"INVESTIGATION OF GTAW USING ARGON-HELIUM SHIELDING GAS MIXTURE BY GA ON SDSS MATERIAL"

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ABSTRACT

Gas tungsten are welding has wide application in industries due to its advantages such as high reliability, low cost, higher production rate, shielding gas is a concept which used in GTAW welding.

In Present work, an attempt has been made to use different shielding gas composition use to improve weld appearance and strength of the weld-melt and using optimal technique like Genetic algorithm getting best combination of process parameters.

Gas tungsten are welding (GTAW) welding with filler wire addition is a candidate process for welding of SDSS. In GTAW, the quality of the weld is characterized by the weld-bead geometry as it influences the mechanical properties and its performance during service. This work focuses on the and optimization using Genetic Algorithm for determining the optimum/near-optimum GTAW process parameters for obtaining the optimum weld-bead geometry during welding of SDSS material. Parameters selected for study were Welding current, Trails were carried using with different Shielding gas mixtures, Filler Rod Diameter.

Key words:-*GTAW, Shielding gas mixture, Genetic algorithm*.

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1 INTRODUCTION

Tungsten Inert Gas (TIG) or Gas Tungsten Arc (GTA) welding is the arc welding process in which arc is generated between non consumable tungsten electrode and work piece. The tungsten electrode and the weld pool are shielded by an inert gas normally argon and helium. deforming the surface plastically, under compressive loads. Under this external load, the surface of the component is subjected to cold working. One such SPD process that has gained increasing acceptability in the manufacturing industry is burnishing. Burnishing is a surface modification process which produces a very smooth surface finish cylindrical surface. The tool may consist of one or more ball or roller. This process does not involve the removal of material from the work pieces.
The tungsten arc process is being employed widely for the precision joining of critical components which require controlled heat input. The small intense heat source provided by the tungsten arc is ideally suited to the controlled melting of the material. Since the electrode is not consumed during the process, as with the GTAW welding processes, welding without filler material can be done without the need for continual compromise between the heat input from the arc and the melting of the filler metal.

As the filler metal, when required, can be added directly to the weld pool from a separate wire feed system or manually, all aspects of the process can be precisely and independently controlled i.e. the degree of melting of the parent metal is determined by the welding current with respect to the welding speed, whilst the degree of weld bead reinforcement is determined by the rate at which the filler wire is added to the weld pool. In TIG torch the electrode is extended beyond the shielding gas nozzle. The arc is ignited by high voltage, high frequency (HF) pulses, or by touching the electrode to the work piece and withdrawing to initiate the arc at a preset level of current.

Selection of electrode composition and size is not completely independent and must be considered in relation to the operating mode and the current level. Electrodes for DC welding are pure tungsten or tungsten with 1 or 2% Thoriated, the Thoriated being added to improve electron emission which facilitates easy arc ignition. In AC welding, where the electrode must operate at a higher temperature, a pure tungsten or tungsten -zirconea electrode is preferred as the rate of tungsten loss is somewhat lesser than with thoriated electrodes and the zirconea aids retention of the balled' tip.

Autogenously GTAW welding (with filler metal) is used in thin square edged sections (mm), while V and X type edge preparations are needed in thicker sections. In this case, the addition of filler metal is necessary. This process is extensively used for welding thin components of stainless steel, aluminum, magnesium or titanium alloys as well pieces of DSS OR SDSS.

Heat input in GTAW does not depend on the filler material rate. Consequently, the process allows a precise control of heat addiction and the production of superior quality welds, with low distortion and free of spatter. It is less economical than other consumable electrode arc welding processes, due to its lower deposition rate, and it is sensitive to windy environment because of the difficulty in shielding the weld pool. Besides it shows low tolerance to contaminants on filler or base metals.

2 LITERATURE REVIEW

A.Karpagaraj, N.Sivashanmugam, K.Sankaranarayanasamy [1] 2015 investigated on Gas Tungsten Arc Welding (GTAW) is a commonly used welding process for welding Titanium materials. Welding of titanium and its alloys poses several intricacies to the designer as they are prone to oxidation phenomenon. The proposed design and arrangement have been employed for joining commercially pure titanium sheets with variations in the GTAW process parameters namely the welding current and travel speed. Bead on plate (BOP) trials were conducted on thin sheets of 2mm thickness by varying the process parameters. Subsequently, the macrostructure images were captured. Based on these results, the process parameters are chosen for carrying out full penetration butt joints on1.6 mm and 2 mm thick titanium sheets.

