A Study of Mechanical Properties of TIG Welded Dissimilar Joint of Mild Steel and Stainless Steel 316

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Abstract— The present work is to research the dissimilar welding of Mild steel and 316 stainless steel. Tungsten inert gas welding with identical parameters and procedures was used to carry out single V grooved butt welding. The use of 316 stainless steel and mild steel has been increased noticeably in building up of railway wagons and modern boilers in where is want corrosion resistance areas and mechanical properties (Toughness, Hardness, Tensile Strength) of the weld. This paper discussed dissimilar weld of Mild steel and 316 Stainless steel using TIG using required Parameters and to evaluate the Mechanical Properties.

Keywords: Welding, Mild Steel, Stain Steel, TIG

I. INTRODUCTION

Welding is a joining process of similar metals but nowadays it is also joining dissimilar metals by the application of heat. Welding could be done with or without the application of pressure. It can be done addition of filler materials or without addition of filler materials. While a welding the edges of metal pieces either melted or brought to plastic condition and it is used for permanent joints. The joint get stronger when it cools down. It's heats when the weld pool is used with the work piece and produces weld in that time. In all fabrication companies welding is very essential (Karalis, 2019). Since welding has utilized in steel creation its uses has extended in other modern segments like a development, mechanical and vehicle producing and so on. Welding is an assembling procedure of making a perpetual joint acquired by the combination of the outside of the parts to be consolidated, with or without the utilization of weight and a filler material. The materials to be joined might be comparable or not at all like one another. The warmth required for the combination of the material might be acquired by consuming of gas or by an electric circular segment. The last strategy is all the more widely utilized on account of a more noteworthy welding speed. Welding is widely utilized in creation as an elective technique for giving or manufacturing and a role as a trade for darted and bolted joints. Since welding has utilized in steel creation its uses has extended in other modern segments like a development, mechanical and vehicle producing and so on. Welding is an assembling procedure of making a perpetual joint acquired by the combination of the outside of the parts to be consolidated, with or without the utilization of weight and a filler material. The materials to be joined might be comparable or not at all like one another. The warmth required for the combination of the material might be acquired by consuming of gas or by an electric circular segment. The last strategy is all the more widely utilized on account of a more noteworthy welding speed. Welding is widely utilized in creation as an elective technique for giving or manufacturing and a role as a trade for darted and bolted joints.It is also used as an repair medium e.g. to reunite a metal at a crack or to build up a small part that has broken off such as a gear tooth or to repair a worn surface such as a bearing surface.

II. LITERATURE REVIEW

David a. Meltzer et al, (2012) supplement to the welding diary, June 2012 Sponsored by the American Welding Society and the Welding Research Council. Strain-Age Cracking Susceptibility of Ni Based Super amalgams as a Function of Strain Rate, Temperature, and Alloy Composition. "standard specialized highlights of BTG framework for supercritical 660/800mw warm units", Government of India Ministry of Power Central Electricity Authority New Delhi. July 2013." Supercritical innovation is a set up and demonstrated innovation with 500 supercritical units. Ultra-supercritical parameters with weight of 250-300Kg/cm2 and fundamental steam temperature 600-610oc. Research is in progress to additionally builds the stream temperature to 700oC. Chengwu et al,(2009) In their work on weld interface microstructure and mechanical properties of copper-steel disparate welding, the microstructure close to the interface between Cu plate and the intermixing zone was researched. Trial results indicated that for the welded joint with high weakening proportion of copper, there was a change zone with various filler particles close to the interface. Nonetheless, if the weakening proportion of copper is low, the change zone is just created close to the upper side of the interface. At the lower side of the interface, the turbulent bursting behaviour in the welding pool led to the penetration of liquid metal into Cu. Gyun Na et al, (2019) Stated that residual stress is one of the most important factors but its effect on high-cycle fatigue is of more concern than the other factors. Residual stress is a tension or compression that exists in a material without any external load being applied, and the residual stresses in a component or structure are caused by incompatible internal permanent strains. Chengwu et al, (209) Welding, which is one of the most significant causes of residual stress, typically produces large tensile stresses, the maximum value of which is approximately equal to the yield strength of materials that are joined by lower compressive residual stresses in a component. The residual stress of welding can significantly impair the performance and reliability of welded structures. The integrity of welded joints must be ensured against fatigue or corrosion during their long use in welded components or structures.

III. METHODOLOGY

Fig. 1: Methodology

IV. EXPERIMENTAL SETUP

A. *Experimental Setup for Welding*

The selected material is cut into require dimension based on the working process shown in fig 2. Then the material is welding through the TIG welding process. The dimensions of a material are 300×30×6 mm.

Fig. 2: Work piece material

1) Experimental Procedure for TIG welding process

The tungsten bend process is being utilized generally for the accuracy joining of basic segments of which require controlled warmth input. A little serious warmth source gave by the tungsten curve is obviously fit to the controlled liquefying of the material. Since the cathode isn't expended during the procedure, likewise with the MIG or MMA welding forms, welding without filler material should be possible without the requirement for persistent tradeoff between the warmth contribution from the bend and the dissolving of filler metal. As the filler metal, when required, could be added straightforwardly to the weld pool from a different wire feed framework or physically, all parts of the procedure can be absolutely and autonomously controlled for example the level of liquefying of the parent metal is controlled by the welding current as for a welding speed, while the level of weld globule fortification is dictated by the rate at which the filler wire is added to the weld pool. In TIG burn the anode is reached out past the protecting gas spout. The curve is lighted by high voltage, high recurrence (HF) beats, or by contacting the cathode to the workpiece and pulling back to start the circular segment at a present degree of current.

