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Experimental Investigation Of Welding Processes On Process Parameters

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Abstract— In this research work two dissimilar metals of stain less steel -310 and stainless steel -202 are welded by using TIG welding. Tungsten electrode inert gas welding is a method of welding in which the arc is maintained by a tungsten electrode and shielded from the access of air by an inert gas. SS-310 is a grade of stainless steel which has a composition of 22-24% of Nickel and 19-22% of chromium. SS-202 is a grade of stainless steel which has a composition of 17-19% of chromium and 8-10% of Nickel. An experimental investigation of improving mechanical properties is done on both the sheets. The standard dimension used is 150x300x3 mm for identifying pores through non-destructing testing like radiography and DPT. Experiments were performed to determine UTS, yield strength and % elongation.

Keywords—toughness, shielding ,radiography, penetration

1. INTRODUCTION

Arc welding is a group of welding processes in which fusion is obtained by heating with an electric arc or arcs, with or without the use of filler metal. Gas tungsten-arc welding is an arc welding process in which fusion is produced by heating with an electric arc between a tungsten electrode and the work while an inert gas forms around the weld area to prevent oxidation. GTAW is most commonly used to weld thin sections of stainless steel and non-ferrous metals such as aluminium, magnesium, and copper alloys. Stainless steel is notable for its corrosion resistance, and it is widely used for food handling and cutlery among many other applications. Stainless steel is used for corrosion-resistant tools such as this nutcracker. Butt joint is a joint between two work pieces in such a manner that the weld joining the parts is between the surface planes of both pieces joined. SS-202 grade has excellent toughness at low temperatures. It is one of the most widely used hardening grades which possess good corrosion resistance, high hardness and strength.SS-310 is a medium carbon austenitic stainless steel, for high temperature applications like furnace parts and heat treatment equipment.

2. EXPERIMENTATION

In this experimental investigation two grades of stainless steel 310 and 302 are been taken into consideration with 150x300 mm dimension and thickness 3 mm.tehy are subjected to gas tungsten arc welding.

1. **SS sheets**

Stainless steel of grades SS-310 and SS-202 are taken and cut according to the required dimension mentioned by wire cut EDM carefully. Number of sheets used for welding is four.

2. **Filler metal**

For welding grades SS-310 and ss-202 of 3 mm thickness by TIG welding process, a filler metal must be used and its composition should be usually matched to the grade of stainless steel being weld. It should be straight in length with 150 mm long and 3mm diameter and is used in the experiment.

3. **Shielding gas**

Usually argon and helium are used for shielding in welding of stainless steel.Argon is more widely used since it is readily available and less costly.In this study argon is used as shielding gas with flow rate of 10L/min.

Fig-1 shielding gas

TIG welding set up

Tungsten Inert Gas Welding is the process that is most widely used for joining stainless steel alloys. Stainless steel offers good resistance. Furthermore, it is also environment friendly as it oxidizes the environment.

Fig-2 Welding of SS-310 and ss-202

4. **Joint preparation**

Since the welding was carried out outside the welding chamber, the joints were carefully designed so that both the top and the underside of the weld can be shielded. Groove was selected as 70° as the thickness of the base metal was 2.

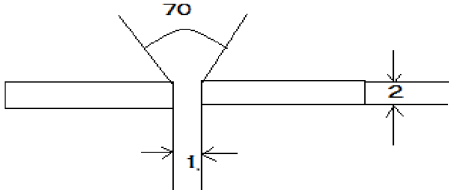


Fig-3 v- groove angle

5. **Welding**

In this experiment, the welding of SS was carried out using SS electrode. Welding is carried out on a C clamp arrangement on which SS sheets are welded and welding parameters are considered. Welding should be done by keeping helmet as it causes blindness.

***Fig 4*- Welding of SS sheet**

TABLE 1- Chemical Composition of grades Ss-310 And Ss-202

GRADE	C	FE	SI	MN	P	S	CR	MO	NI
310	0.25	25	1.5	2	0.45	0.03	24-26	-	19-22
202	0.12	68	0.9	7.50-10	0.06	-	7-19	0.2	0.5-4.0

3. NON DESTRUCTIVE TESTING

The main purpose of NDT is the detection of different material properties, especially non-homogeneous or defects, without mechanical damage of a tested object.

