A Literature Review on Gas Tungsten Arc Welding (GTAW)

Jancypunitha V[1], Dr.B.Ananadavel[2]
[1]*PG Student, Department of Metallurgical Engineering, Government college of Engineering,Salem,11*
[2]*Assistant professor, Department of Metallurgical Engineering, Government college of Engineering,Salem,11*

Abstract-Tungsten Inert Gas (TIG) welding or gas tungsten arc welding(GTAW) is an inert-gas shielded Arc welding process using non- consumable electrode.The electrodes may also contain 1 to 2%Thoria (thorium oxide) mixed along with the core tungsten or tungsten with 0.15 to 0.40%Zirconia (zirconium oxide) . It is used to weld ferrous and non-ferrous metals. This process imply several advantages like low heat effected zone, joining of unlike metals, absence of slag, high heat concentration etc compared to other welding process. The TIG welding parameters are the most important factors affecting the quality, productivity and cost of welding.TIG Welding performance is mostly evaluated based on Tensile Strength of the weld, Weld bead Geometry, Hardness, Depth of Penetration and Width–to-Depth ratio Also known as Aspect ratio. In the present study, we discuss the influence of the different welding parameters such as welding speed, power source, type of current, shielding gas flow rate, electrodes, filer wire, Electrode gap and types of shielding gases which fits best to determine arc stability, arc penetration and defect free welds. Various approaches are proposed in the literature to achieve the solution related with optimization of these parameters. This has been carried out by doing literature survey on the effective point of view which helps to compare their main features and to choose the most suitable approach for a specified application.

Keywords : Aspect Ratio, Non Consumable Tungsten Electrode, Optimization, Process Parameters, Shielding Gas, Tungsten Inert Gas, Weld Bead, Welding ,thorium oxide.

INTRODUCTION

Welding is a metallurgical fusion process where the interface of the two parts to be joined are brought to a temperature above the melting point and then allowed to solidify so that permanent joining takes place. Temperature of the Welding range is in between 1800ºF- 3600ºF.This has been carried out by melting the work pieces at the interface and a permanent joint can be achieved after solidification. Filler material is optionally added to generate weld pool of molten material which solidifies as time passes and gives a strong bond between the materials. Plenty of ways and sources are used in welding process like a gas flame, an electric arc, a laser, an electron beam, friction, and ultrasound. It can be done in many different environments, including open air, underwater and in space. Welding can be classified in Gas welding contains Oxyacetylene Gas welding, in Arc Welding contains SMAW, GMAW, GTAW, SAW and in Energy Beam Welding contains Laser Beam Welding, Electron Beam Welding etc. Welding technology is used in every stage of production and manufacturing. To generate high quality welds consistently, arc welding requires experienced welding personnel to avoid distortion.

TIG Welding

TIG welding process is an Arc welding process developed in late 1930s when a need to weld magnesium became necessity.TIG welding used when a good weld joint appearance, a high quality weld and stability in the wide range of welding applications are required. TIG welding is a process that melts and joins metals by heating them with an arc established between non-consumable tungsten electrodes and the work piece under a shielding gas.

WORKING PRINCIPLE AND MECHANISM OF TIG WELDING

In the Tungsten Inert Gas welding, an arc is maintained between work piece and a non-consumable tungsten electrode. This arc and the weld pool are protected from atmospheric contamination with a gaseous shield of inert-gas such as argon, helium or argon-helium mixture. The filler metal is optionally used depends upon welding requirement. This filler metal can be introduced manually or automatically independent of types of process. TIG welding process itself can be manual or automatic. The welding power source delivers direct current or A.C. depends upon the heat dissipation required. TIG welding gives better result in welding of difficult to weld materials TIG welding is used for huge family of material to achieve high quality welding with coalescence of heat generated by an electric arc established between a tungsten electrode & work piece. Helium and Argon gases and fall under the best suitability for the shielding as they are not chemically reactive. The aim of shielding gas are therefore, to protect the weld pool from surround air thus prevent oxidation, concentrate and transfers the heat during welding and helps to start and maintain a stable arc due to low ionization potential. This is an advantage because while this process is ongoing, the base metal faces change due to superheating of arc and fast cooling rate.

TYPES OF WELDING PARAMETERS

Voltage:

Voltage controls the length of welding arc and resulting width and volume of arc cone. As voltage increases arc length gets longer (and arc cone broader), while as it decreases, the arc length gets shorter (and arc cone narrower).A high initial voltage allows for easy arc initiation and allows for greater range of working tip distance. Depth of penetration decreases as voltage increases. In GTAW welding process filler feeding or Filler melt off rate should be kept constant since it is manual process. Voltage is a controlling variable in manual processes because in manual process it is very difficult to consistently maintain the same arc length. Hence GTAW is constant current (CC) output method.

