

Study of TIG Welding Process Parameter using Boiler Quality Carbon Steel Material (SA 516 Gr60)

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ABSTRACT-This project is carried out to find out the characteristics of the TIG welding process parameter by using Taguchi's method. Even though in manually welding process quality of the weld depends on qualified welder, apart from this quality and strength of weld also depends on the so many processing input variables ,such as current, voltage, flow rate of Gas ,diameter of the filler wire ,root gap, welding speed and so on. In this project Taguchi method uses orthogonal array to set up the few welding specimen for the testing and analysis to find out the charactestic of different welding process parameter.

Keywords: Carbon Steel Material, Specimen, Coupon, TIG Welding, Mechanical Testing, Test Certificate.

1. OBJECTIVE OF THE STUDY

In this work has been made to design of experimentation for good strength weld bead required for the pressurized products such as heat exchangers and pressure vessels. For TIG welding process, different input process parameters are used for welding the joints. These welding input parameters have different effect on the weld bead, which affect the weld pool geometry, mechanical properties and microstructure.

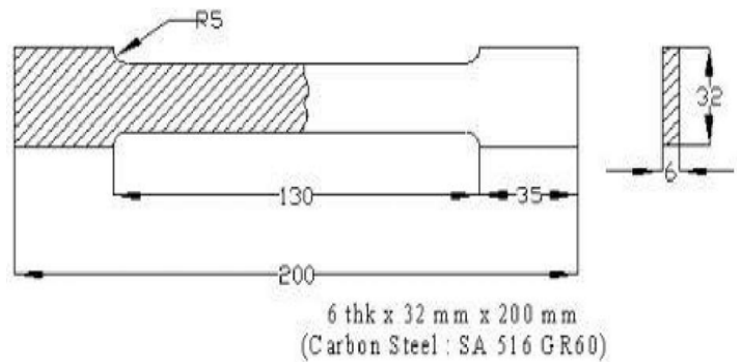
However need for pressurized products is more on safety side. Hence in this work, mainly mechanical properties are considered to study the characteristics of the input parameters.

2. EXPERIMENTAL DETAILS

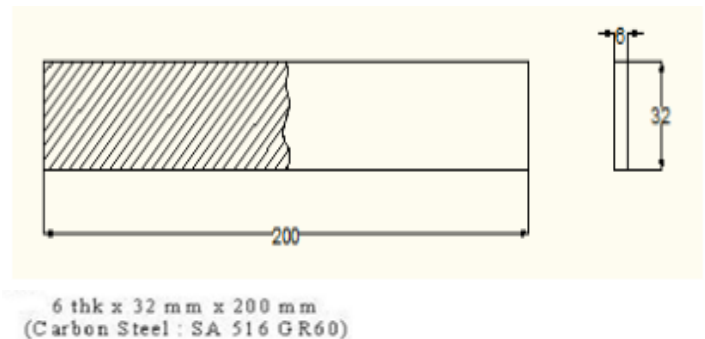
To study the mechanical characteristics of the welded joint, tensile test ,hardness test,bending test is carried out. and corresponding tensile strength, hardness(BHN), and bending strength are analysed to adopt the correct parameter required for the safe operation of the pressurized products,as it is subjected to tensile,bending during the operation of the pressurized Fluid.In this experimentation carbon steel material having the grade SA516GR60 is used .

2.1 TEST PIECES (SPECIMEN) FOR MECHANICAL TESTING

2.1.1 TENSILE TESTING SPECIMEN



2.1.2 BENDING TESTING AND HARDNESS TESTING SPECIMEN



3. RANGE OF INPUT PARAMETERS FOR WELDING THE SPECIMEN

As per ASME section-IX, welding of Carbon steel material SA 516 GR60 of 6mm thickness is used and required range of input parameters for TIG welding are as follows,

Current : 140-145 amp
Flow rate of inert gas : 9-13 lit/min
Diameter of filler wire : 2-2.5mm

4. ORTHOGONAL ARRANGEMENT

Table 4.1: Orthogonal Arrangement for Experiment

The following table shows the range of input process parameters used in the welding of Carbon steel material of SA 516 GR60 specimen.

