OPTIMIZATION OF TIG WELDING ON STAINLESS STEEL (304) AND HIGH CARBON STEEL(IS2062)

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ABSTRACT

In the present study, the TIG welding parameter for welding a dissimilar material of SS304 and High carbon steel (IS2062) have been investigated .In which the various input parameter taken are current, voltage, gas flow rate and time consumption for welding the techniques that is used for optimization is Taguchi L9 orthogonal then the various output response are hardness and depth of penetration are taken.

Key words: *Stainless steel, Taguchi, Bead geometry, Heat affected zone,High carbon steel.*

INTRODUCTION:

TIG is one of the welding process that is used in the industry. And also the input parameter plays a vital role in determination of welding joints the major problem in the TIG welding is that the weld geometry this property directly affects the base material when improper welding parameter are chosen. So to over come the correct welding parameter are to be chosen for welding the base material is the major welding parameter include current, voltage, gas flow rate because this parameter are consider as primary adjustment in the welding process.

MATERIALS:

The base material used in the investigation is STAINLESS STEEL (304)ANDHIGH CARBON STEEL(IS2062) . It is widely used in boiler, aerospace body. The chemical composition of the stainless steel consists of C-0.22,SI-0.40,MN-1.50.

WORK MATERIAL:

The dimension of work material are 5mm thick, and the dissimilar material are High carbon steel(IS2062) and stainless steel(SS304) are established. The work materials dimensions are length100mm,width50mm then the work piece are selected based on the journal references. The parent material are welded without any formation of groove. The, TIG welding are done using straight polarity, welding current, welding speed and the distance of electrode to work piece are welding current 125 amps welding voltage 14vand travel speed are9sec.The electrode used for welding is L309 and argon gas is used as shielding gas.

OBJECTIVES

The objective of the project is to

- *To optimize the suitable welding parameter like current voltage and gas flow rate for the selected materials of SS304 and high carbon steel IS 2062 .*

- *To selection of suitable welding parameters leading to improvement of the welding strength of the materials.*
- *To determine the weld profile for the welded area based on the filler material used specially the NICKEL and STAINLESS STEEL (304L).*

METHODOLOGY

- *First the ss304 and high carbon steel (IS2062) is taken with 5mm length and breath with required dimension are taken.*
- *Welding is done for 9 different pieces with different parameters such as voltage, current, speed, etc. The welded pieces are then cut for different testing method and result is been analyzed*
- *The testing method consist of two testing*
    1. *MECHANICAL TESTING. – HARDNESS TEST*
    2. *CHEMICAL TESTING – DOP TEST*

WELDED SPECIMEN AFTER WELD:



WELDING PARAMETER AND THEIR LEVELS:

Symbol	Welding parameter	Level-1	Level-2	Level-3
I	Current	90	105	125
S	Speed	35	51	60
G	Gas flow rate	9	8	8
V	Voltage	12.6	13.6	14.8

PRINCIPLE OF TIG WELDING:

In our project we uses a principles that of the welding polarity are matained the base material are given the positive and the electrode are given as negative.The filler rod used for welding dissimilar material are 309L filler rod.And we matained a input parameter like current, voltage and gas flow rate of the material is been main characteristics of our project.

CHEMICAL COMPOSITION FOR ER309 FILLER ROD:

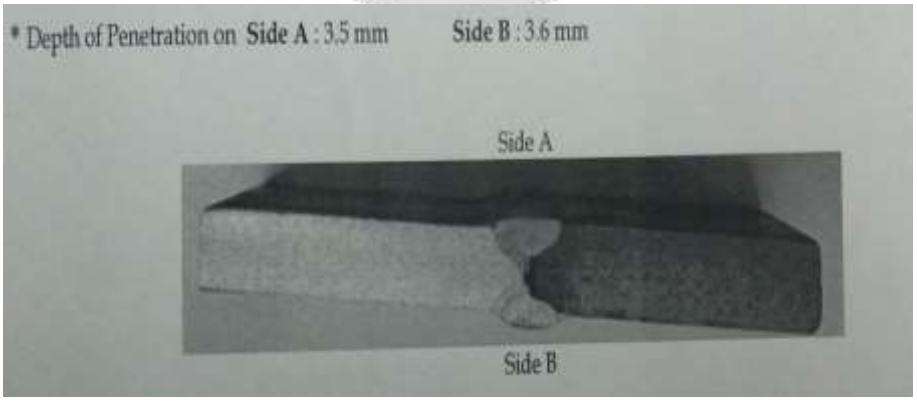
C = 0.12 max
Cr = 23.0 – 25.0
Ni = 12.0 – 14.0
Mo = 0.75 max
Mn = 1.0 – 2.5
Si = 0.30 – 0.65
P = 0.03 max
S = 0.03 max
Cu = 0.75 max