Methods of NDT USED

Most commonly used methods are:

1. Penetration testing
2. Radiography

1. Radiography:

Radiographic testing is a non destructive testing method of inspecting materials for hidden flaws by using the ability of short wavelength electromagnetic radiation to penetrate various materials. An x-ray machine can be used to detect the flaws in the specimen. Areas of the film exposed to less energy remain lighter. Therefore, areas of the object where the thickness has been changed by discontinuities, such as porosity or cracks, will appear as dark outlines on the film.

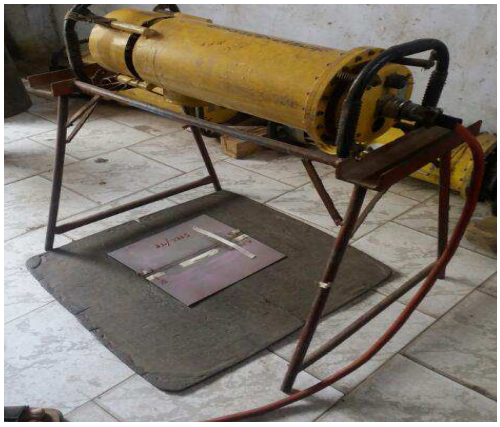


Fig 5- Radiography Test

2. Dye Penetrant

It is a widely applied and low-cost inspection method used to locate surface-breaking defects in all non-porous materials. In this method a liquid penetrant is applied to the surface of the product for a certain predetermined time, after which the excess penetrant is removed from the surface. The surface is then dried and a developer is applied to it. The penetrant which remains in the discontinuity is absorbed by the developer to indicate the presence as well as the location, size and nature of the discontinuity.

Table-2 Parameters taken into consideration while conducting DP

PARAMETER	DESCRIPTION
Material	ss-310 and 202
method	Visible, Solvent removable
Dwell time and temperature	15 min at room temperature
Acceptable standard	ASTM-E-165
Developer	M/s. The oriental chemicals work

3. Tensile Testing

Tensile testing is a fundamental test in which a sample is subjected to a controlled tension until failure. The most common testing machine used in tensile testing is the universal testing machine

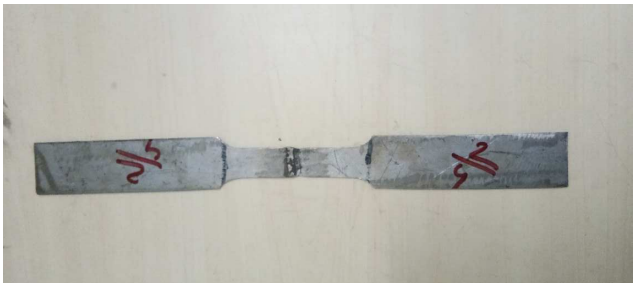


Fig 6- Tensile specimens of SS-210 & 310

4. RESULTS AND DISSCUSSION

Based on the testing procedures qualification and acceptance test results and its discussions are analysed in this segment. The welding was done manually on precision TIG 375 machine The AC current was used for welding of the SS-310 and SS-202.

RADIOGRAPHY

According to the ASME SEC XI slandered with film size of 4o cm and focal spot size of 2x2 mm and density at about 1.8 to 3 g/cc.Ti-6Al-4V is given for radiography to check for flaws and detects if any. Finally, the results showed that the test pieces are acceptable that means the flaws are within the acceptable limit.

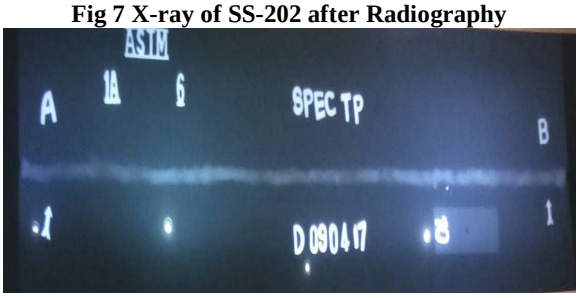
Table 3: Parameters and Specifications

PARAMETERS	SPECIFICATIONS
Material	SS-310
Current	3 Amp
Sfd	100 cm
Densitty	2-3
Voltage	125 kv
Film Size	40 cm

