Testing and comparative study of stainless steel (SS316) weldments performed by different welding process.

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Abstract:-

Bending strength play important in welding process selection that's why structural or mechanical member should sustain that amount of bending force. Bending test is used to find bending strength of different welding process such as MIG, TIG, SMAW etc. on stainless steel alloy (SS316).The material we used is SS316 of 150*150*8 dimensions by performing this experiment we will find which welding process is most suitable for bending load. We also studied input parameters of welding such as arc voltage, welding current, speed of welding, root gap and output parameters are tensile strength , bending strength, microstructure and impact energy.

KEYWORDS:- MIG, TIG, SMAW, Bending strength, tensile strength and microstructure.

1.INTRODUCTION:-

Welding is a joining process used to join two different or same materials like metals, alloys or plastics, together at their contacting surfaces by application of heat and or pressure. During welding, the work-pieces to be joined are melted at the interface and after solidification a permanent joint can be achieved. During welding a filler material is added to form a weld pool of molten material which after solidification gives a strong bond between the materials. Weld ability of a material depends on different factors like the metallurgical changes that occur during welding, changes in hardness in weld zone due to rapid solidification, extent of oxidation due to reaction of materials with atmosphere and possibilities of crack formation in the joint position. TIG welding was developed during 1940 at the start of the Second World War. TIG's development came about to help in the welding of difficult types of material, e.g aluminium and magnesium. The use of TIG today has spread to a variety of metals like stainless, mild and high tensile steels. GTAW is most commonly known as TIG (Tungsten Inert Gas).

Stainless steel is a metal alloy which is made up of steel mixed with elements such as nickel, chromium, molybdenum, aluminum, sillicon, and carbon. Iron mixed with carbon to produce steel is the main component of stainless steel. Chromium is added to make it resistant to rust. The addition of nickel increases corrosion resistance properties of stainless steel in case of aggressive usage. Other alloying metals like copper, titanium and vanadium are also added in order to improve the other mechanical properties and structure of stainless steel. In all, there are more than 150 grades of steel, but only 15 are used regularly.

Properties of stainless steel:-

Stainless steel is tough, ductile with cryogenic and high temperature strength properties. Duplex stainless steel made up of combination of austenite and ferrite crystal structures. Chromium and nickel are the main alloying elements in duplex stainless steel. It is corrosion resistant. Stainless steel is a hard and strong substance, it is not a good conductor of heat and electricity, it is ductile, magnetic, retains its strength and cutting edge regardless of temperature.

Applications of stainless steel:-

Stainless steel is preferred for making kitchen utensils because it does not affect the flavor of food and is easy to clean. Stainless steel is also used for manufacturing surgical instruments, cookware, sheets, plates, wire, bars, kitchen cutlery, industrial equipment, building construction materials and hardware. Stainless steel is also used in processing plant and commercial kitchens.

The below table shows the properties and chemical composition of stainless steel (SS316)[7]:-

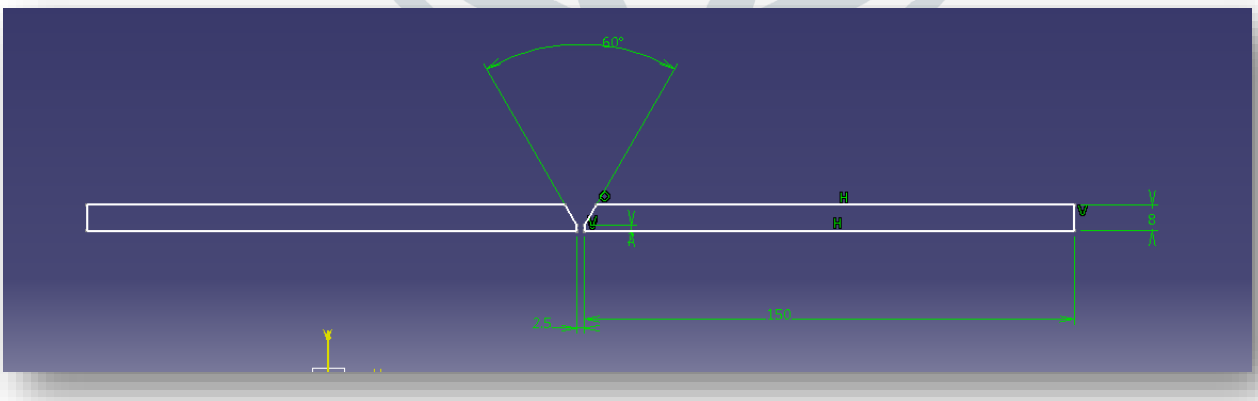
Property	Minimum value(S.I)	Maximum value (S.I)	Units (S.I)	Minimum value (Imp.)	Maximum value (Imp.)	Units (Imp.)
Atomic Volume (average)	0.0069	0.0072	M^3/lmol	421.064	439.371	In^3/kmol
Density	7.87	8.07	Mg/m^3	491.308	503.794	Ib/ft^3
Hardness	1700	2200	Mpa	246.564	319.083	ksi
Bulk Modulus	134	152	Gpa	19.435	22.0457	10^6 psi
Compressive strength	170	310	Mpa	24.6564	44.658	ksi
Tensile strength	480	620	Mpa	69.6181	89.9234	ksi
Shear Modulus	74	82	Gpa	10.732	11.8931	10^6 ksi
Young's Modulus	190	205	Gpa	27.5572	29.7372	10^6 ksi
Melting Point	1648	1673	K	2506.73	2551.73	0 F
Specific Heat	490	530	J/kg.k	0.37955	0.4101665	BTU.ft/h.ft^2.F

