International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 06 Issue: 06 | June - 2022 Impact Factor: 7.185 ISSN: 2582-3930

MINIMIZATION OF MATERIAL LOSSES OF SS 304 JOINER MADE BY TIG WELDING

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Abstract - Gas Tungsten Arc welding (GTAW) or Tungsten Inert Gas (TIG) is an electric arc welding process, which produces an arc between a non-consumable tungsten electrode and the work to be welded. TIG is used very commonly in areas, such as rail car manufacturing, automotive and chemical industries. Stainless steel is extensively used in industries as an important material, because of its excellent corrosion resistance. TIG welding is one of the welding processes, often used to weld similar and dissimilar metals. The major areas of research have been in characterization of weld, parameter optimization and strength of welded joints .

By This paper we gives exact pair of process parameters for TIG welding i.e. current, welding speed and arc length for 0.8 mm thick ss304 material plate. Most important parameter for TIG welding is Current which increases or decreases the strength of the weld bead. Current mostly makes impact on heat generation and heat is makes impact on grain size and strength of weld bead.

By using the Taguchi method it is necessary to use L9 array.it gives best pairs of parameters. Rockwell hardness test is best hardness test for checking the quality of weld bead as well as tensile test is also good for knowing strength of welding.

***Key Words*:** TIG welding, Optimization, Parameters, Tensile Testing, Rockwell hardness Testing

1.INTRODUCTION *(Size 11, Times New roman)*

Austenitic stainless steels are widely utilized in industrial applications due to their strength, corrosion resistance, mechanical workability, and excellent electrical and thermal conductivities. Austenitic stainless steels containing chromium and nickel as the principal alloying elements (in addition to iron) are identified as AISI 300 Series types. Those containing chromium, nickel, and manganese (in addition to iron) are identified as AISI 200 Series types.

The 31 stainless steels in the austenitic group have different compositions and properties but many common characteristics. They can be hardened by cold working, but not by heat treatment. In the annealed condition, all are nonmagnetic,although some may become slightly magnetic by cold working.At room temperature the 300 and 200 Series stainless steels retain an austenitic microstructure.

While resistance to corrosion is their principal attribute, they are also selected for their excellent strength properties at high or extremely low temperatures. They are considered to be the most weldable of the high-alloy steels and can be welded by all fusion and resistance welding processes.

2. PROBLEM STATEMENT

Minimization of losses of SS304 material joiner by TIG welding at the starting and ending position of base metal

OBJECTIVE

1) To select parameters of TIG welding.
2) To conduct test on ss 304 material as per the DOE by Taguchi method.
3) To check quality of weld bead by Tensile test and Hardness Test.

1) **NEED FOR PARAEMTERS CHANGE :**

In the given setup parameters of TIG welding are not suitable for 0.8 mm thick plate .Those parameters makes failure of continous welding .

PARAMETRIC STUDY

- Welding Current: A significant effect of electrical current on the ultimate tensile strength of the weldments is obtained depending on the joint type rather than welding type

- Welding Speed:Effects of TIG welding current The maximum welding speed was increased with increase of TIG welding current.
- Arc length:Arc length is critical in determining the arc energy density during TIG welding. For the TIG welding of Mg alloy, the arc length has more impact on the weld penetration and weld surface shape

TIG Welding Machine 200A

- No. of Phase : Single Phase
- Weight : 9 Kg
- Rated Input Voltage : AC220V +/- 15%
- Arc Initiating for TIG: HF(High Frequency)
- Current Adjustment Range : 10- 200Amp
- Electrode Diameter for TIG: 1.6-2.0mm(MS &SS) Continues welding
- Power Factor : 0.73
- Duty Cycle : 60 % @ 25 Amps

TAGUCHI METHOD

The Taguchi method is a simple and low-cost method of obtaining process optimization with strong quality and performance.The technique greatly reduces the number of experiments needed and offers a good relationship between input and output parameters.The Taguchi method was used to create regression equations and predict mechanical properties.Data are interpreted, discussed, and analyzed using the Taguchi method.

From the analysis of variance, it will possible to identify the most influential parameter, the welding voltage, with a contribution of 43.55% for the welding penetration and 75.26% for the bead width,which should be considered in the designs of automatic welding processes to improve the quality of final welds.

SOLUTION ON THIS FAILURE

- We are using taguchi method for current,Arc length and welding speed.

