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Experimental Investigation of Similar & Dissimilar Joints on Stainless Steel with TIG & MIG Welded

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Abstract: Now days, most of the structural fabrications possess welded joints that are produced using suitable welding technique. However, the joining of thick plates in a single pass welding is a cumbersome task to many fabricators. Likewise, the selection of welding technique, filler wire and welding condition for the similar and dissimilar welding of several metals is at the development stage. The similar and dissimilar metal joints of have been emerged as a structural material for various industrial applications which provides good combination of mechanical properties like strength, corrosion resistance with lower cost. Selections of joining process for such a material are difficult because of their physical and chemical properties. The stainless steel of similar and dissimilar material joints are very common structural applications joining of stainless steel is very critical because of carbon precipitation and loss of chromium leads to increase in porosity affects the quality of joint leads deteriorate strength. In the present study, stainless steel of grades 310 and 316 were welded by Tungsten Inert Gas (TIG) and Metal Inert Gas (MIG) welding with compound flux of 50 % SiO_2 + 50 % TiO_2 processes. The mechanical behavior like hardness, tensile strength and bending properties of similar and dissimilar metal joints were investigated.
Keywords: Mechanical Properties, ATIG, MIG, SS310, SS316, Micro Structure.

I. INTRODUCTION

Welding is the process of continuing to connect materials such as metals, a mixture or plastics, along with their own contact with the surface by applying heat or pressure. Welding is a common process used to track mining assessments of various drugs. A parts engine they bind to the skin and then dissolve. Permanent factors can be achieved. Sometimes filler material cement added to form distilled water materials that come next. The verification material provides a valid link. Weld the availability of materials depends on several reasons the changes that occur in the welding time change to hardness in a compact area thanks to the rapid elongation of coagulation oxidation due to the reaction of the material with atmospheric oxygen and overturning to form cracks in the joint location. Welding it happens here and there from farms to rural estates. In door farms and construction sites factories and workshops. The welding processes are quite simple they can understand and learn basic skills quickly. Welding is the bonding of metals at the molecular level. A fistful of a homogeneous union between two or more metals where the strength of the framed exceeds the strength basic metal parts. Easiest degree: welding it involves the use of four parts: metals, the heat source; metal and brass shield type. Metals heat to the protected melting point in an air, then a metal charge is added to the heated area produce only one metal. It is possible with or without filler metal and with or without pressure. To exist they use different types of welding today. Gas metal arc welding (GMAW) or MIG-tungsten (GTAW) or TIG arc flux-cored welding and electrode welding the most common types are found in industrial settings.

S.P. Gadewar et al. [1] studied the process TIG welding parameters such as welding current, gas flow rate; the thickness of the piece on the SS304 geometry. They it was found that the process parameters could be considered largely mechanical. Radha Raman Mishra et al. [2] tensile strength MIG and TIG Various welded structures in steel and stainless steel. TIG the MIG welding process used to weld several keep your sword and your sword. Four samples were prepared for the experiments weld smooth steel SS202, SS304, SS310 and SS316 and I found that TIG is more suitable than MIG for several metal, mild steel and stainless steel welding supplies with better strength. Also, percentage dilution in stainless steel shows that the different internodes are larger in the MIG complex. Lokesh Kumar G et al. [3] He studied some fundamental observations microstructures and mechanical properties, formed a AISI 304 (AAS) and AISI 430 (FSS) with AWS E308L electrode coated in austenitic stainless steel. Where does it form a unlike the solder joint with the use of filler materials. The Experiments are performed by blocking the welding process. Metal arc welding (SMAW) and tungsten inert gas welding (TIG).

