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An Experimental Study on the Effect of MIG Welding Parameters on the Weldability of Galvenize Steel

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ABSTRACT: MIG welding parameters are the most important factors affecting the quality, productivity and cost of welded joint, Weld bead size, shape and penetration depend on number of parameters. Lot of research work has been done regarding the effect of variables on the process. The quality of a welded joint is directly influenced by the welding input parameters Inadequate weld bead dimensions such as shallow depth of penetration may failure of a welded structure since the effect of various welding process parameters on the weldability of galvanized Steel specimen having dimensions 50 mm × 40 mm× 5 mm, welded by metal inert gas welding were investigated. The welding current, arc voltage, welding speed, are chosen as welding parameters. The depth of penetrations were measured for each specimen after the welding operation is done on closed butt joint and the effects of welding speed, current, voltage parameters on depth of penetration were investigated.

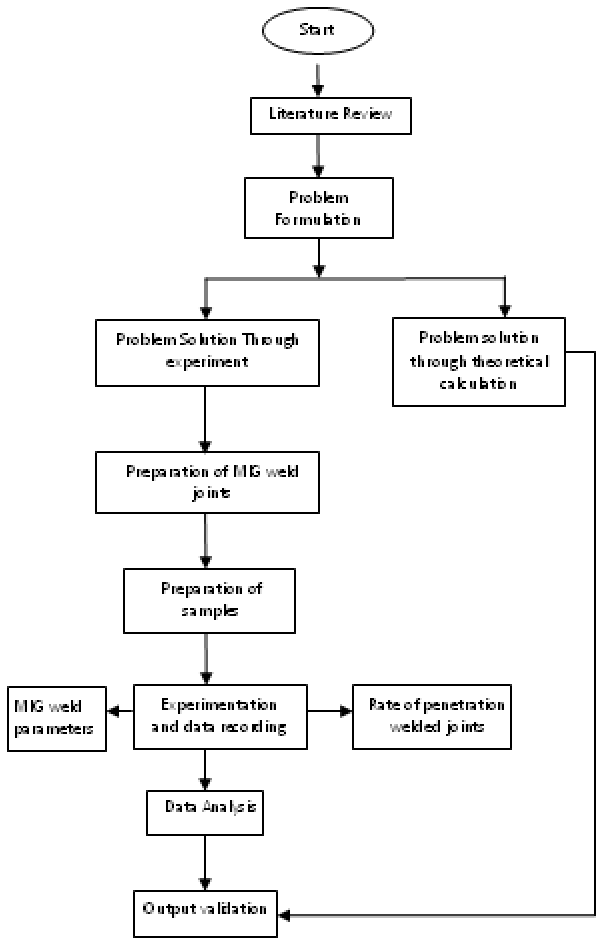
Keywords: Gas Metal Arc Welding (GMAW), Welding current, arc voltage, welding speed, shielding gas