Table no.1 properties of SS316

Carbon (c)	Mn	S	P	Si	Carbon equivalent max.	Cr and Ni
0.22	2.00	0.030	0.40	0.045	0.08	16.00-18.00 &10.00-14.00

2. PREPARATION OF TEST SPECIMEN:-

First 6 sample piece is prepared by cutting 8mm thick stainless steel plate into 150*150*8 area. Each sample piece is chamfered from one side at an angle of 30 degree with root clearance of 2.5 mm . The below figure shows the preparation of sample piece



1) First step is to cut the sample piece and making it suitable for welding by cutting sample with 30 degree chamfered from one side with 2.5mm root clearance.

2) Performed the different welding on the sample piece of SS316

3) Observed the different welding parameters of welding process and note it.

4) After that we will get 3 test coupons and perform the bending test on thart test coupons .

5) After test find the best bending strength from these welding processes.

3. LITERATURE REVIEW:-

Aamir R. Sayed et al. [1] Experimental analysis on different mild steel weldments by ultrasonic testing Sahil Ambekar, Yash Sontake, Shrijit Tembhekar B.E. students department of mechanical engineering. In this research paper they take material mild steel E250Br and perform different welding processes on that material and the result is observed that there is a defect in submerge arc welding as per welding must had not been done properly and fillet material is not inserted as per the required purpose. The lack of fusion defect is observed which is up to 15%.

Behcen Gulenca et al. [2] Experimental study of the effect of hydrogen in argon as a shielding gas in MIG welding of austenitic stainless steel
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In this study, 304L stainless steel was bonded by MIG welding and mechanical and microstructural properties of the welded samples were investigated. Welding was carried out under different shielding media, which are argon and different additions of hydrogen in Ar. As current values,140, 180 and 240 A were chosen for the welding current parameters. The sample that was welded under 1.5% H2–Ar shielding media and with a welding current of 240 A was found to be the best in terms of means of tensile strength. Impact tests revealed that toughness of the welding increases with increasing hydrogen amount in Ar and welding current. For all the welding parameters, hardness test results showed that base metal gave a higher hardness value than HAZ and weld metal. Welded samples were also characterized by means of bending test and microscopic investigations.

K Abbasi et al. [3] A review study of effect of MIG welding parameters on weld bead and shape factor characteristics of mild steel specimen. In this paper they used welding current, welding arc voltage, welding speed , heat input, etc and studied effect on depth of penetration and weld width.

Anil Kumar et al. [4] A review study of MIG welding on aluminum alloy.
Various research had done on response parameters like microstructure, micro-hardness, depth of penetration heat affected zone of welded specimen and in this literature survey have been conducted that heat treatment on weld specimen has greater effect on metallurgical properties of specimen.

Arjun A Abhyankar et al. [5] An Experimental Study of Arc Welding Parameters for Ultimate Strength in Bending and Hardness on DMR 249A and Optimization. In this paper an experimental study has been done to find the optimal input parameters of arc welding like welding current , arc voltage, electrode angle and welding speed to achieve max. ultimate bending strength and hardness for DMR-249

4. PERFORMANCE METHODOLOGY:-

In given experiment we are perform different welding process such as MIG, TIG and SMAW on stainless steel alloy (SS316) TIG welding by wearying parameter voltage, current and gas flow rate. in that experiment argon is used as a shielding gas. For perform an experiment required TIG welding setup. first, we find
influence welding parameter which is highly affected the welding properties then perform a combination of welding . And test is by various testing technique like 1) Spectrography, 2) Microstructure, 3) Ultrasonic test, 4) DPT Dye Penetration Test 5) Hardness, 6) Tensile, 7) Bending. 8) X-ray Test (Radiography Test). All processes are being carried out as per ASME standards. Then find an optimum input parameter for tensile strength and percentage of elongations. After finding optimum parameter change shielding gas with Ar+67%He and perform a welding process. Then test it and find that it is suitable for our application or not .and which kind of change occurred in microstructure find it by comparing them.

Conclusion:-

This paper gives the idea of working on SS 316 by different welding processes and fron above literature review it is cleared that various work has been done on E250Br that's way we select the material SS316 .So our main aim is to find the best quality of welding process for SS316.

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