Symbol	Welding Parameters	Level 1	Level 2	Level 3
I	welding current (amp)	100	110	120
L	Arc length (mm)	4	5	6
S	welding speed (m/min)	5	6	7

3. TESTINGS

A. HARDNESS TEST

Rockwell Hardness Testing machine

Rockwell hardness test measures the permanent depth of indentation on the material by applying a fixed load using an indenter. The smaller the indentation value, the harder is the material. The Rockwell hardness test follows the principle of the differential-depth method.

Specimens for Rockwell Hardness Test

Procedure For Rockwell Hardness Testing

Firstly, the specimen was put on anvil in contact with the indenter. A minor load of 10 kg was applied and the dial is set to zero and then major load is applied. Preliminary force (10kg for normal and 3kg for superficial testing) to a penetration depth of h0 in the specimen to be tested.H0 refers to level for subsequent measurement of the residual indentation depth(h).Automatically or manually zeroing the penetration measuring instrument or dial indicator.

After that, additional test force (60,100 or 150 kg for normal and 15, 30, 45kg for superficial testing) is applied for a dwell

period (30seconds).Machine will show the Rockwell Hardness Number HR on the machine.Later on, gently remove the additional force while leaving in place with the preliminary force so that the elastic deformation follow the removal of final force is recovered.After that the depth of penetration was measured using the instrument. Furthermore, Rockwell hardness can be calculated using the residual indentation depth (h) and a formula defined in the standard, taking account of the applied Rockwell scale.

Results of Rockwell Hardness Test

Sr.No.	Welding Current (A)	Welding Speed (m/min)	Arc Length(mm)	Rockwell Hardness Number (HRB)
1	100	5	4	20.62
2	100	5	5	21.84
3	100	5	6	21.92
4	100	6	4	27.5
5	100	6	5	26.34
6	100	6	6	25.86
7	100	7	4	27.94
8	100	7	5	26.72
9	100	7	6	32.1
10	110	5	4	31.56
11	110	5	5	30.94
12	110	5	6	32.00
13	110	6	4	32.02
14	110	6	5	32.64
15	110	6	6	34.28
16	110	7	4	35.7
17	110	7	5	36.86
18	110	7	6	36.1
19	120	5	4	33.82
20	120	5	5	30.18
21	120	5	6	33.64
22	120	6	4	29.26
23	120	6	5	28.54
24	120	6	6	30.18
25	120	7	4	22.12
26	120	7	5	20.48
27	120	7	6	25.28

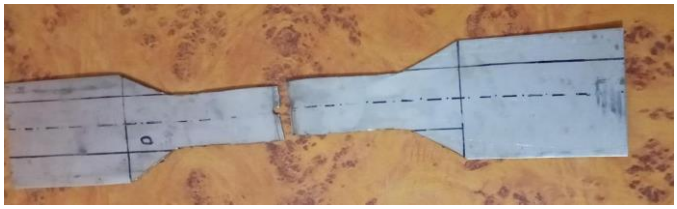
Tensile Test

The Tungstun Arc welding is a variant of arc welding. In this process it is impossible to see the welding arc or the liquid weld pool. This welding process is operator as well as environmental friendly. Much of the published literature is focused on bead on plate, bead on joint, modeling and optimization .For attaining good weld quality and reducing angular distortion for square butt joint top and bottom reinforcements are necessary, which is difficult for thicker sections of the plates. In this case joining of thick plates by multi-pass welding is a usual industry practice.