I. INTRODUCTION

Welding is one of the most important methods of joining of two similar and dissimilar metals with or without application of pressure [2]. Metal inert gas/ metal active gas (MIG/MAG) welding is an arc welding process, the melting takes place by Joule effect and a continuous electric arc, where the additional metal is supplied by a roll of wire [4]. It is an arc welding process where heat is generated for arc between the workpiece and a consumable electrode. A bare solid wire called electrode is continuously fed to the weld zone, it becomes filler metal as it is consumed. Gas metal-arc welding overcomes the restrictions of using electrode of limited length and overcomes the inability to weld in various positions, which is a limitation of submerged-arc welding [7].The GMA welding parameters like welding current, welding speed, arc voltage are the most important factors affecting the quality, productivity and cost of welding joint. Weld bead geometry directly affects the cost of welding. Hence these parameters are necessary to be controlled after careful study. Shielding gas used in the process not only protects the molten metal pool and keeps arc stable, but also affects the properties of weld and determines the shape and penetration patterns. Changing the weld parameters (weld speed, welding current, arc voltage) and changing the composition of shielding gas, creates changes in penetration [10]. An electric arc is struck between a continuous filler metal electrode and the weld pool, with shielding from an externally supplied gas, which can be an inert gas, an active gas or a mixture. The heat of the arc melts the surface of the base metal and the end of the electrode. The electrode molten metal is transferred through the arc to the work where it becomes the deposited weld metal (weld bead). The quality of the welded material can be evaluated by many characteristics, such as bead geometric parameters (penetration, width and height). These characteristics are controlled by a number of welding parameters and therefore to attain good quality, it is important to set up the proper welding process parameters[13].Gas Metal Arc Welding (GMAW), sometimes referred to by its subtypes Metal Inert Gas (MIG) welding or Metal Active Gas (MAG) welding, is a semi-automatic or automatic arc welding process in which a continuous and consumable wire electrode and a shielding gas are fed through a welding gun. A constant voltage, direct current power source is most commonly used with GMAW, but constant current systems, as well as alternating current, can be used. There are four primary methods of metal transfer in GMAW, called globular, short-circuiting, spray, and pulsed spray, each of which has distinct properties and corresponding advantages and limitations [16].

The process control parameters chosen for the study are welding current (I), welding speed (V), welding gun angle (T) and shielding gas flow rate (Q). A mathematical model was developed to correlate the process parameters to depth of penetration. The developed model was then compared with the experimental results; it was found that the deviation falls within the limit of a 95% confidence level. Additionally, the results obtained from the mathematical model were more accurate in predicting penetration [17].

A. Flow chart of Methodology



B. Selection of Welding Parameters

Depth of penetration of a welded butt joint depends on a number of influencing factors like welding parameters, properties of workpieces, wire electrode, welding phenomenon etc. Studies reveal that, Welding speed, Voltage, Current are the three welding parameters which influence in determining the depth of penetration of a butt welded joint and thus these three parameters are considered as design factor in the present study**.**

C. Preparation of Specimens

In the present work, 18 galvanized steel specimens, with dimensions of 50 mm x 40 mm x 5 mm of each was used as the work piece. These specimens were prepared with a butt joint and root face were prepared, and faces were cleaned by a surface grinder.

To make a butt joint, two plates were tacked at the two ends along the width, with a constant root gap of 0.7 mm. Once the welding is over all the plates were cut by using a hacksaw, to a required shape for measuring depth of penetration. The welding torch was mounted on a fixed arm of a portable gas cutting machine, which can move at different known speed. Copper coated mild steel wire of 0.8 mm diameter was used in the experiment as the electrode. The wire was fed through the welding gun by a roller drive system. The shielding gas used was CO_2, supplied in a regulated manner at a constant flow rate and at a constant pressure.

18 Galvanized steel specimens, with dimensions of 50 mm x 40 mm x 5 mm of each was used as the workpieces

MIG Welding Machine.

II. EXPERIMENTAL WORK

This data was obtained from a detailed MIG welding experiment in which the welding parameters were precisely controlled and the penetration precisely measured. The thickness of the plate taken is 5 mm and a 0.8 mm diameter wire has been used to weld it. The shielding gas used is a mixture of Argon-78%, Carbon Dioxide-20% and 2% Oxygen..

In this experiment, metal inert gas welding is used. It is a process which yields coalescence of metals by heating with a welding arc between a continuous filler metal wire electrode and the work piece. Firstly, 2 specimens of dimensions 50mm× 40mm× 5 mm are prepared, then closed butt joint are made by these specimens. Before welding, edges of the work pieces are suitably prepared. The edges and the area adjoining them is cleared of dust using wire brush. Afterwards, the work pieces to be welded were positioned with respect to each other and welding process was performed under constant voltage and current in flat (down hand) position. Speed of welding is defined as the rate of travel of the electrode along the seam or the rate of travel of the work under the electrode along the seam.

