A Review Paper on GTAW for Identifying usage of Argon gas

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ABSRACT- Welding is used to join metals. Arc welding does this by using an electric arc that creates an intense amount of heat, which melts metals and allows them to join together. Gas Metal Arc Welding (GMAW) process is leading in the development in arc welding process which is higher productivity and good in quality. In this study, the effects of different parameters on welding penetration and hardness measurement in given work piece by using the argon gas metal arc welding are investigated. The shielding gas in GTAW has significant impact on the weld bead shape. Using Argon will form a wider Arc and lower heat transfer to the anode surface, which means less penetration and colder arc. The penetration and hardness were measured for 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.

Keywords— GTAW, Hardness, Welding Parameter, Shielding Gas, Argon gas, Penetration.

1.INTRODUCTION

Welding is a fabrication process whereby two or more parts are fused together by means of heat, pressure or both forming a join as the parts cool. Welding is usually used on metals and thermoplastics but can also be used on wood. The completed welded joint may be referred to as a weldment. Welding is the most common, economical and efficient way of joining the two similar or dissimilar metals permanently and effectively. It is basically the easiest and simple process of joining two or more pieces of metal to make them act as a single entity. The welding process involves higher number of variables than those involved in any other manufacturing process. There are numerous number of applications of the welding process like in heavy machineries such as cranes, printing presses and textiles industries etc.

Welding current is the most influencing parameter in welding process which controls the depth of fusion; the electrode feed rate and depth of penetration. The amount of heat developed during welding depends upon the current used for given size of electrode and filler wires. It is therefore essential that a correct current is used to produce good quality of weld and reduce the distortion problems on the job. Welding voltage is the electrical potential difference between the tip of the welding wire and the surface of the molten weld pool. It determines the shape of the fusion zone and weld reinforcement. High welding voltage produces wider, flatter and less deeply penetrating welds than low welding voltages. Depth of penetration is maximum at optimum are voltage. The effect of welding current on arc time which help to analysis the arc time with respect to varying welding current was that by increasing welding current the arc time decreases. It is clear from figure that describes the arc time decreases by increasing welding current.

Welding gases are gases used or produced during welding and cutting processes like shielding gases or gases produced by the decomposition of fluxes or from the interaction of ultraviolet light or high temperatures with gases or vapours in the air.

THE TYPES OF WELDING GASES USED FOR SHIELDING

1. ARGON (AR)
2. HELIUM (HE)
3. CARBON DIOXIDE (CO2)
4. OXYGEN (O2)
5. NITROGEN (N)
6. HYDROGEN (H)
7. ACETYLENE
8. PROPANE
9. PROPYLENE

ARGON GAS

Argon is a chemical element (Ar). It is the third most abundant gas in the atmosphere, which makes it largely available and therefore, relatively cheap. Argon is produced by distillation of liquid air. It is then put in gas bottles and sold. The argon gas is widely used in different welding techniques. The argon welding gas serves as a shield for the fresh weld of its surrounding atmosphere. This provides several benefits, making the welds more seamless and durable. We will talk more about that further down this article, but first, let us answer some of the most common questions about the Argon properties

2.LITERATURE SURVEY

[1] Howse et al. (2000) associated the greater penetration of activated TIG welding to a constriction of the arc. Information on these processes is necessary to determine the TIG penetration capability improvement function of the activated flux. Because austenitic stainless steels have a higher coefficient of thermal expansion and lower thermal conductivity than carbon and alloy steel, it can induce a large amount of shrinkage and distortion after welding fabrication.

Determining the effect of the activated flux on weld distortion is essential to improving the performance of the stainless steel activated TIG technique. This study used five different kinds of oxide fluxes to investigate the effect of single component flux on the morphology and distortion of Type 316L stainless steel TIG welds. Aside from studying the microstructure and hardness of activated TIG weld metal, this study investigated the theoretical and experimental mechanisms for increasing the A-TIG penetration capability.

[2] **Guttikonda Raja Kumar et. al. (2016)** have worked on effect of activated flux and nitrogen addition on the bead geometry of borated stainless-steel GTA welds. Borated stainless steels (304B) are used in nuclear power plants as control rods, shielding material, spent-fuel storage racks and transportation casks as they have a high capacity to absorb thermal neutrons. In this study, bead-on-plate welds were made on 10-mm-thick 304B plates using gas tungsten arc welding with Ar and Ar+2% nitrogen as the shielding gases, activated-flux GTA and electron-beam welding processes.

The effects of the activated flux and nitrogen addition to the weld metal through the shielding gas, on the microstructure, bead geometry and mechanical properties were investigated. Activated-flux GTA welding and electron-beam welding substantially enhanced the depth of penetration and the aspect ratio compared to the other processes. GTA, nitrogen-added GTA and activated-flux GTA welds exhibited a partially melted zone adjacent to the fusion zone; with the activated-flux GTAW process resulting in a significantly thinner partially melted zone (PMZ). No PMZ was noticed in the EB welds. All the welds exhibited a high joint efficiency and impact toughness equal to those of the base material. It is concluded that the activated-flux GTA and EB welding processes are advantageous due to the use of a low heat input and failure location.

