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Studies on Mechanical and Characterization Properties of CMT Welded Aluminium AA7075 Sheets

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ABSTRACT: Aluminium alloy sheets are find utility in various diversities of industrial sectors due to its multifunctional features and global suitability. There have been several literatures reporting mechanical and microstructure analysis and suitability of joining of this material using various welding techniques. Subsequently, it has been proved successful for several welding processes irrespective of the heat flow phenomenon. However, the width of the heat affected zone remains a challenge for all the conventional process. In view of this, it is observed that cold metal transfer technique appears to reduce the HAZ width due to its low heat input to the base metal which is the most prominent features of the process. In this welding, has been done on microstructure and other weld characteristics for Aluminium alloy 7075 sheets.

KEYWORDS: CMT welding, Aluminium alloy 7075 sheets ,HAZ zone .

I. INTRODUCTION

1 COLD METAL TRANSFER WELDING PROCESS (CMT)

The CMT process basically operates in the short-circuit mode (dip transfer) characterized by the low current and voltage, i.e low heat input. An initial high pulse of current is supplied, forming an arc between the advancing electrode wire and the substrate, which melts the electrode tip. The current is reduced following the pulse, and as soon as the short-circuit formation indicated by a sharp decrease in voltage, the current is reduced to a further low background value and the wire is retracted, leading to the detachment of the molten droplet. Every time the short circuit occurs, the digital process-control both interrupts the power supply and controls the retraction of the wire.

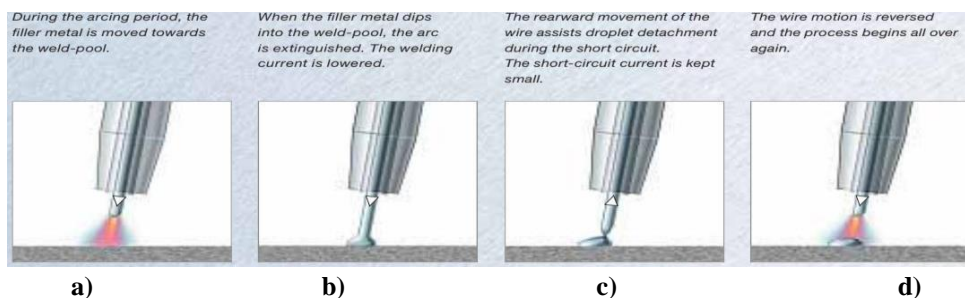










Figure1.0: Different CMT phases, a) arc ignition b) Short circuit phase c) inversion of wire feed direction d) arc re-ignition

A typical CMT welding electrical signal cycle can be defined as the period required to deposit a droplet of molten electrode into the weld pool. The analysis of current and voltage waveform is essential to study the energy distribution of different phases in droplet transfer process

II. RELATED WORK

Experimental trails are carried out on 2mm thin Aluminium alloy 7075 sheets of thickness. It is chosen as it finds greater application in the cars/motorcycle modifications, home utensils, engineering, picture printing etc. The chemical composition of Al 7075 is shown in Table3.1. The consumable electrode with diameter of 1.2mm is used as the filler metal. Samples are scrapped with stainless steel brush by applying light pressure to avoid unwanted heat generation on metal surface and mopped with acetone for removal of dirt, oil residues, moisture and oxides. Argon is used as shielding gas with a fixed flow rate of 18 lit/min. Seam welding is performed with the use of linear 6-dimensional robotic displacement machine. The trails are designed by varying two parameters namely: welding current and welding speed. The other process parameters are maintained constant.

When welding speed was set as 10 mm/s, less heat input coupled with higher cooling rate denied the free movement of weld pool, which exhibits ripples as seen from Table 4.1. Pulsed-CMT yields a stable and spatter-free welding of aluminium AA7075 alloy. Remarkable weld is obtained when current is maintained in the range of 60-70 A and the welding speed maintained at 8-10mm/s. For welding aluminium alloy thin sheets using a filler which is of same composition as of base metal. This composition is potentially less susceptible to solidification cracking, controlled fusion line, narrower heat affected zone (HAZ) and reduced intermetallic phase area.

Welding current (A)	Welding Speed (mm/min)	Weld Bead Appearance	
		Top side	Bottom side
60	500		
60	600		
70	500		
70	600		

III. METHODOLOGY

When welding speed was set as 10 mm/s, less heat input coupled with higher cooling rate denied the free movement of weld pool, which exhibits ripples as seen from Table 4.1. Pulsed-CMT yields a stable and spatter-free welding of aluminium AA7075 alloy. Remarkable weld is obtained when current is maintained in the range of 60-70 A and the welding speed maintained at 8-10mm/s. For welding aluminium alloy thin sheets using a filler which is of same

composition as of base metal. This composition is potentially less susceptible to solidification cracking, controlled fusion line, narrower heat affected zone (HAZ) and reduced intermetallic phase

