International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 07 Issue: 03 | Mar 2020 www.irjet.net p-ISSN: 2395-0072

EFFECT OF WELDING CURRENT ON THE HARDNESS OF MILD STEEL BUTT WELDMENT AT DIFFERENT GROOVE ANGLE

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Abstract - *There are several types of joining process in which some is temporary and others is permanent, while welding is permanent joining process of joining two similar or dissimilar metal plates by the use of heat, amid and devoid of the application of filler material and pressure. After welding it very important to study about mechanical property of the weld metal due to temperature the hardness is very via different zone like fusion zone, heat affected zone. We calculate the hardness of mild steel near fusion zone and HAZ at different welding current. Medium carbon steel (mild steel) has been preferred as parent metal, having plate-thickness 6mm 7mm and groove angle(30^0, 45^0, 60^0) as input variables with the application of electric arc welding technique at different welding current. Direct and interactive effects of welding current and groove angle of MS had been explained over hardness. The result is validate by ANOVA using design expert software.*

***Key Words*: Hardness, Welding Current, Butt Joint, Arc Welding, Rockwell hardness test, MS, HAZ**

1. INTRODUCTION

Electric arc welding is widely used in ship building, construction industry and many of maintenance fabrication industry. Due to its very low cost of operation and portability it is widely used[1]. Electric are welding have a different range of temperature depending upon the welding current.

Hardness is measure of resistance to scratch. There are various types of hardness testing namely brinell hardness test, Rockwell hardness test, knoop hardness test[2]. From the several hardness test we use Rockwell hardness test, to find the hardness of the mild steel plate on different welding current viz. 100 amp. And 150 amp. In this welding the arc should be steady and uniform

Literature review report that comprehensive studies of Hardness had been carried out by so several authors, tranquil there is general lack of empirical data on different types of Hardness mostly for butt weld (v-groove) joint. Few researchers had provided detail analysis of angular Hardness still groove angle and plate thickness is barely considered. Moreover, the accessibility of data on other types of Hardness is so scared that the verification of theoretical prediction is difficult.

2. EXPERIMENTAL SETUP

Experimental work was setup for measuring the Hardness of butt weld joints having distinctive groove angle and different thickness for the mild steel plates with application of ER-4211 welding electoode (Make: Manglam, size: 3.15mm x 450mm) using Electric arc welding machine (Make: Kabir super cut, current range: 50A to 330A, voltage: 40V)

2.1 PREPARATION OF WELDING PLATE

In the experiment 6 plate is cut from a long MS plate of 6mm thickness. The plate is cut with the help of pipe cutter machine. The dimension of the specimen is (100X50X6)mm which is degisinated by P1, P2, P3, P4, P5, P6. similarly from MS flat of 7 mm thickness different plate is cut and the dimension of specimen is (100X50X7) which is deginated by P7, P8, P9, P10, P11, P12.

Fig.2.1: Specimen of Mild Steel

Fig.2.2: Specimen Of Mild Steel after welding

3. CALCULATION OF HARDNESS

Rockwell is a fast hardness test method developed for production control, with a direct recite, mainly used for metal such as mild steel. The Rockwell hardness testis calculated by measuring depth of an indent after loading with a indenter with a specific load, the indenter may be spherical or conical.

In this test a hardened steel ball of 2.5,5 or 10 mm in diameter is used as indenter.

The loading force is in the range of 300N to 30000N for testing lead alloy, 5000N and 30000N for steel

The Brinell Hardness Number (HB) is calculated by the formula:

$HB = 2F/(3.14D*(D-(D^2 - D_i^2)^{1/2}))$

Where

F- applied load, kg, **D** – indenter diameter, mm

D_i – indentation diameter, mm

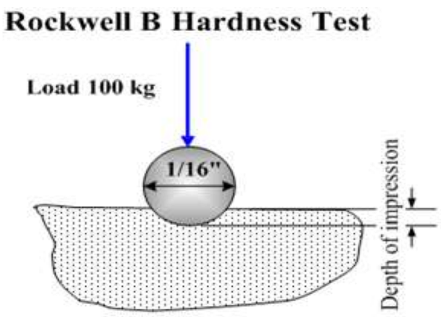


Fig. 3.1- Indenter in hardness test.

