Experimental Investigation of Tig Welding In Steel 304a with Two Different Trails

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Abstract- *With the advantage of lower fumes formation during the process, tungsten inert gas (TIG) welding is a suitable technique for joining the metals. In this research finding 304A stainless steel is used as a material for experimental work. It has an ability good ductile and corrosion property in nature with nickel inclusion. In case of tungsten inert gas welding, there is a great chance for influence for different parameters in achieving the mechanical strength property. The quality of the weld largely depends on the mechanical properties of the welded specimens. For this work the input process parameters considered are voltage, welding current, gas flow rate and speed. The prediction of output parameters Vickers hardness and Tensile strength was carried out through Universal testing machine.*

Keywords- Tungsten Inert Gas, Ductile and Corrosion, Welded Specimens, Universal Testing Machine

I. INTRODUCTION

Welding is the process of fusing two materials together using extreme heat, pressure and (or) fillers. Welding processes have developed to fit every industrial need imaginable. The two types of welding most prevalently in use are Arc welding Gas Arc welding.

1.2 TYPES OF WELDING

1. Arc welding
2. Gas welding
   i. Mig welding
   ii. Tig welding

1.3 ARC WELDING

Arc welding is a process utilizing the concentrated heat of an electric arc to join metal by fusion of the parent metal and the addition of metal to joint provided by a consumable electrode. Either direct or alternating current may be used for the arc, depending upon the material to be welded and the electrode used. A welding power supply is used to create and maintain an electric arc between an electrode and the base materials to melt metals at the welding point. In such as welding processes the power supply could be AC or DC, the electrode could be consumable or non-consumable and a filler materials may or may not be added. The most common types of arc welding are:

- Shielding Metal Arc Welding (SMAW)
- Gas metal Arc Welding (GMAW)
- Gas Tungsten Arc Welding (GTAW)

1.4 GAS WELDING

In this method a focused high temperature flame generated by gas combustion is used to melt the work pieces (and filler) together. The most common type of gas welding this Oxy-fuel welding where acetylene is combustion in oxygen. Oxy-fuel is one of the oldest welding processes, besides forge welding. Still used in industry, in recent decades it has been less widely utilized in industrial application as other specifically devised technology have been adopted. It is still widely used for welding pipes and tubes, as well as repair work. It is also frequently well suited, and for fabricating some types of metals based artwork. As well, oxy-fuel has an advantage over electric welding and cutting processes in situation where accessing electricity would present difficulties, it is more self -contained, in this sense “more portable”.

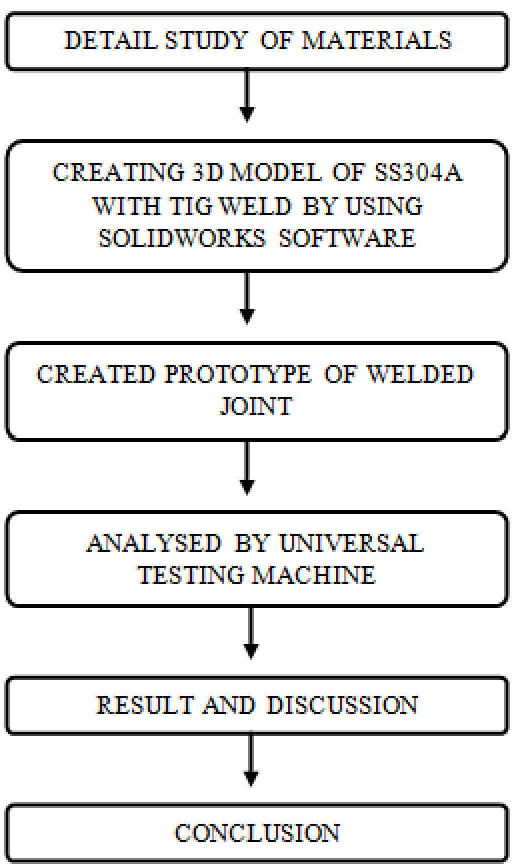
1.5 OBJECTIVES:

- In this work, of first a detailed study of TIG Welding and process parameters are made.
- Then problems in welding of Austenitic stainless steel with ferritic stainless stool using conventional Welding process are analyzed.
- In the next phase design of Experiment are done by conducting several Welding in the test specimens and the effect of each parameters and depth of penetration is analyzed.

