Critical Review of Welding Parameters of TIG Welding for SS304

Harsh Chokshi[1] Sargit Kanani[2] Abhi Patel[3] Tilala Akshay[4] Prof. Pratik Moradiya[5]
[1,2,3,4,5]L. J. Institute of Engineering and Technology, India

Abstract— Quality and productivity plays important role in today's competitive market. Now a day's due to very stiff and cut throat competitive market condition in manufacturing industries. Quality and productivity is directly related to the method of manufacturing. The aim of this study is related to tig welding of ss304. Tig welding is most vital and common operation use for joining of two similar or dissimilar metals. The reason behind this study is to improving weld quality by changing the process parameters and reducing process time.
Keywords: TIG Welding System, TIG Welding for SS304

I. INTRODUCTION

Electrical arc was first described by davy in England in the year 1809,but the beginning of arc welding could become possible only with the improvements in electric dynamos or generators between 1877and 1880.Auguste de meritens established arc welding process in 1881 which was applied to join certain components of electrical storage batteries. Arc and molten pool shielding with an inert gas (co2) was advantage by Alexander in USA in year 1928 and the patent for TIG welding was received by Hobart and Devers in 1930 in USA. First gas tungsten arc spot welding torch based upon TIG welding was introduced around 1946.TIG is an abbreviation for tungsten-inert-gas. The process is also termed as gas-tungsten-arc welding and designated as GTAW. In this process, an arc is struck between a non-consumable tungsten electrode and the base metal. The arc is shielding by the inert argon or helium or argon-helium mixture. A filler wire may or may not be Used. When it is used, it is fed externally into the arc in the form of rod or strip by the welder. The welder also has to control the arc length and travel speed.

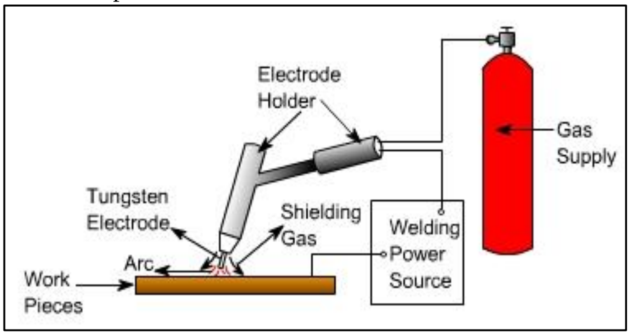

Fig. 1: [Schematic Diagram of TIG Welding System]

A. *Equipment:*

1) Welding power source, high frequency unit, dc suppressor unit and cables.
2) Welding torch, tungsten electrode and filler metals.
3) Inert gas cylinder, pressure regulator and flow meter.
4) Cooling water supply.
5) Water and gas solenoid valves.

B. *Inert Gases Used in TIG welding:*

1) Argon: Argon is most commonly used gas for TIG welding. It can be used on all metals.
2) Helium: Pure helium can be used for welding aluminium and copper alloys.
3) Helium-argon mixtures: Helium-argon mixtures give deeper penetration, greater heat input and hence faster welding.
4) Argon-hydrogen mixture: Addition of hydrogen to argon increases the arc voltage and provides benefits similar to helium.

II. WORKING PRINCIPLE OF TIG WELDING OPERATION

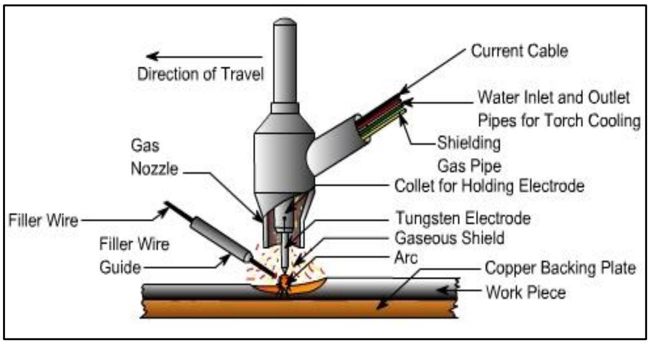

Fig. 2: [Principle of TIG Welding]