Welding Current and Polarity:

The welding current corresponds to the amount of heat applied to the part to affect the weld, and it depends on the material to be welded, material thickness, welding speed, and shield gas. The objective is to achieve defect-free welds with the required penetration. Current has direct influence on weld bead shape, on welding speed and quality of the weld. Most GTAW welds employ direct current on electrode negative (DCEN) (straight polarity) because it produces higher weld penetration depth and higher travel speed than on electrode positive (DCEP) (reverse polarity). Besides, reverse polarity produces rapid heating and degradation of the electrode tip, because anode is more heated than cathode in gas tungsten electric arc.

Welding Speed

The effect of increasing the welding speed for the same current and voltage is to reduce the heat input. The weld speed increase produces a decrease in the weld cross section area, and consequently penetration depth (D) and weld width (W) also decrease.

Type of Shielding Gas and Its flow rate

The choice of proper shielding gas for TIG welding can significantly affect weld quality and welding speed. Argon, helium and argon-helium mixtures use most widely as they are not reactive on tungsten electrodes. They are not producing any adverse effect on the quality of the weld. Argon gas as a Shielding gas medium is more widely preferred as it provides a softer arc, which is smooth and stable it is being less expensive,. Argon is better for welding specially aluminium and magnesium alloy. Flow rate of shielding gas is also major parameter affect the weld quality and it is depending upon types of material and thickness of the same.

Arc Pulsing

Arc pulsing involves four welding parameters: peak current, background current, pulse width (duty cycle), and pulse frequency. Arc pulsing involves using the welding power supply to alternate the weld current rapidly from a high (peak current) to a low (background current) value. This creates a seam of overlap- ping spot welds. This technique reduces the overall heat input to the base material and also can allow for increases in weld speed. Arc pulsing brings many benefits to the welding procedure, often Pramana Research Journal Volume 8, Issue 9, 2018 ISSN NO: 2249-2976 182 https://pramanaresearch.org / improving weld quality and repeatability. In some cases, materials and weld joints with poor fit-up that are difficult to weld successfully with a nonplussed arc can be welded easily with a pulsed arc technique. The results are improved weld quality and increased output.

Arc Length

The arc length is the distance between the electrode tip and the work-piece. The arc length in GTAW is usually from 2 to 5 mm.[10]. If the arc length increases, the voltage to maintain the arc stability must increase, but the heat input to work-piece decreases due to radiation losses from the column of the arc. Consequently, weld penetration and cross section area of melted material decrease with increasing arc length.

ELECTRODES AND ITS TYPES

An electrode is a metal wire that is coated. It is made out of materials with a similar composition to the metal being welded.

Pure tungsten (EWP, colour- coded green), 99.50 percent tungsten. This electrode is good for AC welding with traditional transformer-rectifier power sources. It is favored for aluminum and magnesium because it holds a consistent ball on the end even with the heat of AC. It has a little less than half a percent of additional elements and compounds, which helps minimize weld contamination.

2 percent Thoriated (EWTh-2, color-coded red), 97.30 percent tungsten, 1.70 to 2.20 percent thorium. Thorium increases the current capacity of the electrode, making it easy to sharpen this electrode to a point to gain better arc starts and a more stable arc. It also reduces electrode consumption, meaning that there is less chance electrode material will contaminate the weld puddle. It is good for DC electrode-negative-polarity welding on carbon steel, stainless steel, nickel, and titanium.

2 percent Ceriated (EWCe-2, color-coded orange), 97.30 tungsten, 1.80 to 2.20 percent cerium. This type is favored for DCEN welding during which it maintains a sharp point. It also operates well for welding with an AC inverter machine and creates a small, concentric, stable ball at the end. It runs at 1.5 to 2 times the amperage of pure tungsten in AC.

1.5 percent Lanthanated (EWLa-1.5, color coded gold), 97.80 tungsten, 1.30 to 1.70 percent lanthanum. This type has many of the characteristics of ceriated electrodes, and it can carry much more current than a pure tungsten electrode of the same diameter. Good low-current DC arc starts make it suitable for thin material and delicate parts.

