A Review on Effect of Various Process Parameters on Weld Joint of Dissimilar & Similar Metals in Tig Welding

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Abstract: ***The welding quality is strongly characterized by the weld bead geometry; which plays an important role in determining the mechanical properties of the weld. In present research paper an attempt is made to understand the effect of various welding parameters such as welding speed, welding current, gas flow rate, and heat input that are influences on responsive output parameters such as tensile strength, hardness of welding by using optimization philosophy.***

Keywords: Tungsten Inert Gas Welding

1. Introduction

1.1 Introduction of Welding

Welding is widely used by metalworkers in the fabrication, maintenance and repair of parts and structures. Generally, welding can be defined as any process in which two or more pieces of metal are joined together by the application of heat, pressure, or a combination of both. Most of the processes may be grouped into two main categories: pressure welding, in which the weld is achieved by pressure; and heat welding, which is achieved by heat. Heat welding is the most common welding used today. Arc welding, which is heat-type welding, is one of the most important manufacturing operations for the joining of structural elements for applications, including guide way for trains, ships, bridges, building structures, automobiles, and nuclear reactors, to name a few. It requires a continuous supply of either direct or alternating electric current, which create an electric arc to generate enough heat to melt the metal and form a weld.

The most widely used arc welding processes include;
• Shielded metal arc welding (SMAW),
• Gas tungsten arc welding (GTAW or TIG),
• Gas metal arc welding (GMAW),
• Submerged metal arc welding (SAW).

The arc welding process is a remarkably complex operation involving extremely high temperatures, which produce severe distortions and high levels of residual stresses. These extreme phenomena tend to reduce the strength of a structure, which becomes vulnerable to fracture, buckling, corrosion and other type of failures. The primary goal of any welding operation is to make a weld having the same properties as the base metal. The only way to produce such a weld is to protect the molten puddle from the atmosphere. In gas shielded-arc welding, an inert gas is used as a covering shield around the arc to prevent the atmosphere from contaminating the weld. Gas shielding makes it possible to weld metals that are otherwise impractical or difficult to weld by eliminating atmospheric contamination of the molten puddle. Gas shielded arc welding is extremely useful because it can be used to weld all types of ferrous and nonferrous metals of all thicknesses. In general, the controlling factors are the types of metal you are joining, cost involved, nature of the products you are fabricating, and the techniques use to fabricate them.

1.2 Tungsten Inert Gas Welding

Tungsten inert gas welding (TIG) is a form of shielded metal arc welding. However, in tungsten inert gas welding, the electrode is used only for creating the arc. The electrode is not consumed in the weld as in the shielded metal-arc process. The basic TIG process involves an intense arc between the base metal and a tungsten electrode. The arc, the electrode, and the weld zone are surrounded by an inert gas (i.e. either helium or argon or a mixture of the two as usual) that displaces the air and eliminates the possibility of weld contamination by the oxygen and nitrogen present in the atmosphere. The high melting point of tungsten electrode made it virtually non-consumable. Nowadays,

TIG welding has become an indispensable tool for many industries since high-quality welds are produced with low equipment costs. Figure 1.1.shows schematic diagram of basic principal of TIG Welding.

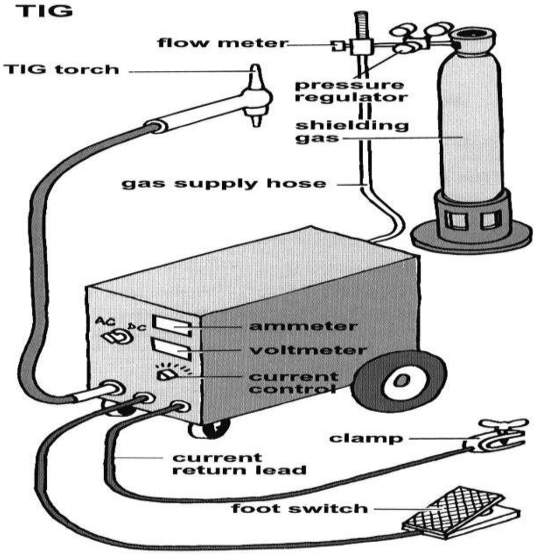

Figure 1.1: Schematic Diagram of Basic Principal of TIG Welding

1.3 Detail of Weld Pool Geometry in TIG Welding

Basically, TIG weld quality is strongly characterized by the weld pool geometry which has several quality characteristics as shown in Figure 1.1. These are;

- Upper width,
- Upper height,
- Penetration

Of the weld pool.