The effects obtained are exposed to welding. Stainless steel welded joint of different process. Former concluded that the best course results obtained Robustness is achieved by comparing the TIG process with unmask the process. Madduru Phanindra Reddy et al. [4] bimetallic and low axial stainless steel alloys studied commonly used in high temperature corrosion environments these applications are made of TIG welding. In this an analysis, an attempt to question the world the capacity of the AISI 4140 and AISI 316 processor with TIG welding with or without the use of filler metal. By dissimilarity ER 309L metal was used as the filling material. Hardness and The tensile strength characteristics were considered in the studies. Vikas Chauhan et al. [5] parametric optimization Low Carbon Stainless Steel (SS-304) MIG Welding Machine steel design according to the Taguchi method. Three MIG parameters welding schemes. Operating current, voltage and speed a Test Design analysis in Taguchi Technological used to acquire data. The MIG process is a lot of welding managed to connect stainless steel (SS304) and low carbon steel. Taguchi's method was used to detect the influence of the procedure. Parameters (current, voltage and welding speed) to the maximum Tensile strength. Cheng-Hsien Kuo et al, [6] studied the effect of the TIG flux in the execution of different welds G3131 mild steel and 316L stainless steel. An experiment was carried out to study CaO, Fe_2O_3, Cr_2O_3 and SiO_2. The type of surface produced in TIG welds the residual oxide flux tended to form slag. Changes in penetration of the joint and increase of the ratio between depth and width obtained using SiO_2 powder. Singh N et al. [7] it was done TIG welding of AISI 202 stainless steel and comparison 5 single heads and 5 double-jointed heads with different flow rates keeping the other parameters constant. Based on tensile forces resistance, micro hardness and microstructure of welds obtained as a double v joint obtained at high current has more intense strength, toughness and toughness each combination and Ravendra. et al [8] conducted experiments with the purpose of studying effect of hammered current on known welds by GTAW. For welding 3mm thick 304 stainless steel welds current 80-83A and the speed range on the highway is 700-1230 mm/min. it's more hardness in the area HAZ by the refinement of the grain. Greater force of distraction in the current welding without impulse. It was observed that UTS and The YS value of the non-impulsive pulse was higher than that of the father metal and veins are struck. Arun Nanda and others [9] plated gasket for maximum tensile strength 320.4 n / mm² for 3 m / min wire speed and 250 welding amps Current. Maximum micro hardness value for glued joint there is a wire speed of 444.9 gf/mm² up to 3m/min and a welding of 250 amps and current for HAZ 431.2 at 250 amps and cable speed of 3 m/min.

II. EXPERIMENTAL PROCEDURE

The ATIG bead on plate welding was carried out on 310 austenitic steel and 316 SS with a chemical composition presented in Table1 was used to conduct the test with similar and dissimilar joints dimension of 150 mm long x 60 mm wide x 5 mm thickness and 200 mm long x 60 mm wide x 5 mm thickness respectively. Prior to the bead on plate welding, the plates were buffed to remove the surface contaminants and then they were cleaned with acetone to get rid of the oxide layers from the surfaces. Just before welding, a thin layer of activating flux paste was applied on the plate using a 5 mm width paint brush. During bead on plate welding, an argon shielding was provided to protect the molten metal from the atmospheric contaminants.

Table I
Chemical Compositions of Base Metals

Elements	C	Mn	P	S	Si	Cr	Ni	Mo	N	Fe
SS-310	0.06	0.95	0.02	0.03	1.58	24-26	18.96	0.25	0.06	Bal
SS-316	0.08	2.00	0.04	0.03	0.75	16-18	10-14	2-3	0.10	Bal

For microscopic observation, the specimen was carefully cut into 10mm width, polished and then etched with picric acid. Further, in order to determine the bend test. The specimen was further cut into 10mm width for tensile testing and the remaining 30mm width of specimen was used for the bend test. A 310SS and 316SS welded specimen is shown in Fig.1(a) and the tensile test specimen with equipment as shown in Fig.1(b).

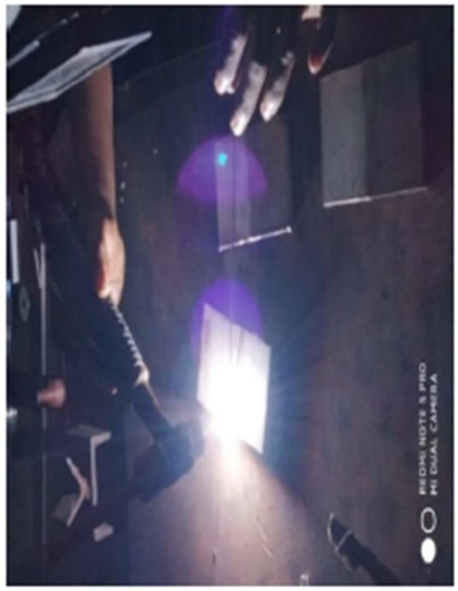

Fig 1(a). Butt Joint of SS310 and SS316 by TIG & MIG

Fig 1(b). Specimen under the Tensile Test

III. TESTING AND RESULTS

A. Hardness Study

Vicker‟s micro hardness test was carried out at the composite area of ATIG and MIG weldment of SS310 and SS316 similar and dissimilar joints. The hardness profile of weldment and the average hardness was found both ATIG and MIG is to be 245.95 HV & 232.96 HV which is slightly lower than the similar metal hardness of 258.16 HV due to the grain coarsening effect as sown in Table-II. The obtained hardness results are in well agreement with the tensile and toughness results.