Zirconiated (EWZr-1, color-coded brown), 99.10 percent tungsten, 0.15 to 0.40 percent zirconium. This electrode has an extremely stable AC arc, holds a ball end well, and resists tungsten spitting (which contaminates the weld). Current-carrying capacity is at least as great as that of thoriated tungsten. It is not suitable for DC.

Rare earth (EWG, color-coded gray) contain additives of rare-earth oxides or combinations of oxides. The additives determine the characteristics, such as stable arc in AC and DC applications, longevity, or higher current-carrying capacity. It is ideal for machine torch applications.

SHIELDING GAS AND THEIR TYPES

The primary gases used for GTAW are argon, helium, hydrogen, and sometimes nitrogen. The composition and purity of the gas or gas mixture should be tailored to meet your process, material, and application requirements. Shielding gases are used in either pure form or in blends of varying components. Therefore, selecting a gas or gas mixture can become quite complex because of the many combinations available.

Argon. Slightly less than 1 percent of the earth's atmosphere is composed of argon, which is colourless, odourless, tasteless, and nontoxic. As an inert gas, argon does not react with other compounds or elements. It is about 1.4 times heavier than air and cannot sustain life. The inert properties of argon make it ideal as a shield against atmospheric contamination, which is why it is used in many welding processes. Argon promotes good arc-starting characteristics and arc stability because of its low ionization potential.

Helium. The second-lightest element after hydrogen, helium is lighter than air. Like argon, it is chemically inert and will not sustain life. Due to its high thermal conductivity and high ionization potential, helium is used as a shielding gas when increased heat input is desired and low tolerance for oxidizing elements exists, such as with aluminum and magnesium welding.

EQUIPMENTS

- Tungsten electrode
- Welding machine (constant current-CC, AC, DC+, DC- or AC/DC). There are advantages to

getting a machine that is designed for TIG welding in order to stay balanced during the weld (see below for explanation). Regardless of type, a high-frequency unit must be built-in or attached.

- Torch or electrode holder
- Shielding gas supply (helium, argon or mixture): argon better for thinner metals due to lower heat requirement
- Filler metal rod
- Personal safety equipment
- Welding gloves

ADVANTAGES

- It is preferred because of its low hydrogen properties and the match of mechanical and chemical properties with the base material.
- Higher weld quality can be maintained by cleaning operations which are free from defects
- Can be used with or without filler metal.
- No use of flux hence no danger of flux entrapment when welding critical component of refrigeration.
- Less Post weld finishing is required.

DISADVANTAGES

- TIG is a time- consuming process. They are slower than any other welding process
- Lower filler deposition rate
- High initial cost
- It cannot use in thicker sheets of metal

APPLICATIONS

- It can weld aluminium, stainless steel, copper, nickel, magnesium and their alloys.
- It can weld high temperature and hard surfacing alloys like titanium ,zirconium etc.
- It can joint sheet metal and thinner sections too.
- Due to high weld quality it is used to weld expansion bellows, instrument diaphragms and transistor case
- TIG is most preferable when it comes to precise weld joint in atomic energy, aircraft and chemical industries.
- When there is a need to achieve a joint which can assured 100 % volumetric inspection then this process is used.

LITERATURE SURVEY

[1] Bhargav C. Patel et al. in their research paper “Optimizing and analysis of parameter for pipe welding: A literature review” emphasis on the study of the effect of different input parameter of TIG and MIG welding on the weld quality. They studied the effect of various welding parameter by conducting different experiments.

[2] L Suresh Kumar et al. studied on the mechanical properties of austenitic steel for TIG and MIG process. They used the TIG and MIG process to find out the characteristic of metal after it is welded. The voltage is taken constant and various characteristics such as strength, hardness, ductility, grain structure, modulus of elasticity, breaking point etc. were analysis. They concluded that for Austenitic steel TIG welding is more suitable while hardness is more in case of MIG welding.

[3] Javed Kazi et al. represent a review on various welding techniques in International Journal of Modern Engineering Research publication in 2015. Their prime focus is on fulfilment of objective of Industrial application of welding with producing better quality product at minimum cost and increase productivity. The attempt is made to understand various welding techniques and to find the best welding technique for steel. Special focuses have been put on TIG and MIG welding. For this study they analysed strength, hardness, modulus of rigidity, ductility, breaking point, % elongation etc. at constant voltage on hardness testing machine and UTM.

[4] Palani.P.K, et al. researched the effect of TIG welding process parameters on welding of Aluminium-65032. Response Surface Methodology was used to conduct the experiments. The parameters selected for controlling the process are welding speed, current and gas flow rate. Strength of welded joints were tested by a UTM.

