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Full Length Article

Performance of Welding Characteristic Inaluminium Alloy 5052 Using Gas Tungeston Arc Welding

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ABSTRACT: In this experimental work, aluminium alloy (5052) weldments were made using Gas Metal Arc Welding (GMAW)with pulsed current and non- pulsed current at different frequencies 2Hz, 4Hz, 6Hz. Non-destructive tests like radiography, liquid penetrate test were conducted, evaluated and compared with pulsed and non-pulsed current welding at different frequencies of thickness materials (2mm of 5052 aluminium alloy). The aim of this experimental work is to see the effect of pulsed current on the quality of weldments. The experimental results pertaining to different welding parameters for the above material using pulsed and non-pulsed current GMAW are discussed and compared.
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Keywords: Gas Metal Arc Welding, Constant Current Welding, Pulsed current welding and Heat Affected zone

1 Introduction

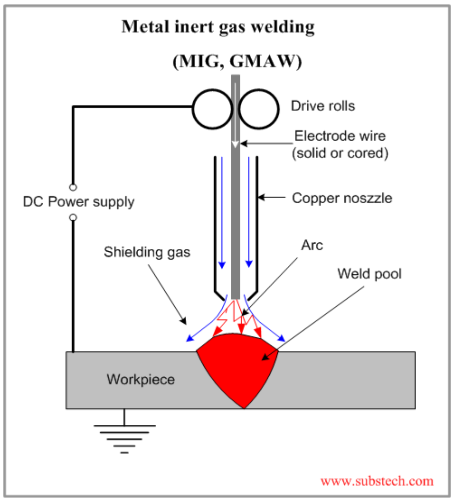
Gas welding (GMAW) is a welding process that hasbeen commercially available for around metal arc 60 years. The basic operation of the GMAW process occurs when an electrical arc is established and maintained between a base material and a continuously feed wire electrode.

The molten weld pool is shielding from the atmospheric conditions by an envelope of shielding gas that is flowed continuously around both the wire filler metal feeding in the weld pool and the weld pool itself.

The heat of the electrical arc serves to locally melt the base metal as well as melt the wire filler metal that is being fed into the weld. There are two entities at play in the GMAW process.

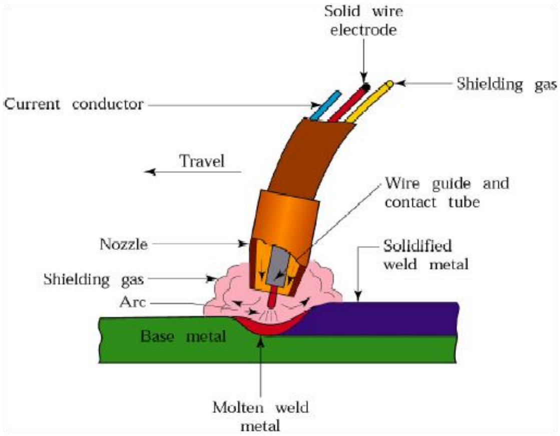
1.1 Burn Rate

This refers to the rate, inches/minute (in/min) or meters/minute (m/min), at which the wire filler metal is melted or consumed by the thermal energy of the welding arc. The primary variables that control the thermal energy of the arc are the welding current, welding voltage, and shielding gas composition.



1.2.Feed Rate

This simply refers to the rate, again in in/min or m/min, that the wire filler metal is feed into the weld.