Universal testing machine

Specimen for Tensile Testing

Testing of plates on UTM



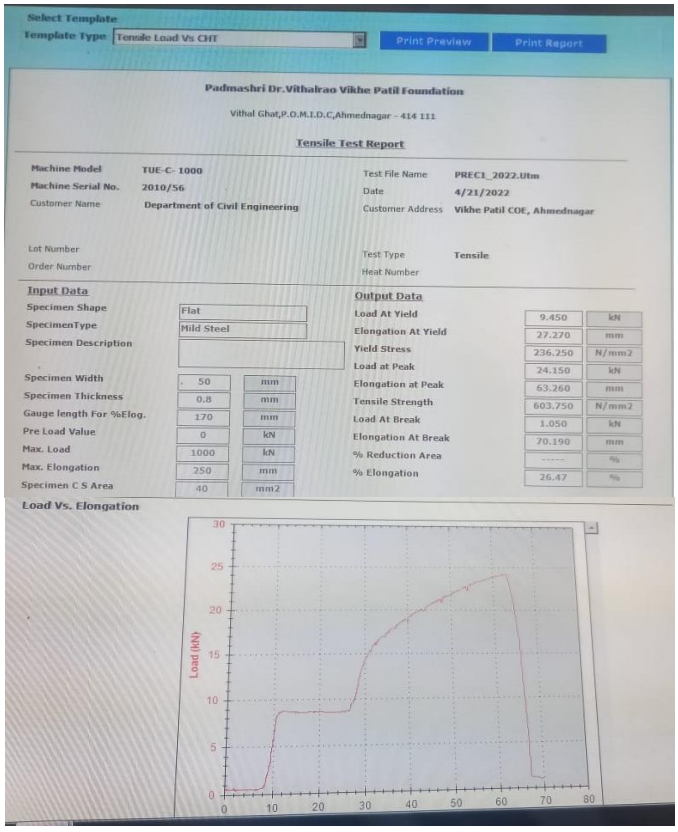
Specimen after Tensile Testing

Procedure For Tensile Testing

For the Tensile test on UTM Firstly we check that is UTM holds 0.8mm thick plates for test or not.After that we hold our specimen in the jaws of UTM .With the help of hydraulic pressure in UTM we starts increasing loads in Uniaxial Direction On our specimen.Firstly specimen gets straight fully linearly and after that development of stress inside a specimen starts.At the Same time on computer load vs deformation graph starts showing the readings.

Firstly it is showing Straight linear graph up to elastic limit and after that it shows curved graph which is plastic region. After that it is showing ultimate tensile region which having highest stress and load level and after that it shows necking region and just after that specimen breaks .

The stress strain graph which is obtained of our specimens are as follows:



Results of Tensile Testing

Sr.No.	Welding Current (A)	Welding Speed (m/min)	Arc Length(mm)	Tensile Sterngth n/mm^2
1	100	5	4	490.0
2	100	5	5	500.4
3	100	5	6	503.2
4	100	6	4	505.6
5	100	6	5	510.4
6	100	6	6	513.5
7	100	7	4	525.3
8	100	7	5	575.3
9	100	7	6	593.2
10	110	5	4	595.3
11	110	5	5	565.3
12	110	5	6	548.3
13	110	6	4	558.4
14	110	6	5	600.45
15	110	6	6	577.3
16	110	7	4	597.5
17	110	7	5	603.5
18	110	7	6	596.4
19	120	5	4	591.6
20	120	5	5	588.4
21	120	5	6	585.3
22	120	6	4	587.5
23	120	6	5	580.5
24	120	6	6	553.5
25	120	7	4	570.6
26	120	7	5	520.8
27	120	7	6	502.3

RESULTS AND DISCUSSION

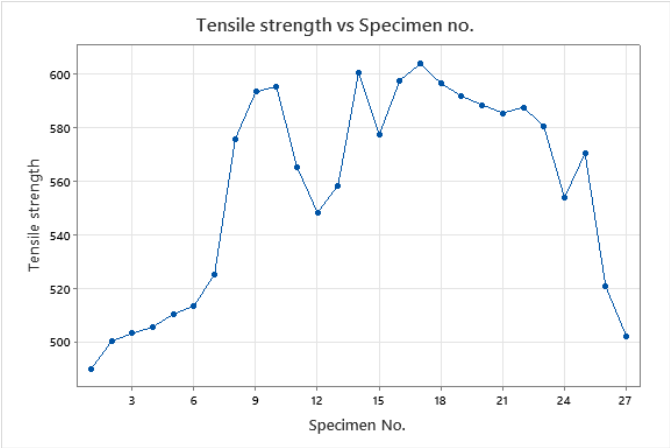
Before

After

Using taguchi method pairs of different combinations performed various tests this work gets minimize the reduction by 2% and improving the strength of weld bead The body of the paper consists of numbered sections that present the main findings. These sections should be organized to best present the material.

Specimen vs Hardness

From this graph we can conclude that the no.17 specimen having highest hardness i.e 36.86 HRB



Specimen vs Tensile Strength

From this graph we can conclude that the no.17 specimen having highest tensile strength i.e 603.75 n/mm2

3. CONCLUSIONS

2) In the present study, we performed the tensile testing coupled with rockwell hardness test to get the dominant factor of strength in SS 304 material.
3) A summary of the main findings is as follows:
4) Taguchi Analysis showed the Different Combinations of parameters like welding current ,Arc length and current .After performing this pairs of combinations it gives best pair of parameters which reduces the losses of base metal ss304.
5) Tensile testing was performed on the specimen on which the minimum losses obtained and from that for best pair is gets highest strength.
6) Hardness testing is performed on rockwell hardness machine and from this for I=110A,S=7m/min and L=5mm gets highest hardness i.e 36.86HRD
7) These results indicated that the joint of SS304 material joiner is gets reduced losses and with the help of tensile and hardness test confirms that this 17th no. pair is best suitable for 0.8mm thick material.

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