[5] R.Satish, et al. researched the weld ability and process parameter optimization of dissimilar pipe joints using GTAW. Taguchi method was used to formulate the experimental layout to rank the welding input parameters which affects quality of weld. Results showed that lower heat input resulted in lower tensile

strength and too high heat input also resulted in reduced tensile strength.

[6] Jay joshi, et al. researched based on Parametric Optimization of Metal Inert Gas Welding and Tungsten Inert Gas Welding By using Analysis of Variance and Grey Relational Analysis in International Journal of Science and Research publication in 2012. They carried out a design experimental method. With the help of Experimental data, they optimized by the grey relational analysis (GRA) technique, in which input parameters for TIG welding such as current, gas flow and output parameter as in tensile strength is considered. To find percentage contribution of each input parameters for obtaining optimal conditions, Analysis of variance (ANOVA) method was used. By analysing the GRA the optimum parameters were evaluated.

[7] Matusiak et al. researched arc welding parameters and the emission of welding fume for the stainless-steel weldments. The nickel and chromium content materials are welded by using MMA, TIG and MIG. The total amount of chromium are mainly depends on the oxidation content in shielding gasses. The argon mixtures produced less nickel content on the argon shielding gas. The fume emission is higher and mainly depends on the welding current during TIG welding Process covered electrodes produced higher chromium content in the fume.

[8] Arun Kumar et al. analysed the welding techniques like GTAW and GMAW for the hollow pipes. The pipes are produced by the different combination of the material and the thickness of the pipe is 4mm and the diameter of the tube is 54mm.GMAW used the argon as shielding gas and GTAW uses some amount of CO2 with argon. Tungsten carbide and chromium carbide contribution increased the hardness and tensile strength values. RTR techniques showed some defects like stubs, cracks and holes in the pipe.

[9] Gajendhiran et al. Make a study on welding parameters on MIG and TIG welding in the International Journal of Recent scientific Research publication in 2016. They concentrate on the selection of manufacturing method should be produced the product with low cost and also increased the productivity. Their focus is on the MIG and TIG welding processes. The process parameters like type of shielding gas, welding current, gas flow rate and welding voltage plays a major role on their mechanical properties of weldments. Center of study surrounded by the welding process parameters that influences on the material mechanical properties of weldments.

[10] S.C. Juang et al. were carried out the selection of the process parameters for TIG welding of stainless steel with the optimal weld pool geometry has been reported. The optimal weld pool geometry has four smaller-the-better quality characteristics, i.e. the front height, front width, back height and back width of the weld pool. The modified Taguchi method is adopted to solve the optimal weld pool geometry with four smallerthe better quality characteristics. Experimental results have shown that the front height, front width, back height and back width of the weld pool in the TIG welding of stainless steel are greatly improved by using this approach.

[11] Raghuvir Singh et al. were carried out investigated the effect of TIG welding parameters like welding speed, current and flux on depth of penetration and width in welding of 304L stainless steel has been studied. From the study it was observed that flux used has the most significant effect on depth of penetration followed by welding current. However Sio2 flux has more significant effect on depth. Optimization was done to maximize penetration and having less bead width.

[12] Naitik s patel et al. represent a review on Parametric Optimization of TIG welding in the International Journal of Computational Engineering Research publication in 2014. They carried out the feature highlighting the TIG as a better prospect for welding then other processes Especially for joining of two dissimilar metals with heating the material or applying the pressure or using the filler material for increasing productivity with less time and cost constrain. They made an attempt to understand the effect of TIG welding parameters such as welding current, gas flow rate, welding speed, that are influences on responsive output parameters such as hardness of welding, tensile strength of welding, by using optimization philosophy.

[13] Balaji. C et al. investigated inert gas tungsten arc welding parameters on the mechanical properties of SS 316 L weldments. 316 ASS rods of dimensions of 25 mm diameter and 75 mm length were used. Current, bevel angles gas volumes inputs were varied at different range of 90, 100 and 110 ampere, 60˚ 70˚ and 80˚ and 1.1, 0.9,0.71 per litre respectively. Taguchi L-9 orthogonal array technique was used. Results obtained showed that the current of 110 A, bevel

Angle of 60˚ and a gas flow of 0.7 l pm offers the maximum tensile strength. While the minimum tensile strength was obtained with current of 100 A, bevel Angle of 60˚ and a gas flow of 0.9 per litre. In addition, sample with the minimum tensile strength gave the maximum micro hardness. They concluded that, as micro hardness increases, tensile strength decreases. Influence of welding speeds and power inputs on the heat affected zone (HAZ) microstructural characteristics and tensile behaviour of type 304 L austenitic stainless steel was studied.

