Parametric Optimization Of Gas Metal Arc Welding (GMAW) Process By Using Taguchi Method On AISI304

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Abstract- *Welding is most commonly used permanent joining method used for fabrication, repair and maintenance purpose. Heat welding is the most frequent applicable welding methods in current manufacturing scenario. Arc welding, which is at type of heat welding is one of the most important manufacturing process. . In present research the experimental work is performed to control the performance of welding process in connection of atmospheric parameters. For the same Taguchi methods is applied for obtaining the parametric optimization. Optimum Parameter in addition of full Weld Penetration the tensile strength obtained to be 707 N/mm2 which is supposed to be within the Standard range of Tensile strength. All these targets are achieved by making an experimental setup.*

Keywords- Arc welding, fracture, buckling, inert gas, Taguchi method.

I. INTRODUCTION

Introduction of Welding

Welding is very ancient method used for permanent joining. The earliest form of welding was known by forge welding method, after that in current scenario there are lot of forms of welding are developed. The American Welding Society (AWS) presents official abbreviations for various welding process. For example, RSW is stands for the resistance spot welding and SMAW is stands for the Shielded metal arc welding**.** The SMAW is an arc-welding process which fuses (melts) metals by the application of extremely produced heat produce from electrodes and due to fusion of metal welding join is prepared. The most significant difference between the various welding processes is the method of heat generation for melting the base metal.

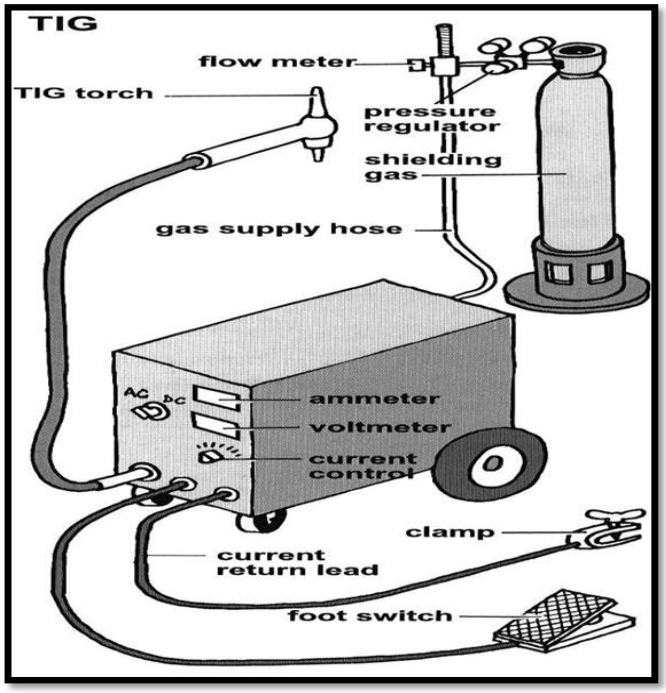


Figure 1 Schematic Diagram of TIG Welding Process

II. LITERATURE REVIEW

1. Kuang-Hung Tseng and Kuan-Lung Chen try to study comparison between TiO2- and SiO2-Flux Assisted TIG Welding Processes. In this study researcher investigates the effects of flux compounds on the weld shape, ferrite content, and hardness profile in the tungsten inert gas (TIG) welding of 6 mm-thick austenitic 316 L stainless steel plates, by usingthe TiO2 and the SiO2 powders. A plasma column made with SiO2 flux shows greater limitation than that made with TiO2 flux.
2. Ugur Esme, Melih Bayramoglu, Yugut Kazancoglu, Sueda Ozgun used Gry relastion analysis and Taguchi method for optimization of weld bead geometry in TIG Welding.Sixteen experiments were performed according to derive objectives required within experimental domains. The objectives were selected in accordingly to the parameters of TIG welding bead geometry; the bead width, the bead height, the penetration, the area of

penetration as well the width of heat affected zone and tensile load. Optimal results have been verified through more experiments.