Arc time was varied during the welding of 18 specimens. Welding speed was calculated for each welded specimen. Having finished the welding processes, in order to measure the depth of penetration, welds were cut perpendicular to the direction of welding on power hacksaw. Then with the help of measuring instrument, depth of penetration of welded specimens was measured.

CALCULATION

During the welding process, following data are chosen:

Copper Coated Steel Wire with a diameter of 0.8 mm used

Speed of welding = Travel of electrode/ arc time mm/min.

Heat input rate or arc energy = V × I × 60 /v joules per mm.

Where,

V is arc voltage in volts,

I is welding current in ampere,

v is speed of welding in mm/min.

RESULTS AND DISCUSSION

Table (a). Depth of penetration of welded specimens.

S. No.	Welding voltage	Welding current	Arc time	Welding speed	Heat input rate	Penetration
	(V)	(A)	(sec)	(mm/min)	(J/mm)	(mm)
1	23	100	22.6	132.74	1039.6	2.07
2	23	100	21.1	142.18	970.6	2.54
3	23	100	20.7	144.92	952.2	2.83
4	23	100	18.6	161.29	855..6	3.09
5	23	100	15.8	189.87	726.8	3.21
6	23	100	14.3	209.71	660.3	4.06
7	23	100	13.7	218.97	630.2	3.44
8	23	100	12.1	247.93	556.6	3.19
9	23	100	11.2	267.85	515.2	2.94

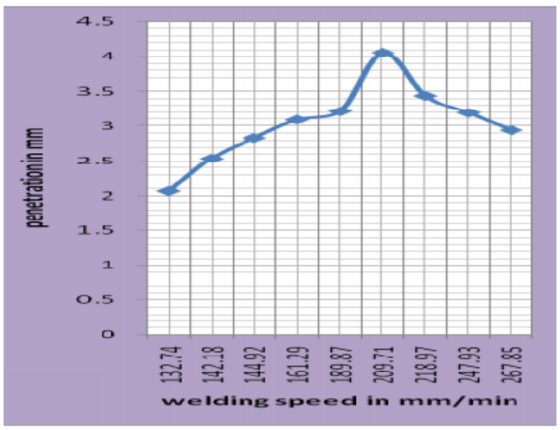
Table (b). Bead width of welded specimen.

S.No.	Welding voltage	Welding current	Arc time	Welding speed	Heat input rate	Bead Width
	(V)	(A)	(sec)	(mm/min)	(J/mm)	(mm)
1	23	100	22.6	132.74	1039.6	15
2	23	100	21.1	142.18	970.6	13.1
3	23	100	20.7	144.92	952.2	12.2
4	23	100	18.6	161.29	855..6	11
5	23	100	15.8	189.87	726.8	10.5
6	23	100	14.3	209.71	660.3	10
7	23	100	13.7	218.97	630.2	9.2
8	23	100	12.1	247.93	556.6	8.5
9	23	100	11.2	267.85	515.2	8.1

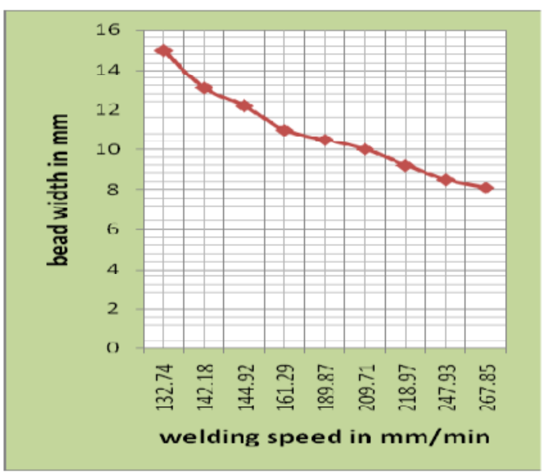
Table (c). Heat Input rate of Welded Specimen.

