Quest Journals
Journal of Research in Mechanical Engineering
Volume 7 ~ Issue 3 (2021) pp: 11-16
ISSN(Online) : 2321-8185
www.questjournals.org

Research Paper

Analysis of Welding Characteristics in Aa 5052 Using Gas Tungsten Arc Welding

Arunkumar K[1], Dhayanithi G[2],

[1]*ME Manufacturing Engineering Student, Department of Mechanical Engineering, Erode Sengunthar Engineering College, Erode-638057*

[2]*Assitant Professor,Department of Mechanical Engineering, Erode Sengunthar Engineering College, Erode-638057, Tamil Nadu, India*

ABSTRACT– *In this experimental work, aluminium alloy (5052) weldments were made using Gas Tungsten Arc Welding with pulsed current at different frequencies 2Hz,4Hz,6Hz. The selected material as Aluminium plate and electrode is taken into chemical analysis test for checking proper composition of materials. With the successful results it is subjected to made weldment with chosen parameters. Non-destructive tests like radiography, liquid penetrate test were conducted, evaluated and compared with pulsed welding at different frequencies of two different thick materials (2mm and 3mm of 5052 aluminium alloy).The aim of this experimental work is to see the effect of pulsed current on the quality of weldment. The experimental results pertaining to different welding parameters for the above material using pulsed and non-pulsed current GTAW are discussed and compared.*

KEYWORD: *Gas Tungsten Arc Welding, Non-destructive test, Radiography,Pulsed current,Aluminium alloys.*

Received 29 Mar, 2021; Revised: 10 Apr, 2021; Accepted 12 Apr, 2021 © The author(s) 2021.
Published with open access at www.questjournals.org

I. INTRODUCTION

The Gas Tungsten Arc Welding – commonly referred to as Tungsten Inert Gas (TIG) – process uses the heat generated by an electric arc struck between a non-consumable tungsten electrode and the work piece to fuse metal in the joint area and produce a molten weld pool. The arc area is shrouded in an inert or reducing gas shield to protect the weld pool and the non-consumable electrode. The process may be operated autogenously (without filler), or filler may be added by feeding a consumable wire or rod into the established weld pool.The TIG process is capable of producing very high quality welds in a wide range of materials and in thicknesses up to about 8 or 10 mm. It is particularly suited to welding of sheet material and for putting in the root run of pipe butt welds. The process tends to be very clean, producing little particulate fume, although it is capable of generating ozone in appreciable amounts and is not regarded as a high-productivity process. Direct or alternating current power sources with constant current output characteristics are normally employed to supply the welding current. For DC operation, the tungsten may be connected to either output terminal, but is most often connected to the negative pole. The output characteristics of the power source can have an effect on the quality of the welds produced. Shielding gas is directed into the arc area by the welding torch, and a gas lens within the torch distributes the shielding gas evenly over the weld area. In the torch, the welding current is transferred to the tungsten electrode from the copper conductor. The arc is then initiated by one of several methods between the tungsten and the work piece.

II. PROBLEM IDENTIFICATION

Gas tungsten arc welding is a more abundantly used welding technique to join the metals, it is noticed that the weldments were EN19 were made into two several thicknesses like 2mm and 3mm. they varying the pulsed frequencies like 2Hz, 4Hz and 6Hz, after making the welding these material were employed like Liquid penetrate test and radiography test. From these test the paper says that porosity were increased with increase in thickness, these defect may affect the entire strength of the metal.

Here a new approach and Aluminium alloy material is replaced instead of using EN19, and same test were done to these material at variable in thickness like 2mm and 3mm by varying the frequency in 2Hz, 4Hz and 8Hz. from these experiment we are going to show that 5052 aluminum alloy is a good suited metal for replacing the EN19 materials were used applications.