3. S. P. Gadeawar Investigated Weld characteristics for a single pass TIG Welding for SS304 and the results of the process parameters like the weld current, the gas flow , the work piece thickness upon Bead Geometry of the welded joint. For joining the work piece by TIG welding for 304 stainless steel, the process parameters play an important role. Increase in welding current result in the increasein 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.
4. Activated flux is a mixture of inorganic powder suspended in an organic solvent. Researchers at the E.O. Paton Electric Welding Institute of National Academy of Sciences of Ukraine (Kiev) introduced a novel concept using the TIG-flux welding to increase penetration of titanium alloy welds in the 1960s, as reported by Gurevich. While using the specific Flux, the compassion of weld shape to variations in the chemical composition of the base metals can be decreased.
5. Heiple and Roper, through including interracially active elements such as O, S, and Se in ferrous alloys, have arranged for the surface tension temperature gradient to change from negative to positive $\partial\gamma/\partial T > 0$, and have proposed the changed convection direction model shown in Figure b. In this case, the weld pool has a narrower width and greater penetration depth.

III. METHODOLOGY

For studying the effects of Welding Process parameters on the weld penetration in the TIG welding heat source is most commonly required. Heat source produces the electric arc which generates the heat for melting the metals and to form the weld for particular purpose which is to be continuous supplied either by direct current or by the alternating electric current. The experiments were carried out on INARC400-i series IGBT Inverter based arc welding power source with soft switching technology TIG Welding machine of WARPP ENGINEERS installed at SAIRAJ INDUSITRIES, Tiny Industry zone M.I.D.C Chikalthana, Aurangabad.

Welding Machine Tool Details

This TIG welding machine has fallowing technical specifications

1.	Input power	18.4 KVA
2.	Current range	20A-400 A
3.	Duty cycle	60%
4.	Weight	43 Kg
5.	Input supply	380-440 V
6.	Efficiency at full load	89%
7.	Power factor	0.95
8.	Ambient Temperature	40 degree C

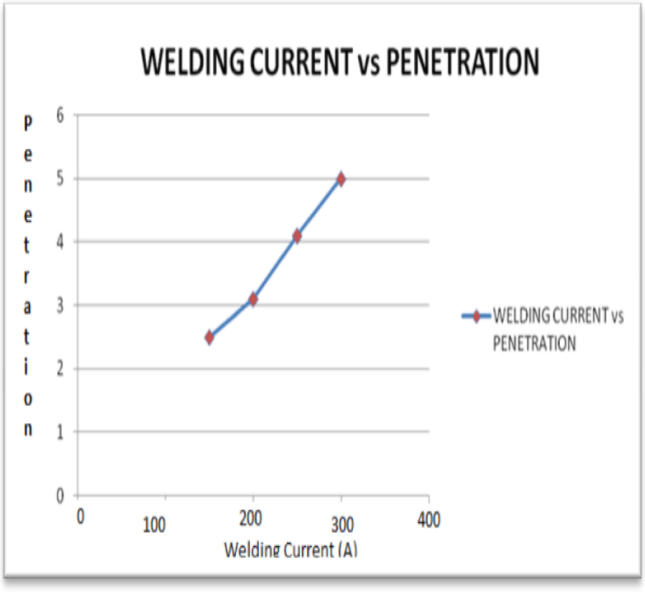
Figure TIG Welding Machine with Argon Cylinder & Welding Torch

Preparation of Specimens

The SS304 sheet is converted in to the desired 100mm×70mm×5mm size by using shearing operation. After shearing the work pieces are straighten by holding them in a press. The burr from the cut edges of the work pieces is removed by manual filing the plate surface was ground using 400 grit (silicon carbide) flexible abrasive paper to remove the impurities, and then clean the surface with acetone .