S.No.	Welding voltage	Welding current	Arc time	Welding speed	Heat input rate
	(V)	(A)	(sec)	(mm/min)	(J/mm)
1	23	100	22.6	132.74	1039.6
2	23	100	21.1	142.18	970.6
3	23	100	20.7	144.92	952.2
4	23	100	18.6	161.29	855..6
5	23	100	15.8	189.87	726.8
6	23	100	14.3	209.71	660.3
7	23	100	13.7	218.97	630.2
8	23	100	12.1	247.93	556.6
9	23	100	11.2	267.85	515.2

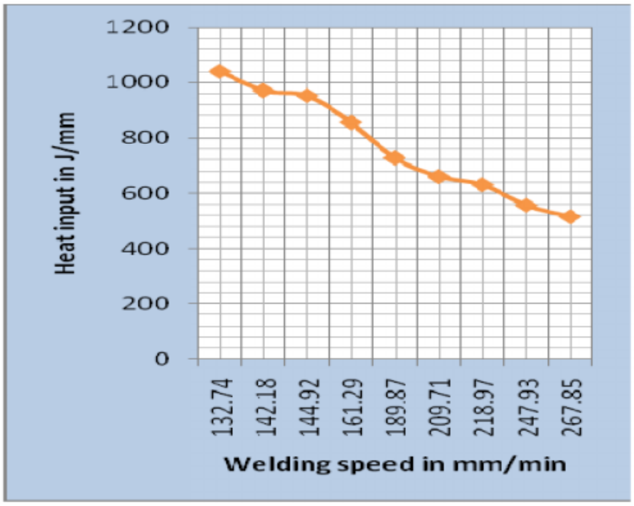
Graph (a). Welding Speed Vs Penetration.



Graph (b). Welding Speed Vs Bead Width.



Graph (c). Welding Speed Vs Heat Input Rate.



Readings of depth of penetration obtained through measuring instrument after cutting all the welded specimens perpendicular to the direction of welding are shown in the table and variations in the penetration are analyzed with the help of graph which is plotted between welding speed and penetration. Voltage (23v) and current (100A) are taken constant and arc time is varied during the welding of specimens. The depth of penetration increases with increasing welding speed, which was optimum value to obtain maximum penetration, because it begins to decrease linearly after this point. Increasing the speed of travel and maintaining constant arc voltage and current increases penetration until an optimum speed is reached at which penetration is maximum. Increasing the speed beyond this optimum results in decreased penetration.

CONCLUSION

Optimum parameter for the weldability of Galvanize Steel specimen of dimension 50mm×40mm×5 mm, when current is 100 amp, arc voltage is 23 V and electrode wire diameter 0.8 mm come out to be:

(1) When the welding speed was taken as a variable parameter. The deepest penetration i.e.4.06 mm was obtained in 209.7 mm/min.

(2) Maximum depth of penetration was obtained when heat input rate was 660.3 J/mm.

(3) Maximum bead width was obtained when welding speed was 132.74 mm/min.

Hence it can be concluded that increasing the speed of travel and maintaining constant arc voltage and current will increase penetration until an optimum speed is reached at which penetration will be maximum. Increasing the speed beyond this optimum value will result in decreasing penetration.

REFERENCES

[1] S. Alam And M.I. Khan [2012] Prediction Of Weld Bead Reinforcement Height For Steel Using Saw Process Parameters, International Journal Of Applied Engineering Research, Issn 0973-4562,Volume 6, No. 152011,PP 1857-1871.

[2] Rossi, B. E. [1954] Welding Engineering. New York: McGraw-Hill Book Company, Inc.

[3] Messler, R. W. [1993] Joining of Advanced Materials. Worburn, MA: Butterworth-Heinemann.

[4] S. Adolfsson, A.Bahrami, G. Bolmsj, I. Claesson, On-line quality monitoring in short-circuit gas metal arc welding, Weld, Res. Suppl. 78 (2) (1999) 59-73.