Table 4 Results of Radiography

Sl.No.	Grades	Physical Observation
1	SS-310	No Defect Seen
2	SS-202	Acceptable

Fig 7 X-ray of SS-202 after Radiography



. **Fig 8 X-Ray Of SS -310 after Radiography**

DYE PENETRATION TEST

5. EFFECT OF CURRENT ON POROSITY

The results show that pores size increases with the increase of frequency. This may be due to more vibration in weld torch and improper cleaning and supply of gases. The SS-310 and SS-202 contains porosity within the acceptable limits.

According to the ASTM E-1417 [23], the Dye-Penetrant (DP) test was conducted on these weldments. The test results are shown in table 12. The experimental results show that no cracks were observed in the weldments of this alloy in non-pulsed current and pulsed current welding.

TABLE 6 Cracks and Pores:

S. No.	Grades	Physical observation
1	**SS-310**	No defect observed on welded area
2	**SS-202**	No defect observed on welded area -

6. MECHANICAL PROPERTIES

The finished weld tensile specimens were tested using

universal testing machine of 40 *ton* capacity. The table 16 shows the tensile test results of each trail two samples of 3 *mm*thickness. The effeciency is calculated from ultimate tensile strength (UTS) of weldments in comparison to the base metal UTS. The results presented were best values obtained from two trails.

7. EFFECT OF CURRENT ON TENSILE STRENGTH

In case of two dissimilar metals SS-310 and SS-202 the required values are obtained which shows TT1 produces highest ultimate tensile strength of 569.23 which is within acceptable limit. In case of similar metals SS-310 the required values show that TT4 produces highest ultimate tensile strength of 559.27 within acceptable limits.

Effect of Current on Yield Strength

In case of two dissimilar metals SS-310 and SS-202 the required values are obtained which shows TT1 produces highest yield strength of 391.75 and can be verified in a graph given below. In case of similar metals SS-310 the required values show that TT3 produces highest yield strength of 355.67.

Effect of Current on % of Elongation

In case of two dissimilar metals SS-310 and SS-202 the required values are obtained which shows TT1 produces highest % elongation of 46.40 that can be relatively shown by a graph. In case of similar metals SS-310 the required values show that TT1 produces highest % elongation of 44.80.

Table 7. Tensile test results of dissimilar metals-310 and 202

SPECIMEN	YIELD STRENGTH	TENSILE STRENGTH ^{2}	% ELONGATION
TT1	342.78	556.70	44.80
TT2	355.67	554.12	41.60
TT3	346.15	548.71	42.40
TT4	335.05	559.27	44.00

Table 8 Tensile Test Results of Similar Materials of SS-310

SPECIMEN	YIELD STRENGTH	TENSILE STRENGTH ^{2}	% ELONGATION
TT1	379.48	569.23	46.40
TT2	373.71	564.43	44.40
TT3	391.75	551.54	45.60
TT4	382.05	566.66	43.00

8. CONCLUSION

1. Tungsten Inert Gas Welding is more suitable than Metal Inert Gas welding for dissimilar metal welding stainless steel, TIG welding process provides better strength. It may be because of less porosity in dissimilar metal welds during TIG welding and carbon precipitation which comes out due to welding is also less. The low percentage of free carbon allows the product (welded stainless steel) better corrosion resistivity, ductility and strength.
2. The radiography examination was done for the four samples of SS 310 and SS 202.the X-ray test picture is present in Figure. The results reveal some pores within the acceptable level. Hence, the soundness of welding is proven and it can be proceeding for further mechanical testing.
3. The dissimilar metal joint of SS 310 and SS 202 has the best ductility for both TIG welding processes.
4. The yield strength of dissimilar joint of SS 202 and SS 310 is best for TIG welding process.
5. The similar metal joint of SS 310 and mild steel has poor ultimate tensile stress when compared to the dissimilar metals on TIG welding.
6. The percentage elongation of TIG welding on dissimilar metals is more when compared to the percentage elongation of similar metals.

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