[14] Oyetunji A Kutelu, et al. The butt joint HAZ square geometry samples were produced using Gas Metal Arc Welding (GTAW) process. Results obtained showed that the microstructures were composed mainly of mixture of austenite and ferrite phases. Variations in volume fraction and grain size of the phases were observed at the different welding speeds and power inputs. Chromium carbide formation and precipitation due to sensitization was seen at the grain boundaries. Optimum ultimate tensile strength (UTS) and yield strength (YS) were obtained for HAZ sample at moderate (4.5 mm/s) welding speed, and optimum % elongation at slow welding speed, and optimum UTS and YS were obtained for HAZ sample at power input of 9.2 KW, and optimum % elongation at 12.00 KW. Influence of the welding variables on tensile characteristics in the HAZ was found substantial.

[15] Gadewar. S et al. investigated the effect of GTA welding current, gas flow rate, thickness of work piece on the bead geometry of AISI 304 L, and reported all the process parameters exhibited high influence on the mechanicalproperties of the material.

[16] Raveendra et al. investigated effect of pulse and non-pulse current on the mechanical properties of 304 SS. A 3 mm thick sheet of 304 SS was used for the work, pulsed current at different frequencies of 3 Hz, 5 Hz and 10 Hz was used. Report obtained revealed microstructure, hardness; tensile characteristics of the weldments were influenced by both non pulse and pulse currents to varying degrees.

[17] Ahmed et al. studied the influence of welding speed on the tensile strength of GTAW 304 L joint, and reported that penetration depth decreased with the increase of bevel height of single V butt joint.

[18] Aamir et al. investigated the effect of TIG pulse rate, pulse frequency, arc travel speed and wire feed rate on tensile and hardness properties of girth welding of SS 304L. The pipes were welded by using orbital welding machine, ER 308 L filler wire was used for reinforcement of weld. Results obtained showed that sample welded with 90 A pulse current revealed superior tensile strength and hardness properties. Tensile property of 605 MPa, and hardness values of the base metal, HAZ and weld metal were 160 HB, 114 HB and 99 HB respectively. With increasing pulse current, tensile strength and soundness of joint was observed to increase, maximum strength of the joint was obtained at 2.5 Hz frequency. And at the arc travel speed of 80 mm/min, maximum strength and soundness of joint was obtained, but with increasing time for making the joint. Also, as the wire feed rate was increased without increase in current; the strength of joint was reported to decrease.

[19] Tsann-Shyi et al. revealed that welding process relies on an intensely localized heat input, which tends to generate undesired residual stresses and deformations in welded structures, especially in the case of thin plates. Increasing the speed of travel and maintaining constant arc voltage and current will reduce the width of bead and also increase penetration until an optimum speed is reached at which penetration will be maximum. Increasing the speed beyond this optimum will result in decreasing penetration Increase in welding speed causes 1) decrease in the heat input per unit length of the weld, 2) decrease in the electrode burn off rate, and 3) decrease in the weld reinforcement.

[20] Iordachescu et al. Excessive high welding speed decreases wetting action, increases tendency of undercut, porosity and uneven bead shapes and Slower welding speed reduces the tendency to porosity. If the welding speed decreases beyond a certain point, the penetration also will decrease due to the pressure of the large amount of weld pool beneath the electrode, which will cushion the arc penetrating force.

[21] Devakumar et al. With increasing welding speed, power or heat input per unit length of weld decreases with attendant less weld reinforcement and decreased penetration, and with excessive high welding speed, wetting action decreases with increasing tendency of undercut, porosity and uneven bead shapes, slower welding speed reduces the tendency to porosity.

[22] Afolabi. A.S. et al. investigated the effects by producing the welds on a 1.5 mm thick plate of 16 wt% Cr FSS conforming to AISI 430 commercial grade, using GTAW to argon environment at a heat flux

between 1008 W to 1584 W and speed between 2.5 mm/s and 3.5 mm/s. The width of the sensitization zone increases with increasing the heat input. The depth of the sensitization zone in the thickness direction is insignificant and it is generally within one half of a millimetre. The use of heat input greater than 432 J/mm increases the development of sensitized regions. This level of heat input corresponds to heat fluxes in the range 1008 -1296 W and welding speed between 3 mm/s and 3.5 mm/s. Under this condition the average cooling time is about 10 s. Most grain attack is restricted to the ferrite-ferrite grain boundaries. The ferrite martensite boundaries do not show visible attack. This indicates that welding condition that promotes the formation of martensite in the HAZ is ideal for the presentation of sensitization.