HARDNESS TEST:

Hardness is a resistance to deformation. The hardness of steel is generally determined by testing its resistance to deformation. There are three general types of hardness measurement. Scratch Hardness is the ability of material to scratch on one another. Different type: Brinell, Meyer, Vickers, Rockwell hardness tests. The hardness was tested by Rockwell hardness -testing machine with 'C' scale. Photographic view of Rockwell hardness-testing machine. Hardness is measured for two runs of each experiment:- Major Load: - 150kg Scale: - Rockwell 'C' scales (HRC) Minor Load: - 10kg Indenter: - Diamond Indenter.

DEPTH OF PENETRATION

Depth Of Penetration is a one of the type of ndt method in which the testing is done for finding out the cracks. The cracks finding can be made using this method. The inspection are done with visual inspection only. Using welded joint dop is seen for the specimen



RESULT & GRAPH

Thus the result given below are taken based on the reading that the selection best parameters can be selected using our result. Thus from this the best parameters are been selected and they are listed below.

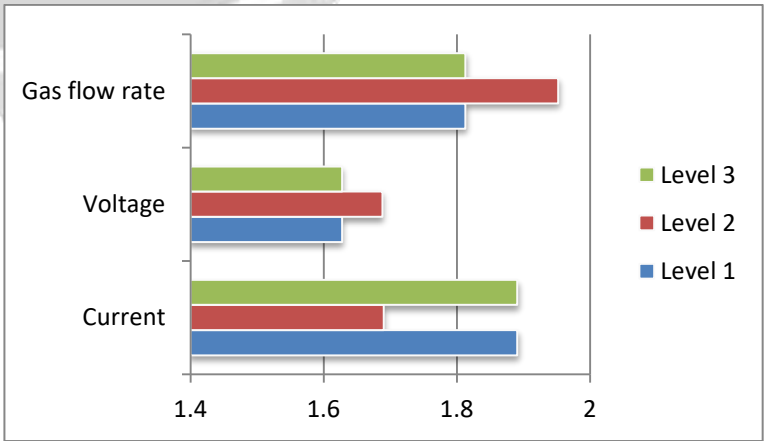
- **INPUT/OUTPUT PARAMETER**

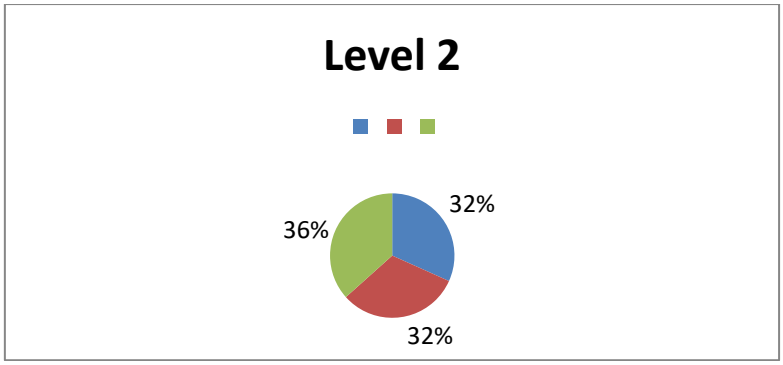
JOB NO	CURRENT IN Amps	VOLTAGE IN Volts	GAS FLOW RATE	TRAVEL SPEED	Rockwell Hardness	Penetration Depth Side A	Penetration Depth Side B
1	95	12	8	60	84	2.5	2.4
2	95	13	8	50	76	1.6	2.4
3	95	14	8	39	76	1.8	2.5
4	105	12	9	51	79	3.5	3.6
5	105	13	9	48	83	2.2	2.4
6	105	14	9	45	73	2.4	1.9
7	115	12	10	47	70	2.8	2.4
8	115	13	10	56	82	2.8	3.7
9	115	14	10	35	74	2.4	2

