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Experimental Analysis on TIG welding process parameters of SS304 By Using Taguchi Method

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Abstract - *Tungsten Inert Gas welding is one of the most widely used techniques for joining ferrous and non ferrous metal. The arc is generated between a non-consumable tungsten electrode and work-piece, Argon gas protects the molten metal form any chemical reaction with he surrounding environment. The SS304 material used for experimental work.In this project SS304 sheet material having 3 mm thickness will weld using TIG welding.*

Keywords: **Tig welding, Anova, Taguchi method, Minitab, Stainless Steel.**

1. INTRODUCTION

Welding, as opposed to lower-temperature metal-joining procedures like brazing and soldering, which do not melt the base metal, is a manufacturing or artistic approach that induces fusion between materials, primarily metals or thermoplastics. A filler material is frequently added to the joint in addition to melting the base metal to create a pool of molten material (the weld pool) that cools to form a joint that can be stronger than the base metal depending on the weld design (butt, full penetration, fillet, etc). (metal parent) To make a weld, pressure can be employed alone or in conjunction with heat. Welding also needs the employment of a shield to protect the filler metals or molten metals from contamination or oxidation. A welding junction is a point or edge that joins two or more metal or plastic parts together. They're created by joining two or more work components (metal or plastic) in a certain shape. Joints are divided into five types by the American Welding Society: butt, corner, edge, lap, and tee. These systems can have a number of arrangements at the joint, where real welding can take place.

2. OBJECTIVE

- I have selected SS304 sheet material With Thickness 3mm for carried out the experiment.
- I Will Use Taguchi Method With L16 Orthogonal Array
- Prepare L16 Base Tig Welding Job
- Find Out Output Parameter(Front Width, Back Width) of Welding Job
- With this work, analyse the effect of welding process parameters on weld bead geometry and optimise the process parameter.

3. DESIGN OF EXPERIMENT

DOE is a technique of defining and investigating all the possible combinations in an experiment involving multiple factors and to identify the best combination. In this, different factors and their levels are identified. Design of experiments is also useful to combine factors at appropriate levels, each within the respective acceptable range to produce the best results and yet exhibit minimum variation around the optimum results. The design of experiment is used to develop a layout of the different conditions to be studied. An experiment design must satisfy two objectives: first the number of trails must be determined and second the conditions for each trail must be specified. Before designing an experiment, the knowledge of the product/process under investigation is prime importance for identifying the factors likely to influence the outcome. The Design of Experiments (DOE) is a method to identify the important factors in a process, identify and fix the problem in a process, and also identify the possibility of estimation interactions.

3.1Taguchi design

This experiment design proposed by Taguchi involves using orthogonal array to organize the parameters affecting the process and the levels at which they should be varied; it allows for the collection of the necessary data to determine which factor most affect product quality with a minimum amount of experimentation, thus saving time and resources.

- Process Parameters

Input Parameter:

1. Factor A: Welding Current
2. Factor B: Gas Flow Rate

Constant parameter:

Work Piece Thickness

Output Parameter:

1.Front Width
2.Back Width

Table-1: Process Parameter Level

Thickness	Parameters	Level1	Level2	Level3	Level 4
3mm	Welding Current	40	60	70	80
	Gas Flow Rate	2.4	3.2	4.0	4.8

Table-2: Taguchi Design Factor

Ex. No.	Welding Current	Gas Flow Rate	Plate Thick Ness
1.	40	2.4	3
2.	40	3.2	3
3.	40	4.0	3
4.	40	4.8	3
5.	60	2.4	3
6.	60	3.2	3
7.	60	4.0	3
8.	60	4.8	3
9.	70	2.4	3
10.	70	3.2	3
11.	70	4.0	3
12.	70	4.8	3
13.	80	2.4	3
14.	80	3.2	3
15.	80	4.0	3
16.	80	4.8	3

4. EXPERIMENTAL WORK

4.1 Working procedure

- Material selection
- Material testing

Specimen preparation

- Experiment work
- Testing result

Fig-1: TIG Welding Machine set-up

4.2 Work piece detail

For study SS304 is selected, as it has a very large scale application in the process industry. The material selected thicknesses as 3mm.The specimen size selected is 60mm X 40mm as per ASTM standards.

Fig-2: Thicknesses of work piece material of SS304

Welding performance of tig welding machine

Fig-3: Welded Job

After welding the work pieces, penetration is checked by visual observations. Specimens with improper penetration are rejected. The effect of welding parameters on Bead Geometry is studied by measuring front width and back width by using Travelling microscope

Table-3: Experiment

Ex. No.	Welding Current	Gas Flow Rate	Plate Thick Ness	Front Width	Back Width
1	40	2.4	3	5.12	4.17
2	40	3.2	3	4.53	4.30
3	40	4.0	3	4.95	4.14
4	40	4.8	3	4.55	4.12
5	60	2.4	3	5.21	4.62
6	60	3.2	3	4.64	4.56
7	60	4.0	3	5.08	5.03
8	60	4.8	3	5.22	4.92
9	70	2.4	3	5.88	5.00
10	70	3.2	3	5.62	5.12
11	70	4.0	3	5.22	5.02
12	70	4.8	3	5.55	5.07
13	80	2.4	3	5.97	5.40
14	80	3.2	3	5.83	5.42
15	80	4.0	3	5.87	5.04
16	80	4.8	3	5.72	4.82

5. CONCLUSION

- In present study parametric analysis has been carried out for front width and back width on SS304 material. Experiments are carried out using Taguchi Method by varying welding current and gas flow rate for 3mm thickness of SS304 material. Minitab 16 software was used for analyze the experimental data.

- We have concluded that at welding current(80A) and gas flow rate(2.4 LPM), at that point measure the maximum F.W.(5.97mm) and welding current(40A) and gas flow rate(3.2 LPM), at that point measure the minimum F.W.(4.53 mm).and at the welding current(80A), gas flow rate(3.2 LPM), at that point measure the maximum B.W.(5.42 mm) and welding current(40A), gas flow rate(4.8 LPM), at that point measure the minimum B.W.(4.12 mm)

- Welding current increase with increase front width and gas flow rate increase with increase front width up to certain limit then after decrease.

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- From the ANNOVA Analysis and experimental result data we have conclude that effect of gas flow rate is minimum and effect of welding current is maximum on front width and back width for 3mm thickness plate

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