IV. EXPERIMENTAL RESULTS

The specimens undergone for the tensile test and finally the results of the tensile test have been listed below on table

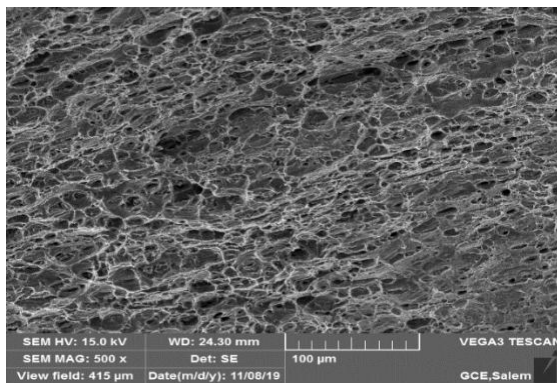
Tensile test results for welded specimen

Test parameters	Observes values			
	1	2	3	4
Samples				
Yield strength (N ² or Mpa)	153	145	148	146
Ultimate Tensile strength (N ² or Mpa)	237	198	224	217
% Elongation in 25mm GL	10.00	5.50	7.50	8.50
Fracture Locations	Base	Weld	Weld	Base

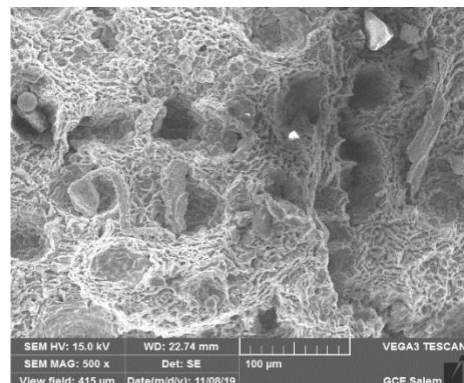
The tensile is conducted as per the ASTM Standard E8/E8M, the results of the tensile have been observed the maximum tensile strength value is 237 Mpa produced by the parameteric effect of sample 1 (60A & 500mm/min) is fracture location on the base metal and sample 3 tensile strength value is 224 Mpa of (70A & 500mm/min) the fracture occurs on the weld zone. The fracture mode surface of the observed samples is ductile fracture is formed, so the base metal and weld surface is ductile nature. The percentage of elongation of the weldments is low, compared to base metal and the yield strength is moderated on weldments, compared to base metal as shown table

SEM ANALYSIS

The microstructure of the weld cross sectional area of the AA7075 was obtained by using an SEM microscope. Four(4) specimens were observed. In these specimens, defects such as lack of fusion and distortion are observed. However, among these Four specimens, two specimens were selected for SEM analysis, namely specimens 1, and as shown in Table. These specimens were selected based on their weld appearance, such as fewer defects and their high tensile values.



(a)



(b)

SEM was used to examine the fracture surface. Fig. illustrates the SEM results. As shown in Fig.a, failure mode I exhibits ductile fracture characteristics and has a rough and irregular fracture surfaces which consists of lots of voids and small dimples. For failure mode II, the fracture surface demonstrates a brittle structure and only a small ductile region was observed. As shown in Fig.b, the brittle fracture surface was relatively flat and smooth. A few of porosities were seen in the brittle fracture surface, which could be caused by the gas floe rates. Furthermore, it was found that the brittle fracture surface did not necessarily represent a low tensile shear strength compared to the case of ductile fracture.

V. CONCLUSION

Welding of 2mm AA6061 thin sheet is carried out with pulsed-CMT process. The welding speed is varied from 7 mm/s to 10 mm/s and welding current is varied from 60 A to 70 A while maintaining voltage constant. The prominent conclusions from this study are follows:

- Pulsed-CMT yields a stable and spatter-free welding of aluminium AA7075 alloy. Remarkable weld is obtained when current is maintained in the range of 60-70 A and the welding speed maintained at 8-10mm/s.
- Maximum ultimate tensile strength of (237Mpa) was achieved base metal and ultimate tensile strength of (224Mpa) was achieved weld metal at a heat input of (73.5&78.6 j/mm). At high heat inputs, tensile strength increased due high welding speed which result end in minimal HAZ.
- SEM was used to examine the fracture surface of high tensile strength samples (1 & 3). failure mode I exhibits ductile fracture characteristics and has a rough and irregular fracture surfaces which consists of lots of voids and small dimples. For failure mode II, the fracture surface demonstrates a brittle structure and only a small ductile region was observed. the brittle fracture surface was relatively flat and smooth. A few of porosities were seen in the brittle fracture surface, which could be caused by the gas floe rates.
- The microstructures reveal fine recrystallization at the joints and cores grains at the weld zone. A uniform distribution of grains and its size in weld HAZ and base metal is distinctly visible. The characterization of the microstructure revealed epitaxial growth with dendrites aligned in columnar fusion emerging towards the source of heat.

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