Further, it is identified from the EDAX results that the intermetallic phases and oxides, which could affect the hardness, are not present in the weld zone.

Table II
Vicker Hardness Testing Values for ATIG & MIG

S.No	Metal	Specimen	Vicker Hardness(HV) ATIG	Vicker Hardness(HV) MIG
1	Similar	SS310	238.16	223.08
2	Similar	SS316	241.53	231.63
3	Dissimilar	SS310-SS316	258.16	244.17

B. Tensile Test

In this experiment, the tensile test has been done both ATIG and MIG welded of SS310 and SS316 Plates of similar and dissimilar joints, results are menctioned in the Table-III. The experimental values of both TIG and MIG are as follows. Due to activated flux present in TIG welding the values of tensile strength is more when compared with MIG and similar metal joint and the tested specimen is shown in below Fig 2.

Table III
Tensile Strength Testing Values for ATIG & MIG

S.No	Metal	Specimen	Tensile Strength(MPa) ATIG	Tensile Strength(MPa) MIG
1	Similar	SS310	538	524
2	Similar	SS316	576	538
3	Dissimilar	SS310-SS316	589	551

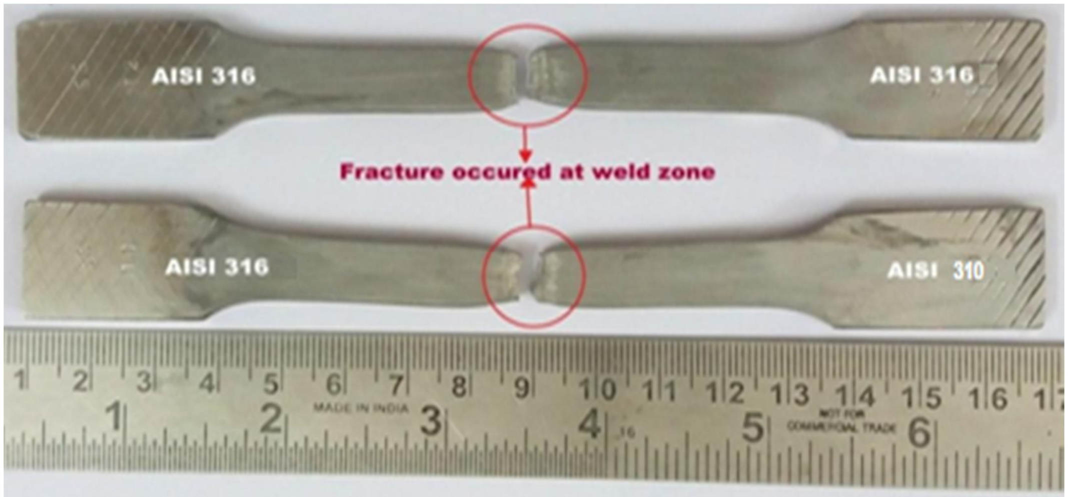

Fig 2. Tensile test specimen after Testing

C. Bend Test

Bending strength of the material can be determined by using 3 point bend test has been done both ATIG and MIG welded of SS310 and SS316 Plates of similar and dissimilar joints. The specimens are made into U shape by the bend test as shown in Fig.3. The results were analyzed and tabulated in the Table 4. Specimen welded with 316L to dissimilar joint is existing more bending strength then similar joints of SS310 and SS316.

Table IV
Bending Strength Testing Values for ATIG & MIG

S.No	Metal	Specimen	Bending Strength(MPa) ATIG	Bending Strength(MPa) MIG
1	Similar	SS310	589.66	563.23
2	Similar	SS316	616.07	579.71
3	Dissimilar	SS310-SS316	676.37	603.13