III. MATERIALS AND METHODS

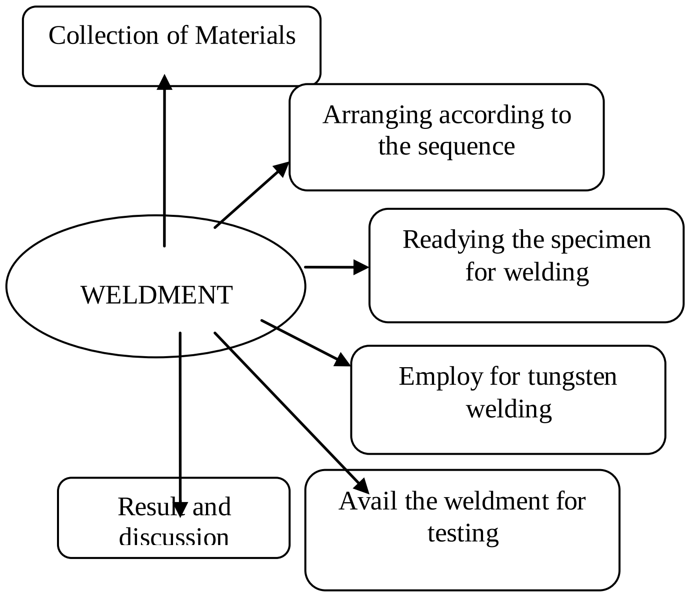
The Experimental material is selected as 5052 Al-alloy of 100mmlong x 50mmwide x 2 mm thickness, which is welded by TIG welding after surface preparation. The chemical composition of Aluminium alloy 5052 contains 2.5% magnesium & 0.25% chromium.
It has good workability, medium static strength, high fatigue strength, good weldability, and very good corrosion resistance,

Table 1 Chemical Compositions of work material 5052 Aluminum alloy

Material	Chemical Composition % wt								
	Si	Fe	Cu	Mn	Mg	Zn	Ti	Cr	Al
5052 Aluminium Alloy	0.7 - 1.3	0.5	0.1	0.4-1.0	0.6-1.2	0.2	0.1	0.25	balance

especially in marine atmospheres. It also has the low density and excellent thermal conductivity common to all aluminium alloys. It is commonly used in sheet, plate and tube form.

IV. METHODOLOGY



V. EXPERIMENTAL DETAILS

The work pieces were made of 5052 aluminium alloy of various thicknesses i.e. 2mm and 3mm. The test specimens were machined to the size of 150 mm X 300 mm and welded with pulsed and non-pulsed current GTAW process. Filler wire material of ER4043 was used during the welding, which reduced the weld cracks and produced the good strength and ductility than other filler metals. These filler metals melt at a temperature lower than that of the base metal, for this reason it yields during cooling, since it remains more plastic than the base metal and relieves the contraction stresses that Parameters used for pulsed GTAW:

Peak current IP, base current IB, peak time TP and base time TB. This welding process was conducted with 3.0 mm diameter 2% Zirconated tungsten 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.

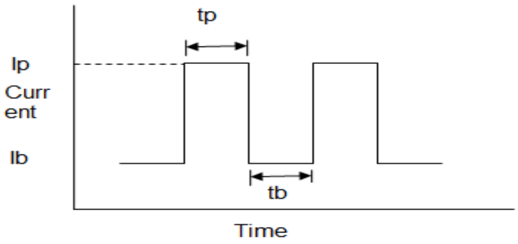


Figure 1 Might cause cracking

Figure 2 Lincoln Electrical square wave TIG 355 GTAW machine

VI. RESULTS AND DISCUSSIONS

1. CHEMICAL ANALYSIS TEST

Accurate analysis of the chemical composition of a material will provide in valuable information ,assisting chemical problem solving ,supporting R&D and ensuring the quality of a chemical formulation of product.A chemical compostion analysis can require the application of a combination of analytical methods in order to achieve a full picture of chemical structure and concentrations of the components in a sample. A test can be considered an observation or experiment that determine one or more characteristics of a given sample product. The purpose of testing involves a prior determination of expected observation and comparision of that expectation to what one actually observes.

The Merits arelisted below:-

❖Both surface and internal discontinuities can be detected.
❖Significant variations in composition can be detected.
❖It has a very few material limitations.
❖Can be used for inspecting hidden areas (direct access to surface is not required)
❖Very minimal or no part preparation is required.
❖Permanent test record is obtained.
❖Good portability especially for gamma-ray sources`

1.Chemical Analysis:

Elements	Symbol	Unit	Specified Values	Observed Values
Silicon	Si	%	0.40 - 0.80	0.616
Iron	Fe	%	0.70 max	0.175
Copper	Cu	%	0.15 - 0.40	0.219
Manganese	Mn	%	0.15 max	0.053
Magnesium	Mg	%	0.8 - 1.2	0.978
Chromium	Cr	%	0.04 - 0.35	0.098
Zinc	Zn	%	0.25 max	0.002
Titanium	Ti	%	0.15 max	0.021
Aluminum	Al	%	Remainder	97.743

Remarks: The above chemical composition meets the requirements of ASTM B221, Grade 6061

Verified by

-- CONCLUDED --

For **MICROLAB**

S. Venkateshwaran
Authorized Signatory

NOTE : This report relates only to the particular sample submitted for test • Any correction in the report will invalidate this report • Samples will be destroyed after 15 days from date of completion of tests unless informed by the customer • Any complaints about this report should be communicated in writing with in 7 days form the date of

Fig 3 Chemical composition report of aluminium

2. MACRO EXAMINATION

Macro Examination, evaluates the quality and consistency of a test sample using only low or no magnification. Macro SS examination of metals can be used to assess quality through the evaluation of a sample's macro structural features, which may include grain flow, porosity and cracks. Before macroscopic examination begins, the test sample must be prepared to specification.