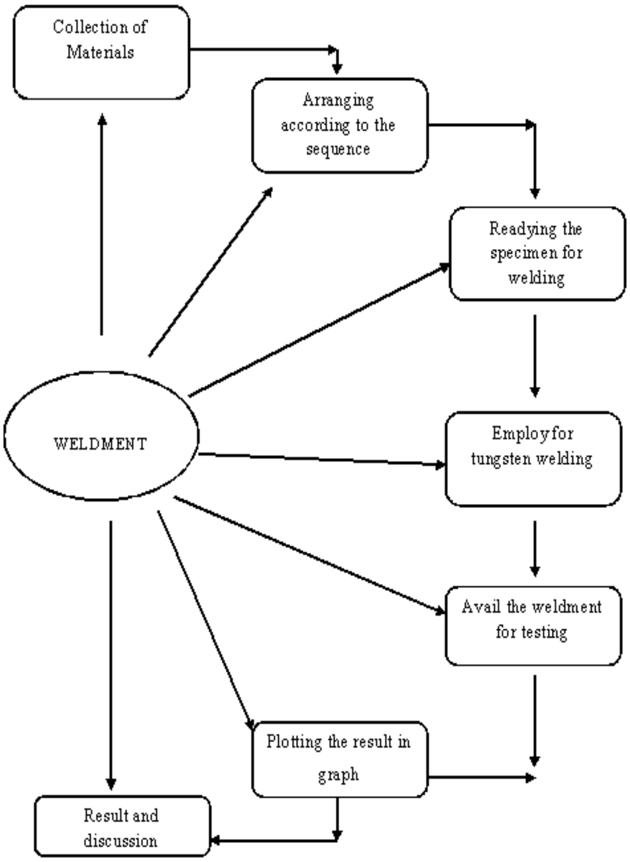
2. PROBLEM IDENTIFICATION

2.1 DEFECTS IN WELDEMENT WITH GTAW

Gas tungsten arc welding is a more abundantly used welding technique to join the metals, since in the [1] viewed journal paper noticed that the weldments were AL 5052 were made into two several thicknesses like 1mm and 2mm. they varying the pulsed and frequencies like 2Hz, 4Hz and 6Hz, after making the welding these material were employed like Liquid penetrate test and radiography test. From these testthe paper says that porosity were increased with increase in thickness, these defect may affect the entire strength of the metal.

Here a new approach of technique Gas Metal Arc Welding (GMAW) and same test were done to these materials at variable in thickness 2mm by varying the frequency in 2Hz, 4Hz and6Hz. From these experiments we are going to show that aluminium is a good suited metal for replacing the Gas Metal Arc Welding (GMAW).

3.EXPERIMENTAL PROCEDURE



4. GMAW welding

The chemical composition and mechanical properties of work material and filler wire as shown in. The aluminium alloy work pieces were chemically cleaned in hot Sodium Hydroxide for 10 minutes followed by dipping in Nitric Acid solution for about 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 suited for AC wherein they keep hemispherical shape and thoriated tungsten electrodes (EWTh-2) should be ground to taper are suitable for DCSP welding are used for this purpose.

Lincoln Electrical square power MIG 256 XT GMAW machine

5.Testing process

This welding process was conducted with 3.0 mm diameter 2% Blue Demon - E4043 electrode for 5052 aluminium The welding parameters used for this welding process both in pulsed current and non-pulsed current for two different

thicknesses of the above material are given in. The edge preparation of the tested 5052 aluminium alloy specimens are shown in after welding process is over, the radiography, liquid penetrant test were carried out on the weldments, according to the ASTM standards, Parameters used for pulsed GTAW: peak current.

Demon - E4043 electrode

A Mastertig AC/DC MIG 256 XT GMAW machine with AC & DCSP was used for welding of 5052 aluminium alloy and AL5052

Chemical Compositions of work material 5052 Aluminum alloy

Material	**Chemical Composition % wt**								
	Si	Fe	Cu	Mn	Mg	Zn	Ti	Cr	Al
5086 Aluminium Alloy	0.19	0.28	0.01	0.026	2.75	0.02	0.02	0.18	balance

Mechanical properties of 5052 Aluminium alloy

Material	UTS(MPa)	0.2% Y.S(MPa)	% Elongation
5086 Aluminium Alloy	260	170	11

Chemical Compositions of filler wire

Material	**Chemical Composition % wt**							
	Cu	Si	Mn	Mg	Fe	Cr	Ti	Al
ER4043	0.17	4.5-6.0	0.24	0.05	0.05	0.05	0.05	Balance

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

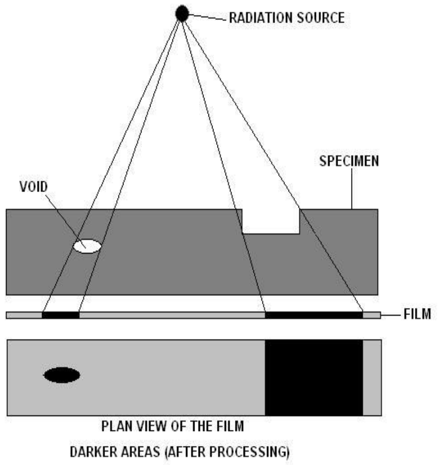
Material Thickness (mm)	Weld Layer	Filler Wire dia (mm)	Current	I (amp)	V (volts)	ARC Travel Speed (cm/mi)
1	ROOT	2.1	AC	89	16	6
2	ROOT	2.9	AC	123	20	5

Welding parameters for pulsed current welding of 5086Aluminium alloy

Material Thickness, (mm)	Weld Layer	Filler Wire dia(mm)	Pulse /Sec (Hz)	Current	I_p (amp)	I_b (amp)	V (volts)	ARC Travel Speed (cm/min)
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

Radiography Test

Radiography is used in a very wide range of applications including medicine engineering forensics, security, etc. In NDT, radiography is the one of the most important and widely used methods, however, one of its major advantages is the health risk associated with the radiation. In general, RT is



method of inspecting materials for hidden flaws by using the ability of short wavelength electromagnetic radiation (High energy photons) to penetrate various materials the intensity of the radiation that penetrates and passes through the materials is the either captured by a radiation sensitive films (Film radiography) or by a planner array of radiation sensitive sensor (Real time radiography) Film radiography is the oldest approach, it still the most widely used in NDT.