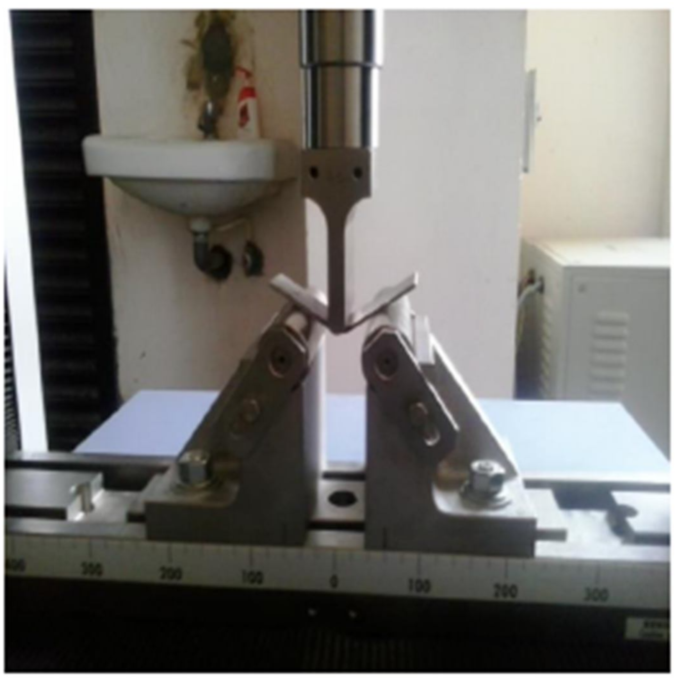

Fig 3. Specimen under bending test

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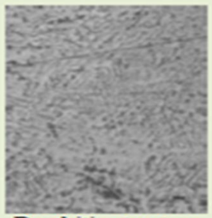
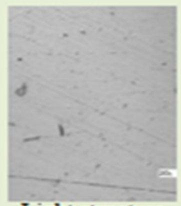
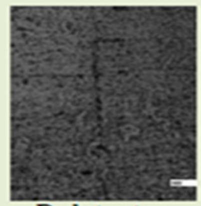
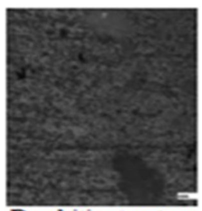
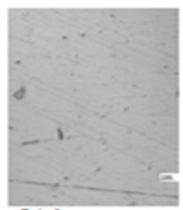
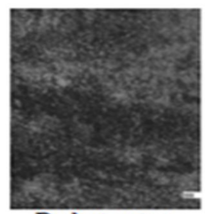
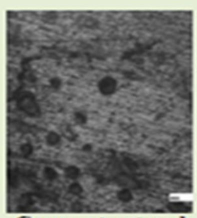
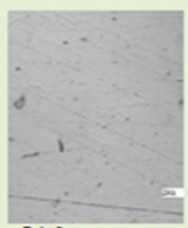
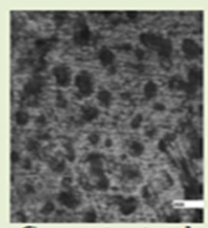
D. Microscopic Study

After the welding operations were carried out on the sample, a microstructure study was conducted to study the effect of welding temperature on the sample. The device is using an optical microscope with 200X magnification. The three main microstructure zones C and F in Table V. are examples, viz. the thermally changed structure of the floor, the adjoining area and the respective metal base. Microstructure remained due to the presence of delta ferrite in the material after heat cohesive. According to Schaeffler's schema, 5-15% of construction data is expected to be carried out.

Table V
Micro Structure Of Three Regions of The Ss310 And Ss316 Weldment at 200x

Specimen	ATIG Weld Zone	Base Metal	MIG Weld Zone
SS 310	 Dendritic structure	 Light structure (austenite)	 Darkstructure (austenite/ferrite)
SS 316	 Dendritic structure	 Light structure (austenite)	 Dark structure (austenite/ferrite)
SS310 & SS316	 Coarse structured (austenite + 2^{nd} phase)	 Light structure (austenite)	 Coarse structured (austenite + 2^{nd} phase)

IV. CONCLUSION

From the above-mentioned experiments, the following conclusions are obtained. Microscopic examination of the base metal for MIG welding showed that the fine grains are smooth, not medium in size. Here lies the 9.0-10.0 metallic microtensive micro-examination pact. The microheat zone (HAZ) revealed heavy grains and the average grain size was between 7.0 and 8.0. Similarly, in TIG, micro examination of the short metal base grains revealed an average grain size of 10.0 and a small check revealed no metallosate martense.