The macro etched sample examined visually and followed by stereo microscope under 10X magnification reveals, complete fusion between weld and base metal. Pin hole were observed at weldarea1C,,2A,2B,2C.The macro etched sample examined visually and followed by stereo microscope under 10X magnification reveals ,in complete root fusion between weld and base metal. Pinhole were observed at weld area 1A and 1B

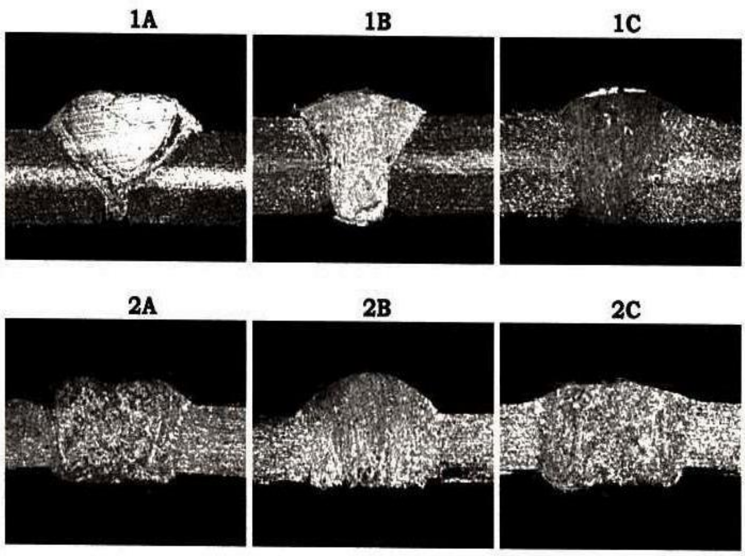
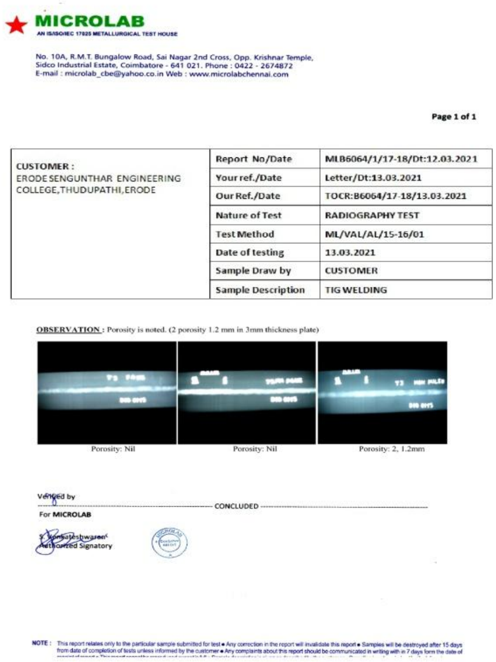


Fig 4 Test Report of Macro examination

3. RADIOGRAPHY TEST

This method of weld testing makes use of X-rays, produced by an X-ray tube, or gamma rays ,produced by a radioactive isotope. The basic principle of radiographic inspection of welds is the same as that formed ical radiography. Penetration gradiation is passed through a solid object, in this case a weld rather that part of the human body, on to a photographic film resulting in an image of the object's internal structure being deposited on the film. The amount of energy absorbed by the object depends on its thickness and density. Energy not absorbed by the object will cause exposure of the radiographic film. These areas will be dark when the film is developed. Areas of the film exposed to less energy remain lighter.