[23] Okonji P.O et al. examined effect of welding current and filler metal types on the percent elongation of 3 mm thick austenitic steel (304L grade) welded joint. They considered five welding currents in the range of 91 - 95 amperes at 1 ampere interval and used three types of filler metal namely ER308L, ER309L and ER316Ld to produce square butt weld joints. Standard equipment and ASTM standard procedure were used for determining percent elongation. And reported based on results obtained that percent elongation for all filler metal types increased with increase in welding current, but were generally lower than that of the base metal. studied the effect of welding on the corrosion resistance of the austenitic stainless steel Alloy 59 (UNS N06027) as well as the galvanic corrosion generated by the base/weld pair estimated from the polarisation curves according to the mixed potential theory. The materials were exposed to polluted phosphoric acid at several temperatures. And the samples' microstructures were studied by SEM and EDX analysis. Based on the results obtained, they reported that the welding process shifted the corrosion potential values to more anodic potentials. And due to welding effect, corrosion current densities and the passive current densities were also observed to increase with increasing temperature. Also, they observed that as a result of passivation of material, open circuit potential values were located in the passive zone of the potential dynamic curves. They reported that galvanic corrosion of the pair was not severe in the studied conditions. The ratio between the galvanic current density of the pair and the corrosion current density of the uncoupled anode was reported to be less than 5, an implication of compatibility of the members in the couple. [24] S.W. Shyu et al. investigated the effects of oxide fluxes on weld morphology, arc voltage, mechanical properties, angular distortion and hot cracking susceptibility as compared to conventional GTAW, when applied to the of welding of 5 mm thick austenitic stainless steel plates. Al2O3,Cr2O3, TiO2, SiO2 and CaO were applied on a type 304 stainless steel for this purpose. They found that by using Cr2O3, TiO2, and SiO2 significant increase in penetration is obtained and also A-GTAW can increase the retained delta-ferrite content of stainless steel 304 weld, which consequently reduces the hot cracking susceptibility of as-welded structure.

[25] D.S. Howse et al. microstructure and mechanical properties of weldments. They found that A-GTAW could increase the weld penetration and depth-to-width ratio of the weld pool and A-GTAW could increase the delta-ferrite content of weld metals and improve the mechanical properties.

[26] M. Tanaka et al. investigated the effect of SiO2 on welding distortion, ferrite number, hardness value and depth of penetration on welding of austenitic stainless steel 304L plates having thickness of 8 mm. They found that there was an increase in depth of penetration and weld aspect ratio which resulted in lower angular distortion. They obtained a ferrite content of 14% by weight in the weld joint obtained; this increase in the ferrite content was attributed to the flux which helped in rapid cooling of the weld joint.

[27] Prof. A.B. Sambherao et al. investigated the effect of TiO2, Fe2O3, SiO2 and Al2O3 fluxes on the surface appearance, weld morphology and retained δ-ferrite content obtained with the GTAW process when applied to the welding of 6mm thick (AISI-316L) austenitic stainless steel plates. He observed that the flux seemed to constrict the arc which helped in increasing the current density at the anode spot, there by resulting in higher weld depth. He found out that a significant increase in penetration (around 300 %) was obtained in welds done with a TiO2 activating flux. This effect is due to the reversal of Marangoni convection and the arc constriction produced by the flux. Al2O3 produced only a small increase in weld depth; therefore he proposed that the fluid flow appears to be in the outward direction when Al2O3 flux is added. As Fe2O3 is unstable, when Fe2O3 mixed with TiO2 flux was used, the oxygen content in

the weld pool increased to a larger extent. This reversed the Marangoni convection very sharply; even more increase in the weld depth was obtained compared to when only TiO2 flux was used. He recommended that combination of fluxes such as mixture of TiO2 and Fe2O3 flux should be used to achieve desirable properties of the weld.

[28] Tseng et al. investigated the effect of oxide powdered fluxes on weld morphology, angular distortion, and hardness of a 6mm thick type 316stainless steel plate. They observed that the SiO2 flux is more preferable over Al2O3. Additionally, they also concluded that to obtain high quality welds and stable weld arc, the activated GTAW process requires large diameter electrodes to support a given level of the weld current.