3.1 ROCKWELL SUPERFICIAL HARDNESS TEST

Rockwell test is applied for thin strips, coatings, carburized surfaces.

Reduced loads (1 kgf, 30 kgf, and 30 kgf) as a major load and deduced preload (3kgf) are used in the superficial test. Depending on the indenter, two scales of Rockwell Superficial method may be used: T (1/16" steel ball) or N (diamond cone).

3.2 CALCULATION AND RESULT

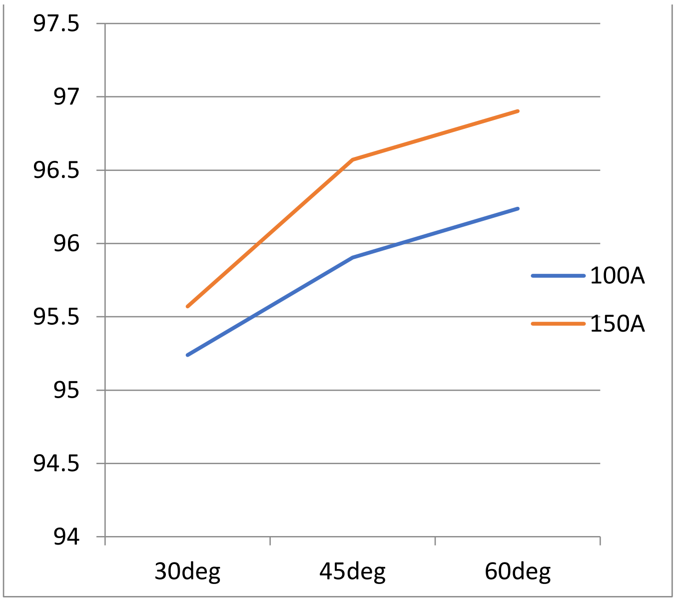
Rock well hardness test result for mild steel for different groove

Table -3.1: Sample Table for 6 mm plate hardness at different groove angle

S.No	Plate	Plate Thickness	Groove	Current(A)	Hardness	Material
1	P1	6mm	30deg	100	95.238HBR	Ms
2	P2	6mm	30deg	150	95.571HBR	Ms
3	P3	6mm	45deg	100	95.904HBR	Ms
4	P4	6mm	45deg	150	96.570HBR	Ms
5	P5	6mm	60deg	100	96.237HBR	Ms
6	P6	6mm	60deg	150	96.903HBR	Ms

As in the above table the hardness along with plate thickness and groove angle is written and brief information about the plate is written bellow.

1) P1 means plate of 6mm thickness with 30deg groove angle with current 100A and its hardness is shown in the above box.
2) P2 means plate of 6mm thickness with 30deg groove angle with current 150A and its hardness is shown in the above box
3) P3 means plate of 6mm thickness with 45deg groove angle with current 100A and its hardness is shown in the above box
4) P4 means plate of 6mm thickness with 45deg groove angle with current 150A and its hardness is shown in the above box
5) P5 means plate of 6mm thickness with 60deg groove angle with current 100A and its hardness is shown in the above box
6) P6 means plate of 6mm thickness with 60deg groove angle with current 150A and its hardness is shown in the above box