MICROLAB

AN IS/ISO/IEC 17025 METALLURGICAL TEST HOUSE

No. 10A, R.M.T. Bungalow Road, Sai Nagar 2nd Cross, Opp. Krishnar Temple,
Sidco Industrial Estate, Coimbatore - 641 021. Phone : 0422 - 2674872
E-mail : microlab_cbe@yahoo.co.in Web : www.microlabchennai.com

Page 1 of 1

CUSTOMER : ERODE SENGUNTHAR ENGINEERING COLLEGE,THUDUPATHI,ERODE	Report No/Date	MLB6064/1/17-18/Dt:12.03.2021
	Your ref./Date	Letter/Dt:13.03.2021
	Our Ref./Date	TOCR:B6064/17-18/13.03.2021
	Nature of Test	RADIOGRAPHY TEST
	Test Method	ML/VAL/AL/15-16/01
	Date of testing	13.03.2021
	Sample Draw by	CUSTOMER
	Sample Description	TIG WELDING

OBSERVATION : Porosity is noted. (2 porosity 1.2 mm in 3mm thickness plate)

Porosity: Nil Porosity: Nil Porosity: 2, 1.2mm

Verified by

---------- CONCLUDED ----------

For MICROLAB

Authorized Signatory

NOTE : This report relates only to the particular sample submitted for test ● Any correction in the report will invalidate this report ● Samples will be destroyed after 15 days from date of completion of tests unless informed by the customer ● Any complaints about this report should be communicated in writing with in 7 days form the date of

VII. CONCLUSION

Aluminum alloy weld ability characteristics vary widely from alloy to alloy framework. The most important factor regulating the weld ability of aluminum alloys is hot cracking or solidification cracking propensity. Sadly almost all heat treatable alloys are vulnerable to hot cracking. The susceptibility to solidification cracking is greatly influenced by weld metal composition, and therefore the correct choice of filler material is an important aspect in regulating cracking solidification. . For produce the joints the pulsed current TIG welding system was used. Argon (pure at 99.99 per cent) was used as shielding gas. This investigation was conducted to determine the influences of pulsed current parameters and optimize the parameters to achieve better mechanical and metallurgical properties of TIG welded aluminum alloy Al 5052.

Findings from this inquiry were collected as follows:

A. Current pulsing results in a comparatively finer and more optimized grain structure in TIG welds

B. A method has been suggested to improve the pulsed current TIG welding parameters to achieve maximum grain precision in the fusion zone

C. In general, peak current and pulse frequency are directly proportional to the welded joints, i.e. if the peak current is raised, then the frequency is directly proportional to the welded joints.

D. Evaluation of the variance approach is more suitable to find out the main and interaction factors of the current pulsed TIG welding process.

Analysis of the variance approach is more suitable to find out the major and interaction factors of the current pulsed TIG welding process.

REFERENCE

[1]. Ario Sunar Baskoro1 & Mohammad Azwar Amat1[2019] "Effects of tungsten inert gas (TIG) welding parameters on macrostructure, microstructure, and mechanical properties of AA6063-T5 using the controlled intermittent wire feeding method" The International Journal of Advanced Manufacturing Technology" Volume 105, pages2237-2251.

[2]. Zi Qi Guan, Hong Xu Zhang[2019] "Effect of magnetic field frequency on the shape of GMAW welding arc and weld microstructure properties", Materials Research Express, Volume 6, Number 8.

[3]. Huan He, Chuansong Wu[2019] " Pulsed TIG Welding–Brazing of Aluminum–Stainless Steel with an Al-Cu Twin Hot Wire ",Journal of Materials Engineering and Performance, volume 28, pages1180–1189.

[4]. Yipeng Wang[a] Baoqiang Cong [ab], "Process characteristics and properties of AA2219 aluminum alloy welded by double pulsed VPTIG welding", journal of Materials Processing Technology, Volume 266, April 2019, Pages 255-263.

[5]. Zheng Ye, Jihua Huang "Join Al–steel dissimilar metal by novel high frequency electric cooperated arc welding" jun2019, Pages 721-723.

[6]. A.Raveendra1, Dr.B.V.R.Ravi Kumar2 [June 2013] " Experimental study on Pulsed and Non-Pulsed Current TIG Welding of Stainless Steel sheet(SS304)", International Journal of Innovative Research in Science, Engineering and Technology, Vol. 2, Issue 6.

[7]. D. W. Becker and c. M. Adams [March 2014] "The effect of gas tungsten arc welding and pulsed-gas tungsten arc welding processes", materials and design 55:335-342.

[8]. T.E.Abioye[ab] N.Mustar[a] H.Zuhailawati[a] I.Suhaina[a] [2019] "Parametric Analysis of High Power Disk Laser Welding of 5052-H32 Aluminium Alloy" Volume 17, Part 3, 2019, Pages 599-608.

[9]. Vahid M.Khojastehnezhad Hamed H.Pourasl [2018] "Microstructural characterization and mechanical properties of aluminum 6061-T6 plates welded with copper insert plate (Al/Cu/Al) using friction stir welding" Volume 28, Issue 3, Pages 415-426.