- **GRAY RELATIONAL SCALES**

	Level 1	Level 2	Level 3
Current	**1.891065**	1.69075	1.891065
Voltage	1.627937	**1.688507**	1.627937
Gas flow rate	1.813074	**1.952819**	1.813074

GRC			
Welding Time	**HB**	**A**	**B**
1	0.33333	0.51351	0.64286
0.55556	0.53846	1	0.64286
0.37313	0.53846	0.82609	0.6
0.5814	0.4375	0.33333	0.34615
0.5102	0.35	0.6129	0.64286
0.45455	0.7	0.54286	1
0.4902	1	0.44186	0.64286
0.75758	0.36842	0.44186	0.33333
0.33333	1	0.54286	0.9





CONCLUSION

- TIG welding specimen can bear higher load, yield stress and tensile strength.
- Ductility is higher in MIG welding compared to TIG welding.
- As per the experimental result all parameters in TIG welding is better.
- Therefore, TIG welding is best suitable for steel.

The experiments were carried out and the optimization was done using Grey relational analysis and TOPSIS. The following findings have been recorded.

- The most feasible combination of parameters through GRA were found to be 14 volts of voltage, 115 amperes of welding current and 10 bar of pressure.
- The maximum Grey Relational Grade was recorded at the combination of 24 volts, 175 ampere and 5 bar.
- The minimum Grey relational grade was found at the combination of 26 volts, 175 ampere and 5 bar.

REFERENCES

- [1] Radhakrishnan V.M.,"Welding Technology & Design",McGraw Hill, New York, 2006.
- [2] BayramKocabekir, RamazanKacar, Suleyman Gundu z, Fatih Hayat,"An effect of heat input, weld atmosphere and weld cooling conditions on the resistance spot weldability of 316L
- austenitic stainless steel", Journal of Materials Processing Technology 195, 2008, pp. 327–335.
- [3] M. Balasubramanian, V. Jayabalan, V. Balasubramanian, "Developing mathematical models to predict tensile properties of pulsed current gas tungsten arc welded Ti–6Al–4V alloy", Materials and Design 29 (2008) pp. 92–97.
- [4] P. Sathiya, S. Aravindan, A. NoorulHaq, K. Paneerselvam "Optimization of friction welding parameters using evolutionary computational techniques", Journal of materials processing technology 209, 2009, pp. 2576–2584.
- [5] K. Shanmugam, A.K. Lakshminarayanan, V.Balasubramanian,"Effect of weld metal properties on fatigue crack growth behaviour of gas tungsten arc welded AISI 409M grade ferritic stainless steel joints", International Journal of Pressure Vessels and Piping 86, 2009, pp. 517–524.
- [6] A. Kumar, S. Sundarrajan,"Optimization of pulsed TIG welding process parameters on mechanical properties of AA 5456 Aluminum alloy weld-ments", Materials and Design 30, 2009, pp. 1288–1297.
- [7] D.S. Nagesh, G.L. Datta,"Genetic algorithm for optimization of welding variables for height to width ratio and application of ANN for prediction of bead geometry for TIG welding process Applied Soft Computing", 10, 2010, pp. 897–907.
- [8] Kuang-Hung Tseng, Chih-Yu Hsu, "Performance of activated TIG process in austenitic stainless steel welds", Journal of Materials Processing Technology 211, 2011, pp. 503–512,
- 2011.
- [9] M. Aghakhani, E. Mehrdad, E. Hayati, "Parametric Optimization of Gas Metal Arc Welding Process by Taguchi Method on Weld Dilution, 2011.

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