In radiographic testing, the part to be inspected is placed between the radiation source and a piece of radiation sensitive film. The radiation source can either be an x-ray machine or a radio activity sources (Ir-192, co-60, or in rare cases Cs-137). The part will stop some of the radiation where thicker and denser areas will stop more of the radiation. The radiation that passes through the part will expose the film and forms a shadow graph of the part. The film darkness (Density) will vary with the amount of radiation reaching the film through the test object were darker areas indicate more exposure (Higher radiation intensity) and lighter areas indicate less exposure (lower radiation intensity). This variation in the image darkness can be used to determine thickness or composition of material and would also reveal the presence of any flaws or discontinuities inside the material.

7.LIQUID PENETRATE TEST

7.1. Pre-cleaning:

The test surface is cleaned to remove any dirt, paint, oil, grease or any loose scale that could either keep penetrant out of a defect, or cause irrelevant or false indications. Cleaning methods may include solvents, alkaline cleaning steps, vapour degreasing, or media blasting. The end goal of this step is a clean surface where any defects present are open to the surface, dry, and free of contamination. Note that if media blasting is used, it may "work over" small discontinuities in the part and an etching bath are recommended as a post-blasting treatment.

7.2.Application of Penetrant:

The penetrant is then applied to the surface of the item being tested. The penetrant is allowed "dwell time" to soak into any flaws (generally 5 to 30 minutes). The dwell time mainly depends upon the penetrant being used, material being tested and the size of flaws sought. As expected, smaller flaws require a longer penetration time. Due to their incompatible nature one must be careful not to apply solvent-based penetrant to a surface which is to be inspected with a water-washable penetrant.

7.3.Excess Penetrant Removal:

The excess penetrant is then removed from the surface. The removal method is controlled by the type of penetrant which used. Then they Water-washable, solvent-removable, lipophilic post emulsifiable, or hydrophilic post-emulsifiable are the common choices. Emulsifiers represent the highest sensitivity level, and chemically interact with the oily penetrant to make it removable with a water spray. When using solvent remover and lint-free cloth it is important to not spray the solvent on the test surface directly, because this can remove the penetrant from the flaws. If excess penetrant is not properly removed, once the developer is applied, it may leave a background in the developed area that can mask indications or defects. In addition, this may also produce false indications severely hindering your ability to do a proper inspection.

7.4.Application of Development:

After excess penetrant has been removed a white developer is applied to the sample. Several developer types are available, including: non-aqueous wet developer, dry powder, water suspend able, and water soluble. Choice of developer is governed by penetrant compatibility (one can't use water-soluble or suspend able developer with water-washable penetrant), and by inspection conditions. When using non-aqueous wet developer (NAWD) or dry powder, the sample must be dried prior to application, while soluble and suspend able developers are applied with the part still wet from the previous step. NAWD is commercially available in aerosol spray cans, and also in may employ acetone, isopropyl alcohol, or a propellant that is a combination of the two. Developer should form a semi-transparent; even coating on the surface. The developer draws penetrant from defects out onto the surface to form a visible indication, commonly known as bleed-out. Anyareas that bleed-out can indicate the location, orientation and possible types of defects on the surface. Interpreting the results and characterizing defects from the indications found may require some training and/or experience [the indication size is not the actual size of the defect]

7.5. Inspection:

The inspector will use visible light with adequate intensity (100 foot-candles or 1100 lux is typical) for visible dye penetrant. Ultraviolet (UV-A) radiation of adequate intensity (1,000 micro-watts per centimetre squared is common), along with low ambient light levels (less than 2 foot-candles) for fluorescent penetrant examinations. Inspection of the test surface should take place after 10 to 30 minute development time, depends of product kind. This time delay allows the blotting action to occur. The inspector may observe the sample for indication formation when using visible dye.

7.6. Post Cleaning:

The test surface is often cleaned after inspection and recording of defects, especially if post-inspection coating processes are scheduled.

1. Section of material with a surface-breaking crack that is not visible to the naked eye. 2. Penetrant is applied to the surface. 3. Excess penetrant is removed. 4. Developer is applied, rendering the crack visible.

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