iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 7 **Issue:** II **Month of publication:** February

DOI: http://doi.org/10.22214/ijraset.2019.2044

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 6.887
Volume 7 Issue II, Feb 2019- Available at www.ijraset.com

A Review Study of Dissimilar Metal Welds of Stainless Steel and Mild Steel by TIG Welding Process

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Abstract: ***Tungsten inert gas welding is the (TIG) is additionally called gas tungsten arc welding (GTAW). Tungsten Inert Gas Welding which is known as TIG welding is relatively high strength welding technique. is a kind of advance welding process which become a popular choice when a weld of high-level quality or considerable precision welding is needed ?***
The objective of study is to understand the various welding parameter like welding current, voltage, gas flow rate, inert gas, welding speed, electrode etc. In this work we discuss about the Tungsten Inert Gas Welding of joining heat treatable of stainless steel and mild steel. Output parameters such as hardness of welding, tensile strength of welding, DPT, spectrography by using optimization philosophy. The main effort is to investigate optimal machining parameters and their contribution on producing better best weld quality.

Keywords: TIG, stainless steel and mild steel, tensile properties , hardness, microstructure.

I. INTRODUCTION

Welding is a joining of two or more parts by the application of heat and pressure, such joints are permanent in nature. In which process coalescence of materials is produced by heating them to recrystallization temperature with or with or without use of pressure and with or without the use of filler material. Welding is used for permanent joints of metals. TIG welding is a part of welding process and it can be wildly used in modern industries for joining either similar or dissimilar materials**.** By the used of TIG welding process we can join easily join Stainless steel plate and mild steel plateare there are various engineering applications such as nuclear reactor , civil construction , thermal power plant , vessels and heat exchangers and it is also used for various industrial applications.

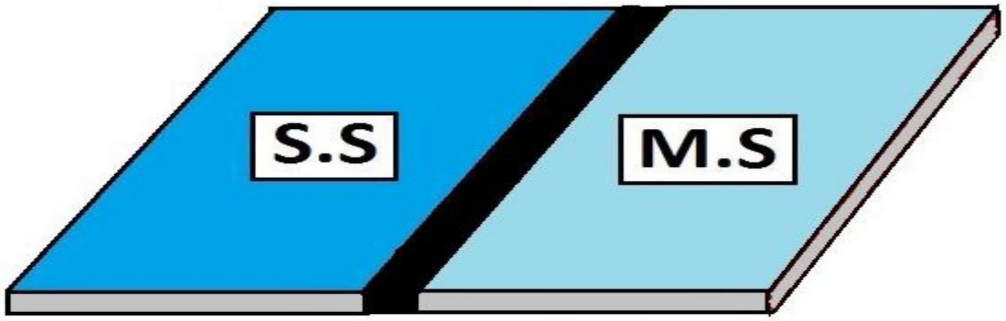

Fig. 1: Diagram of TIG welding plate

The materials used for dissimilar welding were SS-316 and MS-E350BR, nominally 8 mm in thickness. The chemical compositions of SS-316 and MS-E350BR alloy are shown in Tables 1 and 2, respectively.

%	C	Mn	Si	p	S	Cr	Mo	Ni	N
316	0.08	2.0	0.75	0.045	0.03	18.0	3.00	14.0	0.10

Table 1. Chemical compositions of SS-316

%	C	Mn	S	P	Si	Nb+V+Ti	N	C.E.Value
E350BR	0.20	1.50	0.045	0.045	0.45	0.25	-	0.42

Table 2. Chemical compositions of E350BR

The various propertie of stainless steel (SS316) and mild steel (E350BR) [6] are as follows:

Property	Minimum value (S.I)	Maximum value (S.I)	Units (S.I)	Minimum value (Imp.)	Maximum value (Imp.)	Units (Imp.)
Atomic volume	0.0069	0.0072	m^3/kmol	421.0977	439.7650	in^3/kmol
Density	7.87	8.07	g/cc	491.308	503.689	In/in^3
Compressive strength	170	310	Mpa	25.6574	44.9676	ksi
Tensile strength	480	620	Mpa	69.6158	89.9876	ksi
Elastic limit	170	310	Mpa	25.6574	44.9676	ksi
Melting point	1648	1673	K	2506.73	2551.76	°F
Specific heat	490	530	J/kg.K	0.379191	0.410145	BTU.ft/h.ft^2.F