[3] **Memduh Kurtulmus et. al. (2017)** have worked on Activated Flux TIG Welding of Austenitic Stainless Steels. The TIG welding with active flux (A-TIG welding) consists in depositing a thin layer of flux on the work piece surface just before the welding. It is found that with this process it is possible to increase the weld penetration and productivity up to three times higher or more compared to the TIG process in metals. In this review paper, ATIG welding of austenitic stainless steels is examined.

The welding flux, the shielding gas and the welding parameters affect the weld penetration in A-TIG welds. The effects of the activated flux welding mechanisms, the flux chemical composition, thickness of the flux, flux powder size welding current, the arc voltage, the arc length, the welding speed and composition of the shielding gas on weld geometry of austenitic stainless steel A-TIG welds are explained in detail.

[4] M. Zuber et al. (2014) have worked on effect of flux coated Gas Tungsten Arc Welding on 304L. Purpose of present work is to investigate the effect of oxide flux on welding of austenitic stainless steel 304L plates having thickness 8 mm its effect on welding distortion, ferrite number, hardness value and depth of penetration. SiO2 is used as a flux in the form of powder mixed with the acetone and applied on bead plate without making a joint preparation and without addition of filler wire.

The result showed that this technique can increase depth of penetration and weld aspect ratio resulting in lower angular distortion. Finite Element analysis of plate has been carried out using SYS WELD. Three dimensional double ellipsoidal heat source is used to model the heat flow during the welding finally transient thermal analysis of welded plate has been done for study the peak temperature reaching in flux coated GTA welding.

[5] **Kumar et al**., developed a mathematical model for SAW using Response Surface Methodology, to predict critical dimensions of the weld bead geometry and shape relationships. The models have been checked for their adequacy and significance by using the F-test and the test respectively. Main and interaction effects of the process variables on bead geometry and shape factors are presented in graphical form. They considered four process variables where welding current had a significant positive effect but welding speed had an appreciable negative effect on most of the important bead parameters. Penetration (P) increased by 2 mm with the increase in welding current by 1000 Amperes from 375 to 475 amperes whereas penetration decreased by about 1.4 mm with the increase in welding speed from 24 to 30 m/hr. The bead width decreased by 2.12 mm with increase in welding speed from 24 to 30 m/hr.

Reinforcement decreased from 3.39 to 2.92 mm when welding speed increases from 24 to 30 m/hr, but when current changed from 375 to 475 amperes, it value increased from 2.59 to 2.97 mm. Open circuit voltage had a negative effect on penetration, but more significant negative effect was observed on reinforcement. Voltage had a significant positive effect on bead width, weld penetration size factor and weld 18 reinforcement form factor.

[6] **Tarng et al**., used Fuzzy Logic in the Taguchi method to optimize the submerged arc welding process parameter with multiple performance characteristics, an orthogonal array, signal to noise ratio, multi response performance index and analysis of variance have been employed.

The process parameters namely arc current, arc voltage, welding speed, electrode extrusion and pre heat temperature have been optimized with the deposition rate and the dilution. RSM was employed to develop mathematical relationships between the welding process parameters and the output variables of the welded joint to determine the welding input parameters that lead to the desired weld quality.

[7] **Mostafa and Khajavi ,** described the prediction of weld penetration as influenced by Flux Cored Arc Welding process parameters like welding current, arc voltage, nozzle-to-plate distance, electrode-to-work angle and welding speed. The optimization result shows penetration will be maximum when welding current, arc voltage, nozzle-to-plate distance and electrode-to- work angle is at their maximum possible value and welding speed is at its minimum value. Increase in welding current (I) increases the depth of penetration (P). Increase in welding speed (S) causes a decrease in depth of penetration (P).

Increase in arc welding voltage (V) resulted in an increase in depth of penetration (P), Increase in electrode-to-work angle from 90° to 120° (i.e. for normal to backhand) had resulted in increase of depth of penetration. Increase in nozzle-to-plate distance (N) also causes an increase in depth of penetration (P). Based on this investigation it can be concluded that the developed model can be used to predict adequately the weld bead penetration within the specified range of the process parameters. The optimization method can also be used to find optimum welding conditions for maximum weld bead penetration.

Their results are in agreement with the results of Chandel.

[8] **Erdal Karadeniz** et al., have investigated the effects of various welding parameters on weld penetration in Erdemir 6842 steel of 2.5 mm thickness welded by Robotic Gas Metal Arc Welding Process. The welding current, arc voltage and welding speed have been chosen as variable process parameters. The depths of penetration have been measured for each specimen after the welding operations and the effects of these welding process parameters on penetration have been determined.