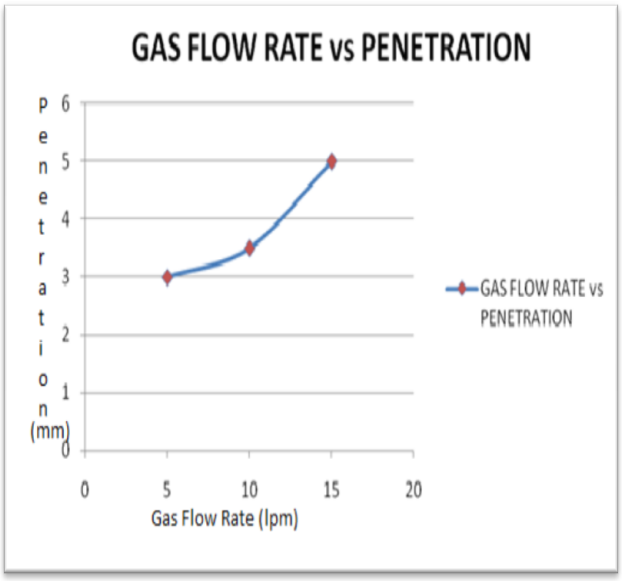
Effect of Current on Weld Penetration

Welding current is the most influential parameter because it affects bead shape, controls the rate at which electrode is melted and therefore also controls the deposition rate, heat affected zone, the depth of penetration, and the amount of the base metal melted. Gas flow rate 10 LPM, Welding speed 1.6 mm/s and torch angle 60 degree. Following result is observed for various current.



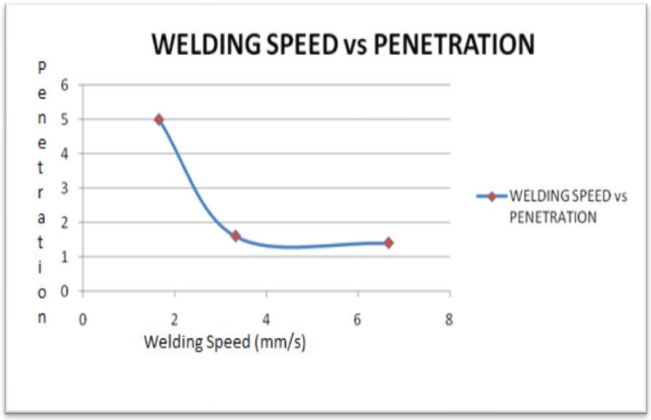
Effect of Gas Flow Rate on Weld Penetration

In the second case, for studying the gas flow rate effects on the weld for parameters which are constant to Current 200 A, the welding speed of 1.6 mm/s and the torch angle of 60 degree. Following are the impacts which are observed for various Gas flow rate.



3Effect of Welding Speed on Weld Penetration

In the third case, for studying the effects of welding speed on the weld penetration taking these parameters as constant current as 200 A, gas flow rate as 10 LPM and the torch angle of 60 degree. Following result are observed for various Welding speed.



IV. RESULT AND DISCUSSION

RESULTS OF THE EXPERIMENTS

The best result for welding penetration by the Taguchi Method is given as below;

1. According to Taguchi methods, an attempt is made to determine set of values of process variable at their selected levels
2. Predicted optimum value of the welding penetration 4.89 mm but the actual value for the welding penetration is 5.00 mm at the conditions of confidence interval as shown in table where results are according to the Taguchi method.

Predicted Value Vs Actual Value of Welding Penetration

Response	Predicted Value	Actual Value
The welding Penetration Set for the optimum value of the process parameters are as below, • Welding Current 175 Amp • Gas flow rate 12.5 LPM • Welding Speed 1.66 mm/sec	4.89 mm	5.0 mm

Adding advantage to welding Penetration is that one additional test is performed which analyze the tensile strength. The standard value of tensile strength for 5mm AISI304 Plate is in the range of 540 to 750 N/mm^2 and when the Specimen is welded with Cr2O3 Coating. Optimum Parameter in addition of full Weld Penetration the tensile strength obtained to be 707 N/mm2 which is supposed to be within the Standard range of Tensile strength.

V. CONCLUSION

Aim of project is find out best process parameters for welding of SS304 plate of 5mm thickness. Selection of process parameters is on bases of literature review and economical suitability of industrial application. Design of experiment is most suitable method for find out best process parameters for ATIG Welding. According to literature review, preliminary experiments and economical consideration process parameters selected as current 150A,175A,200A, Gas flow rate (LPM) 10,12.5,15 and for time period of 30, 45, 60 Second and experiments take at same time at same machining environment by etching work piece at time in chemical**.** The next chapter deals with the results and analysis of experiments done on the Stainless Steels

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