II. LITERATURE REVIEW

IzzatulAini Ibrahim1et.al were analyzed GMAW process is leading in the development in arc welding process which is higher productivity and good in quality. They were studied, the effects of different parameters on welding penetration, micro structural and hardness measurement in mild steel that having the 6mm thickness of base metal by using the robotic gas metal arc welding are investigated. The variables that choose in this study are arc voltage, welding current and welding speed. The arc voltage and welding current were chosen as 22, 26 and 30 V and 90, 150 and 210 A respectively. The welding speed was chosen as 20, 40 and 60 cm/min. The penetration, microstructure and hardness were measured for each specimen after the welding process and the effect of it was studied. As a result, it obvious that increasing the parameters value of welding current increased the value of depth of penetration. Other than that, arc voltage and welding speed is another factor that influenced the value of depth of penetration. The microstructure had shown the different grain boundaries of each parameter that affected of the welding parameters. **D.S. Yawas**et.al were investigated fatigue behaviour of welded austenitic stainless steel in 0.5 M hydrochloric acid and wet steam corrosive media has been investigated. The immersion time in the corrosive media was 30 days to simulate the effect on stainless steel structures/equipment in offshore and food processing applications and thereafter annealing heat treatment was carried out on the samples. The findings from the fatigue tests show that seawater specimens have a lower fatigue stress of 0.5 _ 10_5 N/mm2 for the heat treated sample and 0.1 _ 10_5 N/mm2 for the unheat-treated sample compared to the corresponding hydrochloric acid and steam samples. The post-welding heat treatment was found to increase the mechanical properties of the austenitic stainless steel especially tensile strength but it reduces the transformation and thermal stresses of the samples. These findings were further corroborated by the micro structural examination of the stainless steel specimen. **M.N.Chougule et.al** were carried out Gas metal arc welding (GMAW) controls the metal from the wire rod by developing the arc as well as by controlling the input process parameters. High heating at a one location during welding and further rapid cooling generates residual stress and distortion in the weld and base metal. In the last few decades, various research efforts have been directed towards the control of welding process parameter aiming at reducing residual stress and distortion they are strongly affected by many parameters like structural, material and welding parameters. Such welding failure can be minimized by controlling the weld heat input. The distribution of the temperature in weld joint of AISI202 grade high strength steel is investigated by Finite Element Method (FEM) using ANSYS software and experiment has been performed to verify the developed thermo-mechanical finite element model using the GMAW process. Basic aim of our paper is to analyse temperature distribution and residual stresses in dissimilar metal welded plates to avoid future failure in material because experimental process is costly. The behavior of weld zone is affected by variation in temperature distribution, microstructure and mechanical properties of the material. The residual stress gradient near the fusion zone is higher than in any other location in the surrounding area. Because of this stress gradient, cold crack at the fusion zone in high strength steel occur. The main objective of this simulation is the determination of temperatures and stresses during and after the process. Temperature distributions define the heat affected zone (HAZ) where material properties are affected. Stress calculation is necessary because high residual stresses may be caused fractures, fatigue which causes unpredictable failures in regions near the weld bead region. **LI YAJIANG** et.al were experimentally analyzed distribution of the residual stress in the weld joint of HQ130 grade high strength steel was investigated by means of finite element method (FEM) using ANSYS software. Welding was carried out using gas shielded arc welding with a heat input of 16 kJ/cm. The FEM analysis on the weld joint reveals that there is a stress gradient around the fusion zone of weld joint. The instantaneous residual stress on the weld surface goes up to 800 ~ 1000 MPa and it is 500 ~ 600 MPa, below the weld. The stress gradient near the fusion zone is higher than any other location in the surrounding area. This is attributed as one of the significant reasons for the development of cold cracks at the fusion zone in the high strength steel. In order to avoid such welding cracks, the thermal stress in the weld joint has to be minimized by controlling the weld heat input. **Q.Wang** et.al were carried out influences of parameters of tungsten inert gas arc welding on the morphology, microstructure, tensile property and fracture of welded joints of Ni-base super alloy have been studied. Results show that the increase of welding current and the decrease of welding speed bring about the large amount of heat input in the welding pool and the enlargement of width and deepness of the welding pool. The increase of impulse frequency has the same effect on the microstructure compared with the increase of welding current. The effect of welding parameters on the tensile strength and fracture was analyzed. It is found that the root of welding joint is unwelded when the welding current is lower, so that the strength and elongation of welded joint are inferior. And the more welding defects in the welding zone and the more hard and brittle phase precipitates in the overheated zone when the welding current is too high. Consequently, the strength and plasticity go up first and then go down, i.e. they have a peak value with welding current increasing. In addition, the decrease of impulse frequency is beneficial to the strength of the welded joint. **G. Magudeeswaran** were studied activated TIG (ATIG) welding process mainly focuses on increasing the depth of penetration and the reduction in the width of weld bead has not been paid much attention. The shape of a weld in terms of its width-to-depth ratio known as aspect ratio has a marked influence on its solidification cracking tendency. The major influencing ATIG welding parameters, such as electrode gap, travel speed, current and voltage, that aid in controlling the aspect ratio of DSS joints, must be optimized to obtain desirable aspect ratio for DSS joints. Hence in this study, the above parameters of ATIG welding for aspect ratio of ASTM/UNS S32205 DSS welds are optimized by using Taguchi orthogonal array (OA) experimental design and other statistical tools such as Analysis of Variance (ANOVA) and Pooled ANOVA techniques. The optimum process parameters are found to be 1 mm electrode gap, 130 mm/min travel speed, 140 A current and 12 V voltage. The aspect ratio and the ferrite content for the DSS joints fabricated using the optimized ATIG parameters are found to be well within the acceptable range and there is no macroscopically evident solidification cracking.