The welding currents in step of 95A, 105A and 115 A, Arc voltages in steps of 22V, 24V and 26 V and welding speeds in steps of 7,10 and 14 mm/s have been used for all experiments. It has been found that increase in current; substantially increases the depth of penetration while increase in voltage, very slightly increases the penetration. The highest penetration has been observed at 10mm/s welding speed.

[9] **Naitik s Patel et al.,** carried out the features highlighting the TIG as a better prospect for welding then other processes especially for joining of two dissimilar metal 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.

[10] Leroy Gardner, comprising tensile test on flat and corner materials. Initial geometric imperfections were generally low in both the hot rolled and cold rolled steels sections, with large imperfections emerging towards the ends of the cold formed members. Current codified slenderness limit was evaluated on the basis of compressive and bending test on hot rolled and cold rolled section.

[11] Juile mill (2004), self-drilling screw joint for cold rolled steel channel portal. The conclusion of earlier testing by the first author that widely used bolted and plate moments connection is not suitable. They knew joint of portal frames constructed from thin cold formed channel sections. The order traditionally used joint configuration of a mitred joint with two bolts is end is end plates may need to be sized conservatively.

[12] Shah Foram Ashok bhai , steel consumption is more in industrial shed structure using hot rolled steel and cold rolled steel sheets as compared to industrial shed structure using cold formed steel sections. The weight is more in industrial shed which use of hot rolled sheets. The weight of industrial shed with cold formed sections is reduced with 32.03% than industrial shed structure with hot rolled sheets. An attempt is being carried out the comparison between hot rolled and cold rolled steel.

[13] D. Devakumar& D. B. Jabaraj, the gas tungsten arc welding (GTAW) of sheets 2mm thickness of hot rolled medium and high tensile structural steel (HRS) is carried out to investigation of mechanical properties and composition analysis through energy dispersive analysis of X ray (EDAX) to find out the hardness test, tensile test, bend test to determine the mechanical properties of the weldments.

The increase in the weld zone micro hardness and formation of dendritic delta ferrite microstructure, when compared with HRS parent metal having elongation grained austenite with ferrite and the HRS parent metal having fine grains of ferrite, caused the joint efficiency of the HRS weldments to increase.

[14] Ruangyot Wichienrak & Somchai puajindanetr, cold rolled steel industry in type of batch annealing furnace, the mechanical properties of steel sheet have variation by each position. The parameters of annealing temperature and time were analysed to work out the source of mechanical properties variation.

The mechanical properties which were examined i.e., Yield strength, tensile strength, % elongation and hardness. Increasing the annealing temperature could remarkably decrease the yield strength, tensile strength and hardness, whereas the % elongation model 5982.

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[17] **Sanchita.S.Nawale,** thin sheet steel products are extensively used in building industry. These thin steel sections are cold formed i.e. their manufacturing process involves forming steel sections in a cold state (i.e. without application of heat) from steel sheets of uniform thickness. The thickness of the cold rolled sheets is usually 1 to 3mm.

The method of manufacturing is important as it differentiates these products from hot rolled steel sheets. Normally, the yield strength of steel sheets used in cold from sections is at least 280N/mm2, although there is a trend to use steels of high strengths, sometimes as low as 230N/mm2.

[18] **Chunquan Liu et al,** study and investigation of mechanical properties of hot rolled and cold rolled steel. In experimental steel, processes by quenching and tempering (Q&T) heat treatment, exhibited excellent mechanical properties of hot rolled (strength of 1050-1130 MPa) and cold rolled steel (strength of 878-1373 MPa). The fracture modes of hot rolled sample, quenched from 650^{o}c, and cold rolled sample, quenched from 650^{o}c.

[19] Brend Wolter & Gred Dobmann, In forming of steel by hot rolled and cold rolled steels a broad range of semi- finished and final products can be produced with a specific, custom-tailored technological properties. Micro-magnetic techniques, like 3MA have been reached a sophisticated level of industrial standard and are ready to be integrated into the production process of steel manufacturers.

Mechanical properties, like tensile, yield strength and hardness as well as residual or structural stress level can be predicted with high accuracy.

[20] L.F. Guimarães de Souza et al.(2003), have done microstructural investigation of solitary pass 2.25% Cr-1.0% Mo steel weld metal with various manganese substance. Weld metals of the 2.25% Cr-1.0% Mo type with 0.84%, 1.21% and 2.3% Mn created by submerged curve welding were broke down in the as-welded (AW), post weld warm treatment (PWHT) and PWHT pursued by step-cooling (SC) warm treatment conditions. A checked carbide precipitation was watched, specially at grain limits. This could be credited to the SC warm treatment and related with the embrittlement. Notwithstanding, the use of a de-embrittlement warm treatment to this progression cooled weld metal has demonstrated proficient, in light of the fact that the effect vitality after this warmth treatment outperformed those acquired in the pressure assuaged condition. This was unmistakably shown that isolation of polluting influences to grain limits were in charge of the low effect vitality levels.

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