Fig. 3: TIG welding machine

2) Experiment Work for TIG

By setting these provided parameters on the TIG welding machine is operated. Set the first parameter as given in the tabular column 1.

Filler rod	304L
Rod Dia	1.6mm
Current	60-110A
Voltage	10-12V
Gas flow rate	4-6L/min
Polarity	Negative Polarity (DC)
Gas	Argon

Table 1: Calculated parameters for TIG welding.

B. *Experimental Setup for Testing Methods*

The selected material is welded as per the dimensions based on working process shows in the fig. Then specimens are welding and the results are noted down in the table.

1) Experimental work for hardness test

The 300×30×6mm dimensioned plate is placed in the hardness testing machine (Vickers hardness) and to be used diamond type indenter penetration depth of 10mm.

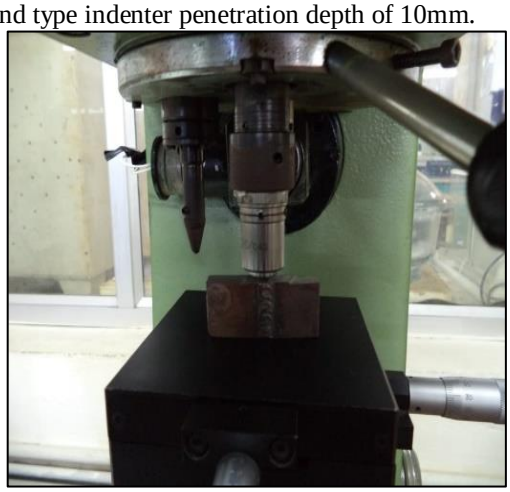

Fig. 4: Hardness Test

Location	Observed Values in HV (10kg load)
Weld Cross Section	177,180,182 Avg: 179.6

Table 2: Calculated parameters for tensile test.

2) Experiment Work for impact test

The 300×30×6mm dimensioned plate is placed to the workbench and testing the impact (Toughness).

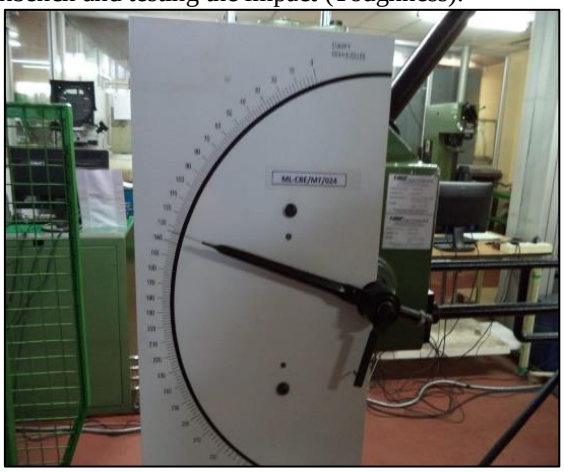

Fig. 5: Charpy Test

Test Parameters	Observed Values
Specimen Size (mm)	55 × 10 × 10
Type Of Notch	Charpy V notch
Test Temperature	+25˚C

Table 3: Calculated parameters for charpy test.

C. Experiment Work for tensile test

Elastic test is utilized to decide the rigidity of the example, % extension of length and % decrease of territory. Malleable test is normally completed in all inclusive testing machine. An all inclusive testing machine is utilized to test rigidity of materials. It is named sometime later that it can perform numerous standard elastic and pressure tests on materials, parts, and structures. The example is set in the machine between the holds and an extensometer whenever required can consequently record the adjustment in measure length during the test. In the event that an extensometer isn't fitted, the machine itself can record the relocation between its cross heads on which the example is held.

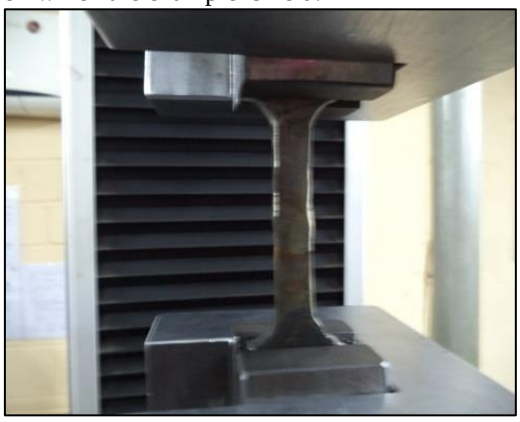

Fig. 6: Tensile Test

Test Parameters	Observed Values
Yield Strength in (Mpa) (0.2% Offset)	315
Ultimate Tensile Strength (Mpa)	521
% Elongation in 50mm GL	11.2
Fracture Location	Weld

Table 4: Calculated parameters for tensile test.

V. Result and Discussion

After completing the experiments readings were noted. With the help of the readings the values are determined by using formulas. Tungsten Inert Gas Welding is more suitable metal welding of TIG welding process provides for better strength. It may be because of less porosity in 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 alloy steel) better corrosion resistivity, ductility and strength.

VI. Conclusion

This research presents a study of properties of dissimilar welding joint between mild steel and 316 stainless steel used TIG welding. Tungsten Inert Gas Welding is more suitable metal welding of TIG welding process provides better strength. It may be because of less porosity in 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 alloy steel) better corrosion resistivity, ductility and strength.

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