Table no. 3. Propertis of SS315

Property	Minimum value	Maximum value	Units	Maximum value	Minimum value	Units
Density	7.87	8.086	g/cc	491.308	503.986	In/in^3
Tensile strength , ultimate	440	456	Mpa	63800	63976	psi
Tensile strength , yield	379	389	Mpa	53700	53865	psi
Modulus of elasticity	205	210	Gpa	29700	29797	psi
Bulk modulus	140	150	Gpa	20300	20367	psi
Shear modulus	80	90	Gpa	11600	11797	psi
Poissons ratio	0.29	0.29		0.29	0.29	

Table No. 4. Properties of E350Br

II. WORKING PRINCIPLE OF TIG WELDING

The electrode in this process is non-consumable made from engineering material Tungsten. This process involves striking an arc between a nonconsumable tungsten electrode and the workpiece. The weld pool and the electrode are protected by an inert gas is passed around electrode from the same torch. Inert gas usually argon, helium, or a suitable mixture of these is used to prevent the atmospheric contamination by garneting envelop around weld pool, molten metal and HAZ.

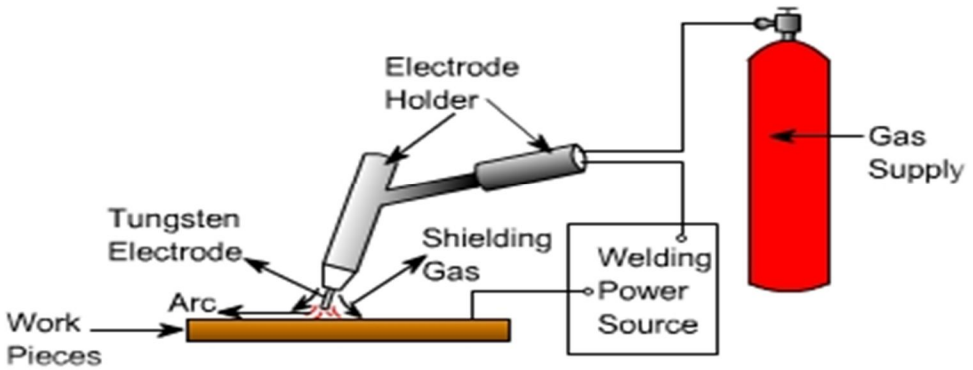

Figure: Schematic representation of TIG welding process

When the gar is supplied by the tank, then it gets ionized and an arc is generated in between electrode and work piece. There is a generation of heat that cause base metal weld with filler rod and filler metal fall on the heated joint. Positive polarity of DC source forming one of the workpieces. The electrodes connected to the negative polarity. The power source could be constant voltage AC or DC power source, with electrode negative and it yields a stable arc and smooth metal transfer with least spatter for the entire current range.

A. Equipment

The main equipments for TIG welding process are welding power source , high frequency unit and cables. For doing Tig welding process we also required welding torch , tungsten electrode and filler metals. To get best quality of welding we also required inner gas cylinder , pressure regulator and flow meter . Usually inert gas is used to prevent welded joints from atmosphere contamination and atmospheric gases also. Cooling water is also required for cooling the system and gas solenoid valve is also main equipment for TIG welding.

B. Applications

TIG welding can used for welding aluminum , magnesium , copper , nickel and their alloy , carbon , alloy and stainless steel. TIG welding is also used for welding sheet metal and thinner section . It is also used for transistor cases , instrument diaphrahms and can-sealing joints.

C. Advantages

No flux is used in TIG welding, that's way there is no danger of flux entrapment if we welding refrigerator and air conditioner system components. During TIG welding process there is clear visibility of arc and job , so operator can execute a better control on the welding and can easily get best quality of welding. BY the use of TIG welding we can weld in all position sound weld can produced with less spatter. TIG welding is also suitable for the high quality welding joints of thin metals.