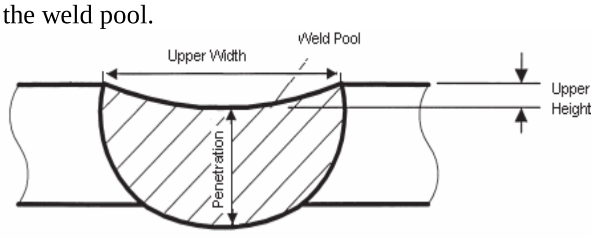

Figure 1.2: Weld Pool Geometry

Weld pool geometry plays an important role in determining the mechanical properties of the weld. Therefore, it is very important to select the welding process parameters for obtaining optimal weld pool geometry. Usually, the desired welding process parameters are determined based on experience or from a handbook. However, this does not ensure that the selected welding process parameters can produce the optimal or near optimal weld pool geometry for that particular welding machine and environment.

Advantages

1) Can be used to weld almost any metal as well as dissimilar metals.
2) Gives very good quality welds (structurally and appearance)
3) No slag involved
4) It is very good process for welding nonferrous metals & stainless steel

Disadvantages

1) Slow
2) Requires high skill to master
3) Tungsten if it transfers to molten weld pool can contaminate the same. Tungsten inclusion is hard and brittle.

2. Literature Review

Ugur Esme et al, [1] studied Application of Taguchi method for the optimization of resistance spot welding Low carbon steel is extensively used for deep drawing of motor car bodies, motor cycle parts, and other domestic applications. Therefore, the present work was planned to optimize the resistance spot welding parameters of SAE 1010 steel sheets with different thicknesses. The level of importance of the welding parameters on the tensile shear strength is determined by using ANOVA. Based on the ANOVA method, the highly effective parameters on tensile shear strength were found as welding current and electrode force, whereas electrode diameter and welding time were less effective factors. The results showed that welding current was about two times more important than the second ranking factor (electrode force) for controlling the tensile shear strength. An optimum parameter combination for the maximum tensile shear strength was obtained by using the analysis of signal-to-noise (S/N) ratio. The confirmation tests indicated that it is possible to increase tensile shear strength significantly by using the proposed statistical technique.

S. P. Gadeawar et al, [2] Investigated Weld characteristics for a single pass TIG Welding for SS304 This paper tries to investigate the effect of process parameters like weld current, gas flow and work piece thickness on the Bead Geometry (Front width and Back width) of the welded joint. The working range of the experimentation is decided by test experiments. For joining the work piece by TIG welding for 304 stainless steel , the process parameters play an important role. During experimentation it is found that, increase in the welding current result in increase in 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 with great extent. The effect of shielding gas flow on Bead Geometry when the current is kept constant. It is observed that for different shielding gas flow the change in Front width and Back width is observed across the weld. For lower thickness of work piece the Front width and Back width value is low ranging from 3mm to 4mm. It is observed that as thickness of the work piece increases the Front width and Back width value across the weld also increases, it is observed for 2mm thickness work piece and 3mm thickness work piece, the Front width and Back width value is ranged between 4mm to 7mm for change in shielding gas flow. For all the gas flow the value of the front width and Back width almost deviate slightly across the mean value.

Radha Raman Mishra et al, [3] carried out a study on tensile strength of Mig & Tig welded dissimilar joints of mild steel & stainless steel. During the study, mild steel and stainless steel of different grades were joined using TIG and MIG welding process. The tensile strength and dilution of welded joints were investigated. The main flaw which occurs in welding dissimilar material by MIG is the development of cracks during the welding, which needs more effort for achieving similar weld has by TIG welding.

R. Sathish et al, [4] carried out a study of Weldability and Process Parameter Optimization of Dissimilar Pipe Joints Using GTAW. The following conclusions are derived from this project, the Gas flow rate is the factor that significantly contributed to a higher percentage and has greater influence on the tensile strength followed by contributions from current and bevel angle. Variation in heat input resulted in significant changes in the mechanical properties of the weld. Results show that lower heat input resulted in lower tensile strength and too high heat input also resulted in reduced tensile strength. An intermediate value of average heat input in the range of 1500 to 1600 J/mm gave the highest tensile strength.

S A Patil et al, [5] studied the optimization of process parameters for enhancing welding penetration in activated flux coated tungsten inert gas welding. During his study they were investigated that the optimum parameters for enhancing weld penetration for AISI304 steel plate
100mm*70mm*5mm* are obtained, when current is 175amp, Gas flow rate is 12.5 litter per mintute, welding speed 1.6mm/second.

Raghuvir Singh et al, [6] investigated the effect of Tig welding parameters like welding current, speed, and flux on depth of penetration & width in welding of 304l stainless steel has been studied. From 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 & having less bead width

3. Conclusion

From various literature surveys it is observed that most of the welding parameters like welding current, welding speed, flux, depth to width ratio are usually used in research work. Also TIG welding is carried out on various materials like mild steel, stainless steel, titanium alloy, brass, bronze etc. Also the welding of dissimilar material is possible bye the use of TIG welding

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