[29] Sakthivel et al. compared the effect of AGTAW with conventional GTAW on welding of 316L(N). They compared the creep rupture behavior of 316L(N) base metal, and weld joints made by A-GTAW and conventional GTAW at 923 K over a stress range of 160–280 MPa. They found an enhancement in creep rupture strength of weld joint fabricated by A-GTAW process over conventional GTAW process.

[30] Badheka et al. studied the effect of oxide fluxes such as TiO2, ZnO and MnO2 on welding parameters like welding current, welding speed, joint gap and electrode diameter on a 6 mm thick dissimilar weld made between carbon steel to stainless steel. They observed that (1) the highest depth/width (D/W) ratio was observed under TiO2 and ZnO fluxes compared to conventional GTAW process, (2) Lowest angular distortion was observed under TiO2 flux compared to conventional GTAW process and (3) Mechanical properties, Joint Efficiency of Activated flux welds are higher compared to conventional GTA welding process

CONCLUSION

After doing the effort of understanding various literatures and making survey based on Influence of process parameters such as Welding current, welding speed, Welding polarity, Arc pulsing, Arc length, types of shielding gas along with their flow rate and aspect ratio on efficiency and output of TIG welding. we can conclude that TIG welding is the most widely used arc welding process due to its vast range of advantages over other welding process. It has been observed that TIG welding can be approach to its best output when the above listed parameters are set to its most suitable atmosphere for the specified work. Welding current depends upon the selection on heat dissipation required either on work piece or electrode. Mostly DCEN or DCSP is used. Tungsten electrode Tip is also shaped accordingly. Welding speed depends upon the types of shielding gas used and thickness of material. When it comes to weld Aluminum TIG is best joining process. Flow rate of shielding gas in both pre weld stage and post weld stage plays a major role into the contribution of weld quality

RFERENCE

[1] S Bhargav C. Patel, Jaivesh Gandhi, “Optimizing and analysis of parameter for pipe welding: A literature review”, International Journal of Engineering Research & Technology (IJERT), Vol. 2 Issue 10, October – 2013, pp. 229-234.

[2] L Suresh Kumar, Dr. S. M. Verma, Dr. V. Satyanarayana “Impact of Voltage on Austenitic Stainless Steel for The Process of TIG And MIG Welding” International Journal of Mechanical Engineering and Technology, Vol. 1, Issue 1, July-August 2010, pp. 60-75.

[3] S Bhargav C. Patel, Jaivesh Gandhi, “Optimizing and analysis of parameter for pipe welding: A literature review”, International Journal of Engineering Research& Technology (IJERT), Vol. 2 Issue 10, October – 2013, pp. 229-234.

[4] Palani.P.K et al, “Modeling and Optimization of Process Parameters for Tig Welding of Aluminium 65032 Using Response Surface Methodology” .2248- 9622, Volume-3, Issue 2, 2013.

[5] R.Satish, “Weldability and process parameter optimization of dissimilar pipe joints using GTAW”.2525-2530, Volume-2, 2012.

[6] Jay joshi, “Parametric Optimization of Metal Inert Gas Welding and Tungsten Inert Gas”.

[7] Matusiak J and WYCIŚLIK A. “The influence of technological conditions on the emission of welding fume due to welding of stainless steels”. Metalurgija, 2010. 49(4): pp. 307-311.

[8] Arunkumar N, “Evaluation of Mechanical Properties of Dissimilar Metal Tube Welded Joints Using Inert Gas Welding Evaluation”. ITERA, 2012. Vol 2(5), pp. 1709- 1717.

[9] Gejendhiran et al, “Study of Welding Parameters on Mig and Tig Welding”, International Journal of Recent Scientific Research, vol. 7, Issue 3, March 2016, pp. 9336-9338.

[10] S.C. Juang, Y.S. Tarng “Process parameter selection for optimizing the weld pool geometry in the tungsten inert gas welding of stainless steel”, Journal of Materials Processing Technology 122 (2002), P33–37.

[11] Raghuvir Singh, Dr. N.M Suri, Prof. Jagjit Randhawa “Optimization of Process Parameters for TIG welding of 304L Stainless Steel using Response Surface Methodology”, International Journal of Mechanical Science and Civil Engineering Volume 2 Issue 2 (June 2013 Issue), P 36-40.

[12] Naitik s patel et al, “A Review on Parametric Optimization of TIG Welding”, International Journal of Computational Engineering Research, vol. 4, Issue 1, 2014, pp. 27-31.

