International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 07 Issue: 04 | Apr 2020 www.irjet.net p-ISSN: 2395-0072

IMPROVING WELDING JOINT STRENGTH WITH ALUMINIUM ALLOY 5052 USING GAS METAL ARC WELDING

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Abstract - *An increased necessity for welding has been created in the automotive, food and medical equipment industries to weld heat-sensitive materials, such as thin sheets, coated thin plates, stainless steel, aluminium and mixed joints. However, related innovations in the area of arc welding are not generally notorious and rarely used to their utmost potential. In the field of gas metal arc welding processes, digitalisation has authorized incorporation of software into the power source, wire feeder and gas regulation. A method has been proposed in which aluminium alloy weldments were made using Gas Metal Arc Welding (GMAW) with pulsed and non pulsed current at different frequencies like 2Hz, 4Hz and 6 Hz. Non-destructive tests involving liquid penetrate test, radiography were conducted, assessed and compared with pulsed and non-pulsed current welding at different frequencies of thickness materials (2mm of 5052 aluminium alloy). Thus the method helps to have a view on the effect of pulsed current on the quality of weldments. It is identified that good weld ability, good mechanical joint properties and acceptable process effectiveness can be obtained.*

Key Words: **Gas metal arc welding, Aluminium alloy, Pulsed and non-pulsed current, Liquid penetrate test, Radiography test**

1. INTRODUCTION

Welding is the method by which two pieces of metals can be joined together. Welding process can be classified as Gas Welding, Arc Welding, Resistance Welding, Solid State Welding, Thermo-Chemical Welding and Radiant Energy Welding. Gas tungsten arc welding is a more abundantly used welding technique to join the metals and the weldments were made with several thicknesses. After the welding, the welded materials were tested with Liquid penetrate test and radiography test. It is identified that in Gas tungsten arc welding, porosity got increased with increase in thickness, which in turn affect the entire strength of the metal. In order to improve the metal strength, Gas Metal Arc Welding (GMAW) has been proposed. The Gas Metal Arc welding involves a feed wire that constantly moves through the gun to create the spark, and then melts to form the weld. The welding method uses aluminium alloy with the variables of welding current and welding voltage. Aluminium alloy have strong corrosion resistance. The welding method also uses aluminium welding wire which contains silicon additives that helps in improved fluidity and also makes the weld less sensitive to cracking. The Liquid penetrate test and radiography tests were conducted after welding to the welded materials with the thickness of 2mm by varying the frequency in 2Hz, 4Hz and6Hz. From the results obtained, it is identified that aluminium alloy is a good suited metal for welding to increase the strength of the metal.

2. PROPOSED WORK

The work pieces were made of 5052 aluminium alloy with the thicknesses of 2mm. The test specimens were machined to the required size and welded with pulsed and non-pulsed current GMAW process. Filler wire material ER4043 was used during the welding, which minimizes the weld cracks and improves metal strength and ductility than other filler metals. These filler metals dissolve at a temperature lesser than that of the base metal, for this cause it yields through cooling, since it retains more plastic than the base metal and relieves the tightening stresses. If welding speed minimized away from an optimum value, deepness of penetration minimises due to the pressure of electric arc on weld pool. Heat input parameter manipulate the cooling rate; weld bead size and mechanical properties of weld. The aluminium alloy work materials were chemically cleaned in hot Sodium Hydroxide for 10 minutes and then dipped in Nitric Acid solution for almost 15 minutes and then washed in water. Lincoln Electrical square wave MIG 256 XT GMAW machine with AC was used for welding of 5052 aluminium alloy test specimen's .The choice of tungsten electrode depends upon the type of welding current selected for the application. E4043 electrode are best suitable for AC wherein they stay in hemispherical shape and thoriated tungsten electrodes (EWTh-2) should be ground to taper. The welding process was conducted with 3.0 mm diameter 2% Blue Demon - E4043 electrode of 5052 aluminium. The welding process will be done both with pulsed current and non-pulsed current for two different thicknesses of the given material. After the edge preparation of the tested 5052 aluminium alloy specimens after welding process got over, the radiography and liquid penetrate test were carried out on the weldments. The welding parameters for pulsed

and non- pulsed current welding were shown in Table 1 and Table 2.