III. TIG WELDING EFFECTING PARAMETERS

TIG gives high quality of weld and weld deposition rate both are influenced very much by the various welding parameters and joint geometry. Proper execution of process and control of different numbers of parameters is essential for successful and best output. Normally a welded joint is produced by different combinations of welding parameters and joint geometries. The weld bead geometry, penetration depth and total weld quality depends on the following operating variables.

A. Electrode size, Welding current.
B. Arc voltage. Arc travel speed.
C. Welding position. Filler material size.
D. Gas Flow rate, Shielding Gas composition.
E. Electrode extension.[4]

IV. LITERATURE REVIEW

B.Y. Kang et.al [1] study of the experimental investigations of weld characteristics for a single of shielding gases (Ar) and (Ar+67%He) of shielding gas in austenite stainless steel GTA Welding on the material of Stainless Steel 304 by used the specimen of 200L x 100w x 12 thick .and analysed. The effect of both shielding gas on same input parameter. after comparison study the conclude that Ae+67%He show same welding effect. cause cost cutting possible.

Dr. Simhachalam et al [2]. has performed a welding experiment on stainless steel -316 (18Cr-8N). The specimen size is 40X15X5mm for experiment and welding is perform by TIG welding. In that performance selecting input parameters such as welding current, voltage, speed and time against response of mechanical properties like tensile strength and hardness the required parameter is achieved by using MINITAB software and find that significant effect was occurred by varying current same effect found when filler rod change but current give more effect

Abhimanyu Chauhan [3] perform a tungsten inert gas welding on 5mm thick plate. Without using filler material. the welding performed by maintaining completely different gap between plates to be welded. The tensile strength and weld bead geometry of the weld has been investigated here. It is noted that, with maintaining a minimum gap full penetration welding of the plate can be done which gives strength which is almost similar to the base material and maximum depth of penetration was acquired with parametric combination of maximum current and minimum welding speed.

Indira Rani et. al [4] investigated the mechanical properties of the weldments of AA6351 during the GTAW /TIG welding with non-pulsed and pulsed current at different frequencies. Welding was performed with current 70-74 A, arc travel speed 700-760 mm/min, and pulse frequency 3 and 7 Hz. From the experimental results it was concluded that the tensile strength and yield strength of the weldments is closer to base metal. Failure location of weldments occurred at HAZ and from this we said that weldments have better weld joint strength Brijesh K. Mauryal et.al [5] Experimentak analysis of dissimilar metal welds of mild steel and stainless steel by Brijesh Kumar Maurya1, Balwant Pratap2, Avaneesh Kumar3, Gopal Rana41 2 3 4 Students.
In this paper they cleared that ultimate tensile strength is always same for 12 and 18 PSI gas pressure.This suggest that if increasing the gas pressure than required value the the strength of weld joint decreases and strength for weld joint is best for average gas pressure.

V. PERFORMANCE METHODOLOGY

In given experiment we are perform a TIG welding by wearying parameter voltage, current and gas flow rate. in that experiment argon is used as a shielding gas. For perform an experiment required TIG welding setup. first, we find influence welding parameter which is highly affected the welding properties then perform a combination of welding . And test is by various testing technique like 1) Spectrography, 2) Microstructure, 3) Ultrasonic test, 4) DPT Dye Penetration Test 5) Hardness, 6) Tensile, 7) Bending. 8) X-ray Test (Radiography Test). All processes are being carried out as per ASME standards. Then find an optimum input parameter for tensile strength and percentage of elongations. After finding optimum parameter change shielding gas with Ar+67%He and perform a welding process. Then test it and find that it is suitable for our application or not .and which kind of change occurred in microstructure find it by comparing them.

VI. CONCLUSIONS

This paper gives the idea of the working of the TIG welding and from above Literature reviews it is clear that various work has been done on TIG welding. To study and optimized the welding output such as tensile strength, hardness of weld joints etc. on varying the input parameters such as welding current, voltage, gas flow rate , welding speed etc. and also some work on TIG welding with summing gases has been carried out on various material similar as well as dissimilar materials.