In this experiment, the Vicker hardness (HV) is 258.16 for ATG and 244.12 for MIG with different surfaces combined. Tensile testicles (MPa) The maximum capacity of MIG welding is 551 MPa and TIG welding 589 MPa. 676.37 MPa Flexible TIG welded testicular joints with different metal fractures MIG frames have a fracture load of 603.13 MPa and are best suited for various frames with 316L filling material suitable for modification. The shell of the electronic fabric was constructed with both MIG and TIG glue with a chemical blend of 10ml HNO3 + 20ml HCL + 30ml Glycerol and obtained values of metals, minerals and bath areas related to metals. It was also observed that the three mechanical properties of hardness, tensile strength and flexural strength were higher than the MIG value. MIG and TIG welding parameters such as pulse, arc voltage and welding speed are used as various process parameters which play a vital role in determining the different properties.

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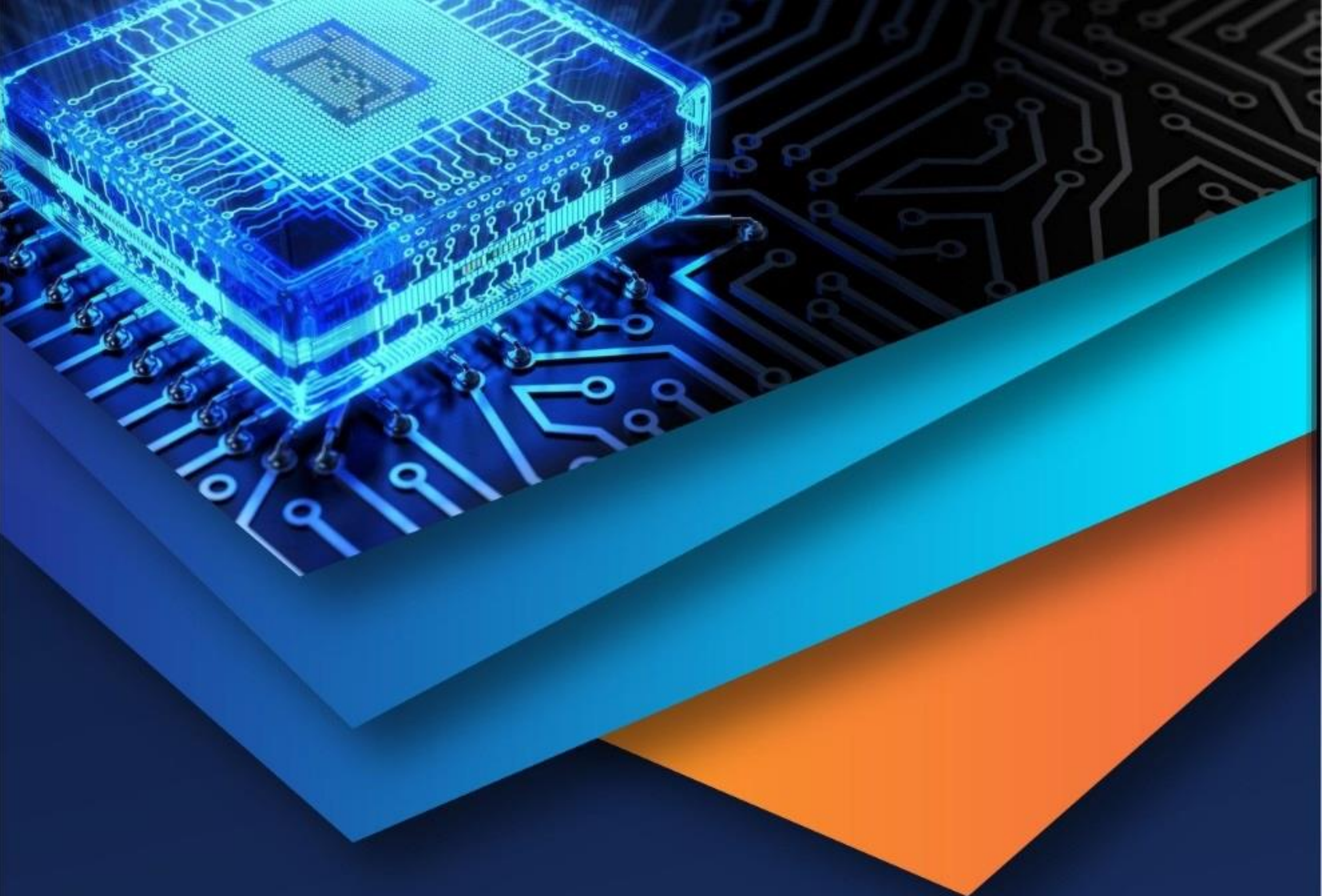

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