[13] Balaji, C., Abinesh, K.S.V., Ashwin, K.S. and Sathish, R. (2012) “Evaluation of Mechanical Properties of SS 316L Weldments Using Tungsten Inert Gas Welding”, International Journal of Engineering Science and Technology, 4, 124-131.

[14] Oyetunji, A., Kutelu, B.J. and Akinola, A. (2013) “Effects of Welding Speeds and Power Inputs on the Hardness Property of Type 304L Austenitic Stainless Steel Heat-Affected Zone (HAZ)”, Journal of Metallurgical Engineering, 2, 124.

[15] Gadewar, S. (2010) “Experimental Investigation of Weld Characteristics for a Single Pass TIG Welding with SS 304”, International Journal of Engineering Science Technology, 2, 3676-3686.

[16] Raveendra, S. (2012) “Weldability and Process Parameter Optimization of Dissimilar Pipe Joints Using GTAW”, International Journal of Engineering Research and Applications, 2, 2525-2530.

[17] Ahmed, K.H., Abdul, L., Mohd, J. and Pramesh, T. (2010) “Influence of Welding Speed on Tensile Strength of Welded Joint in TIG Welding Process”, International Journal of Applied Engineering Research, 1, 518-527.

[18] Aamir, S., Abdul, A., Muhammad, I., Osama, J.M. and Sagheer, A. (2017) “Effect of TIG Welding Parameters on the Properties of 304L Automated Girth Welded Pipes Using Orbital Welding Machine”.

[19] Tsann-Shyi, C., Kuang-Hung, T. and Hsien-Lung, T. (2011), “Study of the Characteristics of Duplex Stainless Steel Activated Tungsten Inert Gas Welds”, Materials and Design, 32, 255-263.

[20] Iordachescu, M., Ruiz, H.J., Iordachescu, D., Valiente, A. and Caballero, L. (2010) “Thermal Influence of Welding Process on Strength Overmatching of Thin Dissimiliar Joints”, Welding in the World, 65, 201-209.

[21] Devakumar, D. and Jabaraj, D.B. (2010) “Research on Gas Tungsten Arc Welding of Stainless Steel—Overview”, International Journal of Scientific and Engineering Research, 5, 39-54.

[22] Afolabi, A.S. (2008) “Effect of Electric Arc Welding Parameters on Corrosion Behaviour of Austenitic Stainless in Chloride Medium” AU Journal of Technology, 11, 171-180.

[23] Okonji, P.O., Nnuka, E.E. and Odo, J.U. (2015) “Effect of Welding Current and Filler Metal Types on Macrostructure and Tensile Strength of GTAW Welded Stainless Steel Joints”, International Journal of Scientific Research and Engineering Trends, 1, 9-12.

[24] H.Y. Huang, S.W. Shyu, K.H. Tseng, and C.P. Chou, “Effects of the Process Parameters on Austenitic Stainless Steel by TIG-flux Welding”, J. Mater. Sci. Technol., 2006, 22(3), pp367–373

[25] D.S. Howse and W. Lucas, “Investigation into Arc Constriction by Active Fluxes for Tungsten Inert Gas Welding”, Sci. Technol. Weld. Joining, 2000, 5(3), pp 189–193

[26] M. Tanaka, T. Shimizu, H. Terasaki, M. Ushio, F. Koshi-ishi, and C.-L. Yang, “Effects of Activating Flux on Arc Phenomena in Gas Tungsten Arc Welding”, Sci. Technol Weld. Joining, 2000, 5(6), pp 397–402

[27] Prof. A.B. Sambherao,” Use of Activated Flux for Increasing Penetration In Austenitic Stainless Steel While Performing GTAW”, International Journal of Emerging Technology and Advanced Engineering, Volume 3, Issue 12, December 2013, pp 520-524.

[28] K.H. Tseng, K-J Chuang, "Application of iron-based powders in tungsten inert gas welding for 17Cr–10Ni–2Mo alloys", International Journal of Scientific Development and Research, (2012), pp36–46.

[29] T. Sakthivel, M. Vasudevan, K. Laha, P. Parameswaran, K.S. Chandravathi, M.D. Mathew, A.K. Bhaduri, "Creep rupture strength of activated-TIG welded 316L(N) stainless steel" Journal of Nuclear Materials 413 (2011), pp36–40.

[30] Badheka, Er Bhawandeep singh, Er Avtar simgh, “Performance of activated TIG process in mild steel welds”, IOSR Journal of Mechanical and Civil Engineering, Volume 12, Issue 2, 2015, PP 01-05