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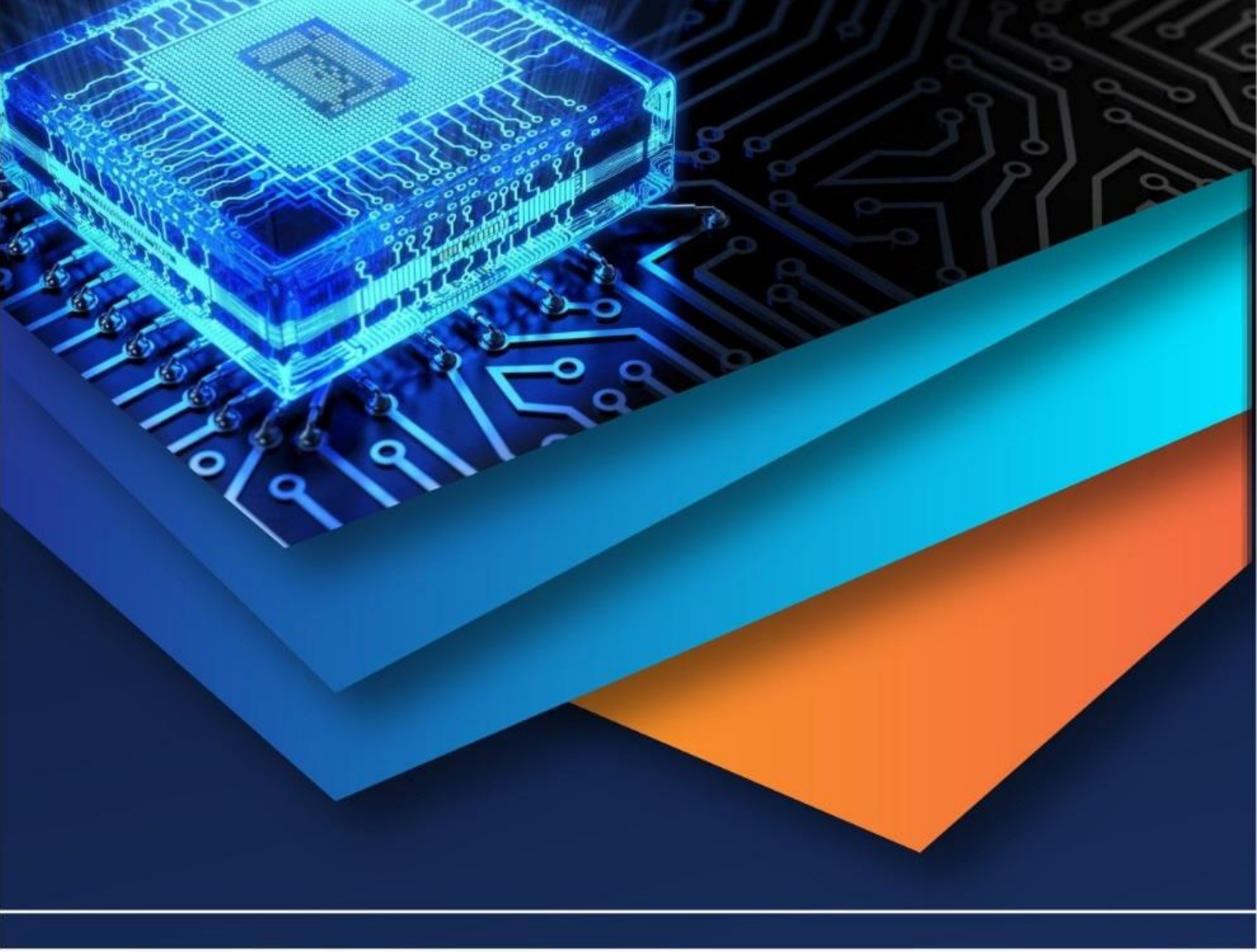
[6] https://www.azom.com/properties?ArticleID=863



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