TIG is an arc welding process, as shown in Fig2. Wherein coalescence is produced by heating the work piece with an electrical arc struck between a tungsten electrode and the job. The electrical discharge generates a plasma arc between the electrode tip and the work piece to be welded. It is an arc welding process where in coalescence is produced by heating the job with an electrical arc struck between a tungsten electrode and the job. The arc is normally initialized by a power source with a high frequency generator. This produces a small spark that provides the initial conducting path through the air for the low voltage welding current. The arc generates high-temperature of approximately 6100 C and melts the surface of base metal to form a molten pool. A welding gas (argon, helium, nitrogen etc.) is used to avoid atmospheric contamination of the molten weld pool. The shielding gas displaces the air and avoids the contact of oxygen and the nitrogen with the molten metal or hot tungsten electrode. As the molten metal cools, coalescence occurs and the parts are joined. The resulting weld is smooth and requires minimum finish.

A. *Advantages:*

1) Because of clear visibility of the arc and the job, the operator can exercise a better control on the welding.
2) This process can weld in all positions smooth and sound welds with less spatter.
3) TIG welding is very much suitable for high quality welding of thin material.
4) It is a very good process for welding nonferrous metals (aluminium)and stainless steel

B. *Disadvantages:*

1) Tungsten if it transfers to molten weld pool can contaminate the same. Tungsten inclusion is hard and brittle.

2) Filler rod end if it by change comes out of the inert gas shield can cause weld metal contamination.
3) Equipment costs are higher.

C. Applications:

1) Welding aluminium, magnesium, copper, nickel and their alloys, carbon, alloys or stainless steel, high temperature and hard surfacing alloys like zirconium, titanium etc.
2) Welding sheet metal and thinner sections.
3) Welding of expansion bellows, transistor cases, instrument diaphragms, and can-sealing joints.
4) Precision welding in atomic energy, aircraft, chemical and instrument industries.
5) Rocket motor chamber fabrications in launch vehicles.

III. LITERATURE REVIEW

Many investigators have suggested various methods to explain the effect of process parameter on Tig welding process in material properties.

1) Ravi Shanker Vidyarthy, Dheerendra Kumar Dwivedi & Vasudevan Muthukumaran suggested in their paper "Optimization of A-TIG Process Parameters Using Response Surface Methodology" that welding process parameters such as welding current (I),welding speed (S), and flux coating density (F) on different aspects of weld bead geometry for example depth of penetration (DOP), bead width (BW), depth to width ratio (D/W), and weld fusion zone area (WA) were investigated by using the central composite design (CCD). bead geometry. An optimized DOP, BW, D/W, and WA of 6.95 mm, 8.76 mm, 0.80, and 41.99 mm2 respectively, were predicted at the welding current of 213.78 A, the welding speed of 96.22 mm/min and the flux coating density of 1.99 mg/cm2. Conformity test was done to check the practicability of the developed models. The conformity test results were in good agreement with the predicted values. 9-12 % Cr ferritic stainless steel (FSS) plates were welded using A-TIG welding. It was observed that all input variables have a direct influence on the DOP, BW, and D/W. Mathematical models were generated from the obtained responses to predict the weld
2) Aakanksha Jadhav suggested in her paper " Optimisation of process parameters of A-TIG welding for penetration and hardness of SS 304 stainless steel weld" that by the use of flux tig welding process of ss304, that time it is necessary to find the optimum parameter for welding process. This parameters will help to control the depth of penetration. A Tig welding parameters such as current, gas flow rate and flux are optimised by the use of Taguchi Orthogonal Array and statistical tool ANOVA.
3) Prashant S Lugade , Manish J Deshmukh suggested in their paper "Optimization of Process Parameters of Activated Tungsten Inert Gas (A-TIG) Welding for Stainless Steel 304L using Taguchi Method" that The major influencing A-TIG welding process parameters, such as electrode gap, welding current, welding speed andgas flow rate are optimized to get desirable ultimate tensile strength (UTS) of weld. Hence this parameters are optimized by L9(34)orthogonal array and percentage contribution of each parameter if calculated by ANOVA a tool of Taguchi method. From experimental results it is observed that, the optimum process parameter are 1 mm electrode gap, 200 A welding current, 100 mm/min welding speed and 10 lit/min gas flow rate. The major percentage contribution of process parmeter for tensile strength is welding speed(44.87%).
4) S.P.GADEWAR suggested in their paper "EXPERIMENTAL INVESTIGATIONS OF WELD CHARACTERISTICS FOR A SINGLE PASS TIG WELDING WITH SS304" that increase in welding current increase in the heat input This increased heat is utilized to melt the base metal.