Table -1: Welding parameters for non-pulsed current welding of 5052 Aluminium alloy

Material Thickness (mm)	Weld Layer	Fillller Wire (mm)	Current	I (amp)	V (volts)	ARC Travel speed (cm/mi)
1	ROOT	2.1	AC	89	16	6
2	ROOT	2.9	AC	123	20	5

Table -2: Welding parameters for pulsed current welding of 5052 Aluminium alloy

Material Thickness (mm)	Weld Layer	Filller Wire (mm)	Pulse/sec (Hz)	Current	I_p (amp)	Ib (amp)	V (volts)	ARC Travel speed (cm/mi)
2	ROOT	3	2	AC	145	75	20	6.0
2	ROOT	3	4	AC	138	77	20	6.0
2	ROOT	3	6	AC	150	74	20	6.0

3. RESULT AND DISCUSSION

3.1 Radiographic Test for 1mm thickness at 2Hz

3.2 Radiographic Test for 1mm thickness at 6Hz

3.3 Liquid Penetrate Test for 1mm thickness at 2Hz

3.4 Liquid Penetrate Test for 1mm thickness at 2Hz

4. RESULT COMPARISION

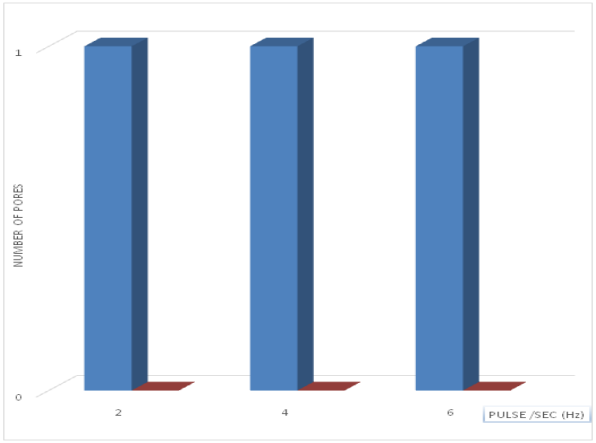

Chart -1: Number of pores in GTAW – GMAW in RT Test

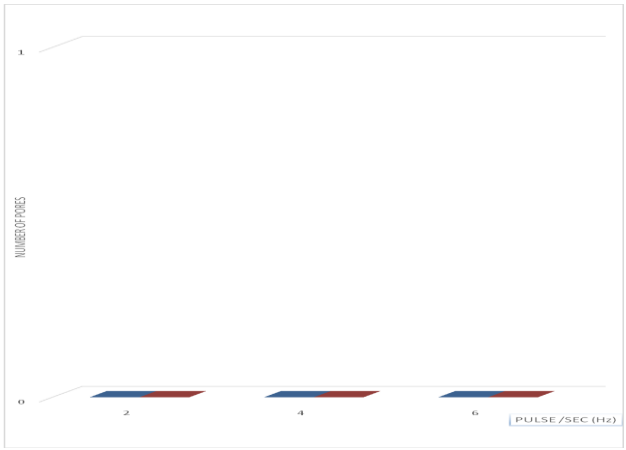

Chart -2: Number of pores in GTAW – GMAW in PT Test

5. CONCLUSION AND FUTURE WORK

Welding is the method by which two pieces of metals can be joined together. Gas tungsten arc welding increases the porosity with increase in thickness while it got undergone with welding operation. This decreases the metal strength. Thus, Gas Metal arc welding has been proposed to improve metal strength by using aluminium alloy. Aluminium alloy 5086 having thickness 2mm thickness are welded at three different frequencies as 2HZ, 4Hz and 6HZ. Radiography test and liquid penetrate test were conducted on the weldments after welding. In the Aluminium alloy, it is observed that porosity decreased in the weldments with increase in thickness and pulsed frequency in Radiography test. No defect was observed on the non-pulsed current and pulsed current weldments during the liquid penetrate test.

In the proposed method, the mechanical properties and chemical properties of aluminium alloy 5086, Chemical Compositions of filler wire, Welding parameters for pulsed current welding of 5086 Aluminium alloy are explored. The aluminium pieces are welded in the required way, also the required tests were taken. Effect of pulsed current and non-pulsed current on these weldments can be studied further by conducting

- Hardness test,
- Tensile strength test
- Microstructure tests.

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