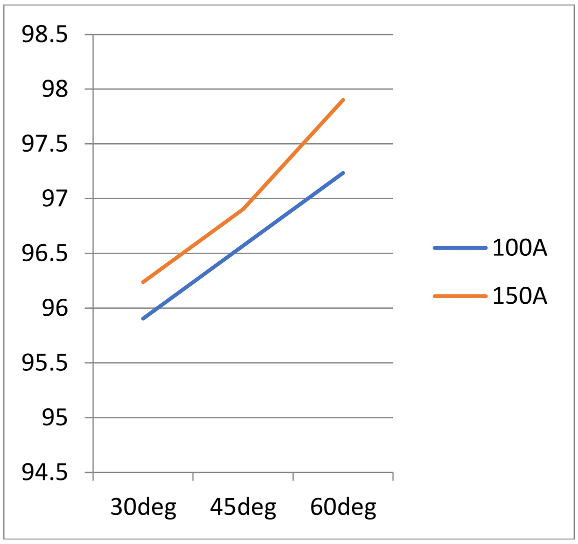
Graph -3.1: Graph 6mm MS Vs Hardness At Different Current

Table3. 2: samole of 7mm thick plate hardness at different groove

S.No	Plate	Plate Thickness	Groove	Current(A)	Hardness	Material
1	P7	7mm	30deg	100	95.904HBR	MS
2	P8	7mm	30deg	150	96.237HBR	MS
3	P9	7mm	45deg	100	96.570HBR	MS
4	P10	7mm	45deg	150	96.903HBR	MS
5	P11	7mm	60deg	100	97.236HBR	MS
6	P12	7mm	60deg	150	97.902HBR	MS

The information related to table is written here for the understanding

1) P7 means plate of 7mm thickness with 30deg groove angle with current 100A and its hardness is shown in the above box
2) P8 means plate of 7mm thickness with 30deg groove angle with current 150A and its hardness is shown in the above box
3) P9 means plate of 7mm thickness with 45deg groove angle with current 100A and its hardness is shown in the above box
4) P10 means plate of 7mm thickness with 45deg groove angle with current 150A and its hardness is shown in the above box
5) P11 means plate of 7mm thickness with 60deg groove angle with current 100A and its hardness is shown in the above box
6) P12 means plate of 7mm thickness with 60deg groove angle with current 150A and its hardness is shown in the above box



Graph 3.2 : Graph 6mm MS Vs Hardness At Different Current

3. CONCLUSIONS

Following conclusion is observed.

1) As we use a large thickness of the plate, the output on hardness scale will increase
2) If the operator increases the value of current the effect on the hardness also increase
3) Hardness value was large as we large the value of groove angle
4) To increase Hardness we can increase either current either groove angle or the thickness

The finale conclusion made from this research is if we wanted to increase the value of hardness we can increase the value of groove and current and if we wanted to reduce the value of hardness.

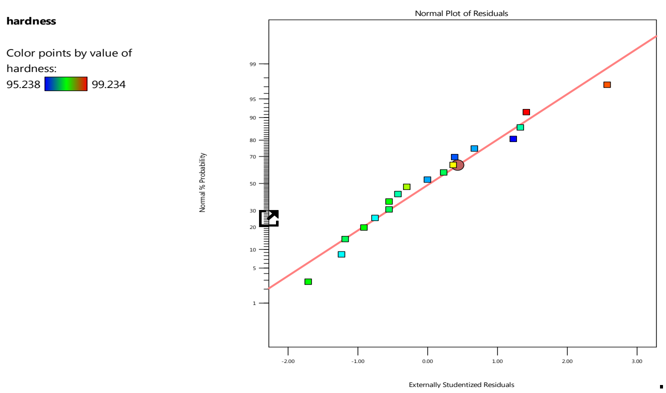


Fig 4.1 Graph of ANOVA for hardness

By this information now welder can adjust the hardness outcome as required on the job and can provide a long life to the work Further more this can provide a long initial hustle free machining simple research is done here a lot of mechanical properties can we detected here and thus leave a lot of work for future a strength change can we calculated on work piece. Compressive strength can also be calculated on these scope for the research on these are very large and a large amount of time also required to perform and assembling all these data

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