Similarly as thickness of the work piece increases rate of gas flow need to be increased to increase the heat diffusion rate. Increase in gas flow avoids the vaporization of the molten metal. It also increases the penetration. The increase in weld current and gas flow results in change in Bead Geometry of the welded joint which dominates the weld characteristics. The variations in the process parameters affect the mechanical properties.

5) Gaurang Baria, Sagar Bhadeshia, Visu Sharma, Shubham Vaishnav, Shivam Pandit suggested in their paper "Effect of Process Parameter during TIG Welding on SS304" that current ,welding speed, time and no. of passes is directly affect the quality of the weld joint. For finding optimum parameter they use graphical method.
6) N.Jeyaprakash, Adisu Haile, M.Arunprasath suggested in their paper" The Parameters and Equipments Used in TIG Welding" that

TIG welding also needs improvements regarding spatter reduction and weld quality of the bead. Shielding gas in TIG welding is desirable for protection of atmospheric contamination. TIG welding process has the possibility of becoming a new welding process giving high quality. And give some optimum parameter charts.

7) Devendran1, Sujay, Sangamithirai, Mohamed Thameem, Hari Kumaraan suggested in their paper "Analyzing the Parameters of SS 304 using TIG Welding" that Over the years the lifespan of many machines have been reduced or have not matched its estimated lifespan due to poor joints and the materials have not adapted to the working conditions. The poor joints may be due to the improper fasteners or due to the improper welding joints. The improper welding methods may be due to the welding method that may not be suitable for the working environment or may not be apt for the material that is used in the machine. Our project deals with studying and analyzing the properties of TIG welded SS 304 specimen by conducting various tests. SS 304 is the most commonly used metal in food processing machines because of its high corrosion resistance. But a slight drawback is that the machines that use SS 304 fail due to its poor fail welding joints. Hence this project deals with finding out whether the TIG welded SS 304 joint can withstand extreme conditions and various tests performed on it.
8) Vijay Gohel, Jatin Makwana, Riteshkumar Ranjan suggested in their research paper "Thermo-mechanical

analysis in TIG welding of S.S 304"that Tungsten inert gas welding (TIG) is a high quality welding process commonly used to join plates of higher in load bearing components. These processes provide a purer and cleaner high volume weldments. The objective is to study the variation of temperature in TIG welded SS 304 plate of 3 mm work piece thickness. In this work, thermal analysis with the help of ANSYS workbench carried out for butt joint stainless steel base metal (SS 304) using Gas tungsten arc welding (GTAW) process. Thermo - Mechanical simulation is developed. Comparison with the temperature measured by the thermocouples records shows that the results from the present simulation have good agreement with the test data.

9) AA Ugla suggested in their paper "Enhancement of weld quality of AISI 304L austenitic stainless steel using a direct current pulsed TIG arc" that effects on the arc pressure of pulse frequencies at levels of 6 and 1,000 Hz, and thereby their effects on the aspect ratio and morphology of the weld metal. The key outcomes of this work are that the frequency of arc pulsation has a strong effect on the breaking of the dendritic arms during the welding process. The obtained microstructure results reveal that the structure of the high pulse frequency current welded specimens are thus generally finer grained, with higher levels of residual ferrite and an absence of columnar grains; such pulse frequencies thus strongly influence the tensile strength and micro hardness of affected weldments as compared to those seen in continuous current welded specimens. Additionally, the most important factor affecting the bead geometry and aspect ratio is identified as the pulse frequency, with a contribution of 64%.