III. WORKING METHODOLOGY



CRACKS:

Cracks are the linear ruptures of the metal under stress. Sometimes they appear large and frequently they are narrow separations. The major classification of cracks is:

1. Hot cracking
2. Cold cracking
3. Reheat cracking
4. Base metal cracking
5. Crater cracking.

REASON FOR CRACKING

1. Base metal composition
2. Welding process characteristics
3. Defective welding filler materials
4. Welding environment
5. Joint design
6. Cracking may occur in:

i) Weld metal
ii) Heat affected zone

IV. MATERIAL SELECTION

Stainless Steels are iron-base alloys that contain a minimum of about 12% Cr, the amount needed to prevent the formation of rust in unpolluted atmospheres (hence the designation stainless). Few stainless steels contain more than 30% Cr or less than 50% iron. They achieve their stainless characteristics through the formation of an invisible and adherent chromium-rich oxide film.

This oxide forms and heals itself in the presence of oxygen. Other elements added to improve particular characteristics include nickel, manganese, molybdenum, copper, titanium, silicon, niobium, aluminum, sulfur, and selenium, Carbon is normally present in amounts ranging from less than 0.03% to over 1.0% in certain grades. Figure 4.1 provides a useful summary of some of the compositional and property linkages in the stainless steel family.

Properties of GFRP:

Young's modulus – 193 GPa
Density – 8.00 g/cm^3
Poisson's ratio –0.265

V. EVALUATION

These steels can be welded by all of the common welding processes that are by covered electrode, inert gas metal are, inert gas tungsten are, submerged are and resistance welding. The newer processes such as electron beam and laser welding have also been used to advantage. Type 308 filter metal should be used in joining Type 304 and Type 308L for joining Type 304L. The major purpose for using. Type 304L is to eliminate harmful carbide precipitation in the weld zone for material that is to be used under severely corrosive conditions.

CORROSION RESISTANCE:

At room temperatures, these steels are highly resistant to corrosion by strongly oxidizing acids, such as nitric. Resistance to more dilute acids varies; in most dilute acids if an oxidizing agent is present it generally prevents attack. The alloys are not recommended for handling hydrochloric acid, the other halogen acids. Or acid halide salts. Organic acids can generally be handled and the steels are resistant to the alkalies and to solutions of organic and in organic salt with expectations of the halides. These steels are highly resistant to corrosion in rural and industrial atmospheres; in marine atmospheres they may develop superficial staining unless they are kept clean.

General Characteristics:

AISI 304 and 304L are lower carbon modifications are Type 302. Type 304 has become the most widely used of the austenitic chromium-nickel stainless steels. It is nonmagnetic in the annealed condition but becomes slightly; magnetic when cold worked. This steel has excellent corrosion resistance to a wide variety of environments and good mechanical properties. It cannot be hardened by heat treatment by work hardens quite rapidly, developing high strength while retaining good ductility.

APPLICATION:

Used extensively in equipment for handling acetic, nitric, and citric acids, food and milk products, in valve trim, screws, bolts, for chemical and refinery equipment, hospital equipment, architectural molding and trim, kitchen equipment.

Welding properties of SS308:

The austenitic stainless steels are considered to be the most weld able of the stainless steels. They are routinely joined by all fusion and resistance welding processes. Tow important considerations for weld joints in these alloys are: (1) avoidance of solidification cracking, and (2) preservation of corrosion resistance of the weld and heat-affected zones.

Fully austenitic weld deposits are more susceptible to cracking during welding. For this reason Types 308 and 308L "matching" filler metals are formulated to solidify with a small amount of ferrite in the microstructure to minimize cracking susceptibility.

For weldments to be used in the as-welded condition in corrosive environments, it is advisable to utilize the low carbon Type 308 base metal and filler metals. The higher the carbon level of the material being welded, the greater the likelihood the welding thermal cycles will allow chromium carbide precipitation (sensitization), which could result in intergranular corrosion. The low carbon "L" grade is designed to minimize or avoid sensitization.

Typical uses include exhaust manifolds, furnace parts, heat exchangers, jet engine parts, pharmaceutical and photographic equipment, valve and pump trim, chemical equipment, digesters, tanks, evaporators, pulp, paper and textile processing equipment, parts exposed to marine atmospheres and tubing.

VI. CONCLUSION

There are 3Signal-to-Noise ratios of common interest for optimization of Static Problems. The formulae for signal to noise ratio are designed so that an experimenter can always select the largest factor level setting to optimize the quality characteristic of an experiment. Therefore a method of calculating the Signal-To-Noise ratio we had gone for quality characteristic. They are

- Smaller-The-Better,
- Larger-The-Better,
- Nominal is Best.

TRIAL NO.	AMPS	VOLT	BEVEL	GPR
1	140	18	55	4
2	140	18	65	6
3	140	22	55	6
4	140	22	65	4
5	180	18	55	6
6	180	18	65	4
7	180	22	55	4
8	180	22	65	6

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