speed exists. In this condition, the appropriate welding heat input range is from 8.1 to 10.7J/cm.

(2) The transverse tensile strength of the butt-joint at 70A and 150cm/min is 250MPa, 98% of that of base metal. The elongation was 6%, lower than that of base metal of 13%.

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