10) Hiren M Bopaliya, Manhar S Kagthara,DR G D Acharya suggested in their paper "STUDY EFFECT OF TIG WELDING PROCESS PARAMETERS ON MECHANICAL PROPERTIES OF SS-304" that Tungsten Inert Gas welding is a procedure that delivers electric circular segment kept up between a nonconsumable tungsten electrode and the part to be welded. The warmth influenced zone, the tungsten terminal and the liquid metal are all protected from environmental tainting by a cover of dormant gas nourished through TIG light. Idle gas has latent substance properties. In these paper mechanical properties of SS-304, for example, quality, hardness, malleability, and grain structure, modulus of elasticity and HAZ were concentrated on and looked into. This paper additionally manages process parameters of TIG welding, for example, welding current, voltage and travel speed with the assistance of Taguchi technique.

IV. Conclusion

From various literature survey efforts to identify in TIG welding process most of welding parameters like welding current, welding speed, depth to width ratio are generally used in research work. Also identify TIG welding carried out on different materials like mild steel, titanium alloy, brass, carbon, stainless steel etc. From the above research paper we find the optimum parameter for our work-piece of 25 mm thickness which is made of SS304 optimum welding current is 150 A, 15 Lit/min of gas flow rate and flux SiO_2+ZnO for multi pass TIG welding . By the use of this we get higher quality of the weld joint due to this surface defects are decrease and also decrease in number of passes.

References

[1] Ravi Shanker Vidyarthy, Dheerendra Kumar Dwivedi & Vasudevan Muthukumaran Optimization of A-TIG Process Parameters Using Response Surface Methodology ISSN: 1042-6914 (Print) 1532-2475 (Online) Journal homepage: http://www.tandfonline.com/loi/lmmp20.
[2] Aakanksha Jadhav " Optimisation of process parameters of A-TIG welding for penetration and hardness of SS 304 stainless steel weld" International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056 Volume: 05 Issue: 10 | Oct 2018 www.irjet.net p-ISSN: 2395-0072
[3] Prashant S Lugade , Manish J Deshmukh "Optimization of Process Parameters of Activated Tungsten Inert Gas (A-TIG) Welding for Stainless Steel 304L using Taguchi Method" International Journal of Engineering Research and General Science Volume 3, Issue 3, May-June, 2015 ISSN 2091-2730
[4] S. P. Gadewar "Experimental Investigations of Weld Characteristics For A Single Pass Tig Welding With Ss304" S. P. Gadewar et. al. / International Journal of Engineering Science and Technology Vol. 2(8), 2010, 3676-3686
[5] Gaurang Baria, Sagar Bhadeshia, Visu Sharma, Shubham Vaishnav, Shivam Pandit "Effect of Process Parameter during TIG Welding on SS304" Vol-3 Issue-3 2017 IJARIIE-ISSN(O)-2395-4396
[6] N.Jeyaprakash, Adisu Haile, M.Arunprasath " The Parameters and Equipments Used in TIG Welding" The International Journal Of Engineering And Science (IJES)|| Volume || 4 || Issue || 2 || Pages || PP.11-20 || 2015 || ISSN (e): 2319 – 1813 ISSN (p): 2319 – 1805
[7] Devendran1, Sujay, Sangamithirai, Mohamed Thameem, Hari Kumaraan "Analyzing the Parameters of SS 304 using TIG Welding" International Research Journal of Advanced Engineering and Science ISSN (Online): 2455-9024
[8] Vijay Gohel, Jatin Makwana, Riteshkumar Ranjan "Thermo-mechanical analysis in TIG welding of S.S 304" 2016 IJEDR | Volume 4, Issue 2 | ISSN: 2321-9939
[9] AA Ugla "Enhancement of weld quality of AISI 304L austenitic stainless steel using a direct current pulsed TIG arc" 2nd International Conference on Engineering Sciences IOP Publishing IOP Conf. Series: Materials Science and Engineering 433 (2018) 012075 doi:10.1088/1757-899X/433/1/012075
[10] Hiren M Bopaliya, Manhar S Kagthara,DR G D Acharya "STUDY EFFECT OF TIG WELDING PROCESS PARAMETERS ON MECHANICAL PROPERTIES OF SS-304" Vol-2 Issue-3 2016 IJARIIE-ISSN(O)-2395-4396