P. Sathiya, P. M. Ajith and R. Soundararajan [2] 2014 has studied The present study is focused on welding of super austenitic stainless steel sheet using gas metal arc welding process with AISI 904 L super austenitic stainless steel with solid wire of 1.2 mm diameter. Based on the Box - Behnken design technique, the experiments are carried out. The input parameters (gas flow rate, voltage, travel speed and wire feed rate) ranges are selected based on the filler wire thickness and base material thickness and the corresponding output variables such as bead width (BW), bead height (BH) and depth of penetration (DP) are measured using optical microscopy. Based on the experimental data, the mathematical models are developed as per regression analysis using Design Expert 7.1 software. An attempt is made to minimize the bead width and bead height and maximize the depth of penetration using genetic algorithm.

G. Magudeeswaran, Sreehari R. Nair, L. Sundar et al. [3] 2014 has studied the weld bead in the form of aspect ratio i.e. width to depth ratio of Activated TIG welding. The input parameters were Electrode gap, Travel speed, Current and Voltage. L9 (34) OA with 4 columns and 9 rows was used for carrying out readings. Results obtained from ANOVA are: electrode gap is the most significant factor on aspect ratio with contribution of 53.99%, followed by current with contribution of 27.62%. The voltage and travel speed are insignificant with contribution of 14.55% and 3.82% respectively. The optimum welding parameters are found to be electrode gap of 1 mm, travel speed of 130 mm/min, current of 140 A, and voltage of 12 V. The aspect ratio is found to be 1.24 for the joints fabricated using the optimized process parameters and is well within the acceptable range to avoid solidification cracking.

M. Hoseinpoor, M. Momeni, M.H. Moayed, A. Davoodi [4] 2014 investigated critical pitting temperature (CPT) of 2205 duplex stainless steel (DSS2205) was assessed using electrochemical impedance spectroscopy (EIS) in ferric chloride solution. In order to verify the results other methods such as ASTM G 48, potentiodynamic and potentiostatic polarization and zero resistance ammeter (ZRA) were also employed. The results show a strong close relation between the results of this method by those of previous methods. CPT of the alloy is 40 _C based on standard method and 44 C, 49 C according to the ZRA and potentiostatic methods. Both potential dynamic and EIS methods give an almost identical CPT value.

N. Kiaee, M. Aghaie-Khafri [5] 2014 has studied parameters namely current, welding speed and shielding gas flow rate on Tensile strength and Hardness using RSM. Applying RSM, simultaneous effects of welding parameters on tensile strength and hardness were obtained through two separate equations. Empirical relation for tensile strength. HAZ hardness and weld hardness was obtained. The adequacy of the developed relationship was tested using the analysis of variance technique (ANOVA). Tensile strength has maximum value of 528MPa can be obtained at the current of 127 A, gas flow rate of 16 l/min and welding speed of 9 cm/min. Maximum value of 213 HV for HAZ hardness is achieved at the current of 150 A, gas flow rate of 15 l/min and welding speed of 13 cm/min. Besides, at the welding speed of 9 cm/min, HAZ hardness value of greater than 186 HV is never obtained. The maximum value of 230 HV for weld hardness can be gained at the current of 150 A, gas flow rate of 15 l/min and welding speed of 13 cm/min, hardness values greater than 205 HV for weld metal may not be obtained at the welding speed of 9 cm/min. The optimum value obtained were current of 130 A, welding speed of 9.4 cm/min and gas flow rate of 15.1 l/min.

R. Sudhakaran, V. Vel Murugan et al. [6] 2013 has developed a neural network model for predicting depth of penetration and optimizing the process parameters for maximizing depth of penetration using simulated annealing algorithm. The process parameters chosen for the study are welding current, welding speed, gas flow rate and welding gun angle. The chosen output parameter was depth of penetration. The experiments were conducted based on design of experiments using fractional factorial with 125 runs.The percentage of error of the neural network model was calculated as the percentage difference between the experimental and predicted value relative to the predicted value. The results show that the percentage error is in the range of 0.7 to -1.2%. When welding current increases, shielding gas increases and gun angle increases, depth of penetration also increases. But when welding speed increases depth of penetration decreases. The maximum depth of penetration obtained from experimental studies was 3.48 mm when the process parameters such as welding current, shielding gas flow rate and welding gun angle were at 110 amps, 25 l/min and 90o, respectively, and welding speed was at 200 mm/min. The optimum values of the process variables obtained from SA are Welding current 110 amps, Welding speed = 210 mm/min, Shielding gas flow rate = 25 l/min, Welding gun angle = 90 for DOP of 3.778mm.