Ex.No	Current (amps)	Flow rate of inert gas (lit/min)	Diameter of filler Wire (mm)
1	140	09	2.5
2	145	09	2.0
3	145	13	2.0
4	145	09	2.5
5	145	13	2.5
6	140	09	2.0
7	140	13	2.5
8	140	13	2.0

Experiment conducted as per the orthogonal array and recorded data for the

- 1) Tensile test
- 2) Bending test
- 3) Hardness test are shown in the table

Table 4.2: Record of Mechanical Testing for the Input Parameters

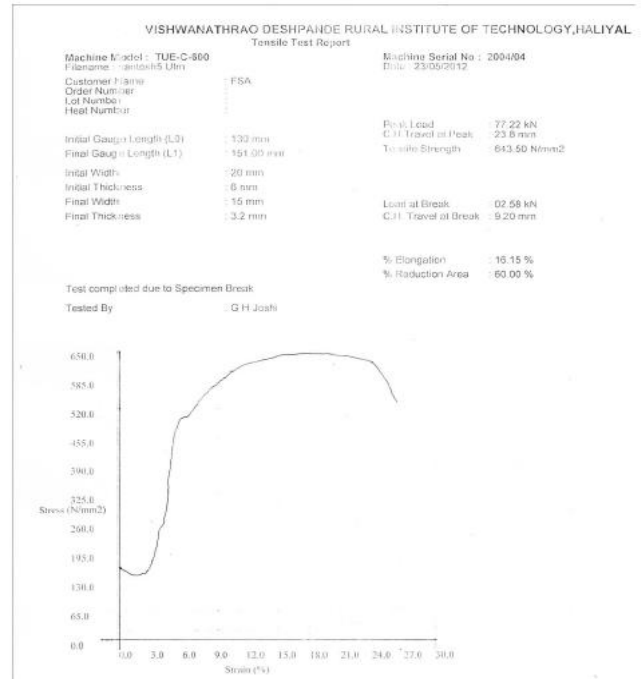
Ex.No	Current (amps)	Ga flow rate(lit/min)	Diameter of filler wire(mm)	Tensile test	Bend test	Hardness test
1	140	09	2.5	608	1880.56	177
2	145	09	2.0	612	1911.11	164
3	145	13	2.0	628.50	1913.89	177
4	145	09	2.5	627.50	1888.89	187
5	145	13	2.5	643.50	1936.11	202
6	140	09	2.0	623	1927.78	187
7	140	13	2.5	616.50	1866.67	177
8	140	13	2.0	619	1902.78	156

5. RESULTS

In this Project, out of eight specimen, specimen 5 is only considered because it has found to be maximum strength in all mechanical testing for a given input parameters during welding process.

5.1 TENSILE STRENGTH FOR SPECIMEN -5

Tensile Test Report for Specimen – 5



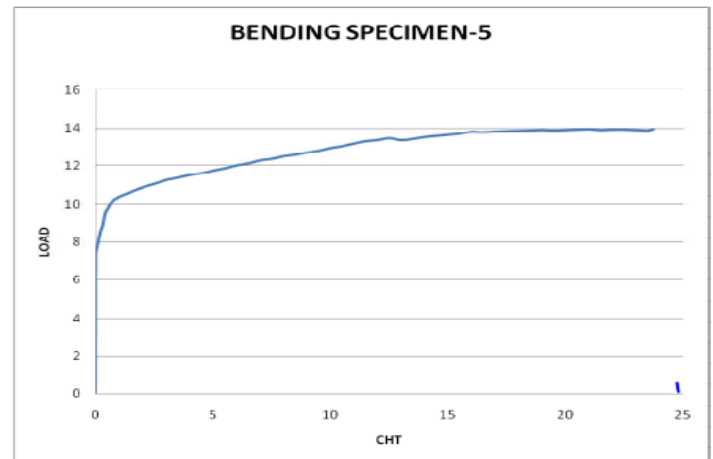
5.2 BENDING STRENGTH FOR SPECIMEN -5

Peak Point

Load at Peak = 13.94 KN

CHT Travel at Peak = 23.74 mm

Transverse Strength = 1936.11 N/mm²



5.3 HARDNESS FOR SPECIMEN -5

$$BHN = \frac{2W}{(\pi D)(D - \sqrt{D^2 - d^2})}$$

$$BHN = \frac{2 \times 187.5}{(\pi \times 2.5)(2.5 - \sqrt{(2.5)^2 - (1.06)^2})}$$

BHN = 202 N (Specimen 5)

6. CONCLUSION

Experiment is conducted as per the orthogonal array and determined tensile strength, bending strength and hardness of the welded specimen. These values are compared with the Test certificate of manufactured plate (Carbon steel SA 516 GR60) material, while comparing all the values .i.e. tensile strength, bending strength, and hardness are found more than the required value of the parent material and satisfied .

Also if proper welding parameters or proper combination of welding parameters are used then failure will not occur in welded joint. Out of these eight specimen, specimen 5 gives maximum mechanical properties at input parameters of current-145 amp, gas flow rate - 13 lit/min and Diameter of the filler wire - 2.5 mm.

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