Dongjie Li, Shanping Lu, Dianzhong Li, Yiyi Li [7] 2012 were investigated the A new welding method named double shielded tungsten inert gas (TIG) has been developed to improve the TIG weld penetration. The main principles to increase the weld depth have been discussed. Results show that the critical oxygen content in the weld pool is around 100*10-6 as the temperature coefficient of surface tension changes from negative to positive. The tracer test using pure silver shows that the direction of Marangoni convection changes as the oxygen content increases in the weld pool. The effect of arc constriction on the weld depth has been evaluated on a water-cooled copper plate, and the result indicates that the torch of double shielded can give a more powerful arc. Heavy oxide on the pool surface has undesirable impacts on the increasing of weld depth as the oxygen excessively accumulates in weld pool. It is possible to form chromium oxide in the weld process, while the iron oxide may form as the weld surface exposes to the air after the shielded gas moving away.

M.T.Z. Butt, M.S. Ahmad and M. Azhar [8] 2012 were investigated the GTAW (Gas Tungsten Arc Welding) process is one of the most significant processes of joining two or more pieces of the same or dissimilar materials to achieve complete coalescence using an inconsumable tungsten electrode. The present investigation is an attempt to study the variations in mechanical properties by both changing the base materials with respect to AISI 316 steel i.e. using SA516GR70 as well as annealing AISI 316 and SA 516GR70 plates initially and then welding to AISI 316. TIG welded AISI 316 with AISI 316 steel gives most moderate results to be used in required applications with least number of service limitations. Since UTS for TIG welded AISI 316-SA 516 is higher than AISI 316-AISI 316 but it has a lower value of impact strength than AISI 316-AISI 316 welds. AISI 316-SA516GR70 weldment has a number of limitations when applicable in service conditions. An attempt to increase the properties by initially annealing can be of worth when the welding parameters could be considered (e.g. welding current, groove design, filler etc), hence mechanical characterization infers that AISI316-AISI316(annealed) can be thought of importance when the prevailing conditions are moderate enough and the weldment is quite feasible to bear such service conditions where as AISI316-SA516(annealed) proves to be of less importance from service point of view due to formation of complex grain structure near the fusion boundary and heat affected zone on the 516 annealed side of the weldment.

P. Sathiya, Mahendra Kumar Mishra , B. Shanmugarajan [9] 2011 This paper investigates the bead geometry, microstructure and mechanical properties of AISI 904 L super austenitic stainless steel joint by CO2 laser–GMAW hybrid welding process. Shielding gas is one of the important parameters for the process stability and efficient synergetic effects between laser and gas metal arc welding (GMAW). A detailed study of CO2 laser–GMAW hybrid welding with different shielding gas mixtures in different ratio (50%He + 50%Ar, 50%He + 45%Ar + 5%O2, and 45%He + 45%Ar + 10%N2) was carried out on AISI 904 L super austenitic stainless steel sheet of 5 mm thickness. The weld penetration of hybrid welding was determined by the plasma shape varying with the shielding gas parameters, especially the plasma height interacting with incident plasma. Finally, hardness test is performed along the longitudinal direction of the weld zone. The results showed that the joint by laser–GMAW hybrid had higher tensile and impact strength than the base metal. The fractrography observation showed the cup-cone shaped fracture while the hybrid welding joint mixed mode of fracture.

P. Sathiya, K. Panneerselvam, M.Y. Abdul Jaleel [10] 2012 were investigated the quality of a weld joint. The quality of the joint can be defined in terms of properties such as weld bead geometry, mechanical properties and distortionIn this study, the weld bead geometry such as depth of penetration (DP), bead width (BW) and tensile strength (TS) of the laser welded butt joints made of AISI 904L super austenitic stainless steel are investigated. Artificial neural networks (ANNs) program was developed in Mat Lab software to establish the relationship between the laser welding input parameters like beam power, travel speed and focal position and the three responses DP, BW and TS in three different shielding gases (argon, helium and nitrogen). The established models are used for optimizing the process parameters using genetic algorithm (GA).

3. CONCLUSION

After Literature review of number of papers I have observed that Most of researches have been carried out to study the effect of various process parameters on material properties and shielding gas but not evaluate best shielding gas mixture. Research Papers of Genetic Algorithm (GA) it has been used for many optimization problems very effectively and its benefits can also be utilized for the optimization of process parameters of GTAW welding Also research on best shielding gas mixture considering the following parameters has never been done. Review of TIG research paper shows there is a repeatable use of some of the parameters in DC TIG welding, Filler rod diameter's effect on quality of weld is very less studied and type of Electrode used for is always kept constant i.e. 2% thoriated tungsten electrode. GTAW with filler metal and heat applied is suitable welding procedure for SDSS. The arc Power and arc sound and polarity were found to be strongly co-relegated with the weld quality

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