[5] Davies, A. C. [1984] The Science and Practice of Welding. Cambridge: Cambridge University Press.

[6] Farhat, H.[2007] Effects of Multiple Wires and Welding Speed on the Microstructures and Properties of Submerged Arc Welded X80 Steel. Saskatoon: University of Saskatchewan.

[7] Syamal Mukherjee, " Metal Fabrication Technology", PHI Learn- ing Private Ltd..

[8] Erdal Karadeniz, Ugur Ozsarac , Ceyhan Yildiz,[2007]The effect of process parameters on penetration in gas metal arc welding processes‖ , Materials and Design, PP.649–656.

[9] Gautam Gautam kocher, Sandeep kumar [2012] Experimental analysis in mig welding with is 2062 e250 a steel with various effects. International Journal of Advanced Engineering Technology, E-ISSN 0976-3945. IJAET/Vol. III/ Issue II/158-162.

[10]. A. Prof. Hani Chotai (2011) A Review on Parameters Controlling Gas Metal Arc Welding (GMAW) Process. international conference on current trends in technology, 'nuicone.

[11]. Chandresh N Patel [2013] Parametric Optimization of Weld Strength of Metal Inert Gas Welding and Tungsten Inert Gas Welding By Using Analysis of Variance and Grey Relational Analysis. International Journal Of Research In Modern Engineering & Engineering Technology, (IJRMEET) ISSN: 2320-6586,Vol-1, Issue-3.

[12]. S.P. Tewari, Ankur Gupta, Jyoti Prakash [2010] " Effect Of Welding Parameters On The Weld Ability Of Material" (International Journal Of Engineering Science And Technology), Vol.2(4), PP. 512-516.

[13] Effect of Welding Process Parameters on Weld Bead Geometry and Optimization of Process Parameters to Maximize Depth to Width Ratio for Stainless Steel Gas Tungsten Arc Welded Plates Using Genetic Algorithm, European Journal of Scientific Research, ISSN 1450-216X Vol. **62** No.1 (2011), pp. 76-94

[14] Ahmed Khalid hussain, abdul latif mohd. [2010]influence of welding speed on tensile strength of welded joint in tig welding process, international journal of applied engineering research,dindigul, volume 1, no.3, PP. 518-527.

[15] K. Manikya Kanti, P.Srinivasa Rao [2008] Prediction of bead geometry in pulsed GMA welding using back propogation neural network‖ , Journal of Materials Processing Technology. 300-305.

[16] Ajit Hooda, Ashwani Dhingra [2012] optimization of mig welding process parameters to predict maximum yield strength in AISI 1040, ISSN 2278 – 0149. Vol. 1, No. 3,

[17] Sudhakaran R., Senthil Kumar K. M. [2011] –Effect of Welding Process Parameters on Weld Bead Geometry and Optimization of Process Parameters to Maximize Depth to Width Ratio for Stainless Steel Gas Tungsten Arc Welded Plates Using Genetic Algorithm‖ , European Journal of Scientific Research, Vol.62 No.1, PP.76-94

[18]Robert, W. M. (1999). Principles of Welding. New York: John Wiley & Sons, Inc.

[19]I.S. Kim "An investigation into an intelligent system for predicting bead geometry in GMA welding process". J Mater Process Technol 2005.

[20]Oberg, E., Jones, F. D., Horton, H. L., & Ryffel, H. H. (1992). Machinery's Handbook. New York: Industrial Press Inc.

[21]Gunaraj V, Murugan N (2000), Prediction and opti- mization of weld bead volume for the submerged arc process - Part 1. Welding J. (AWS), 286s - 294s.

[22]Gridharan PK, Murugan N (2007), Optimization of pulsed welding process parameters for the weld-ing of AISI 304 L stainless steel sheets. Int. J. of Advanced Manufacturing Technology 10.1.1007/S00170 - 008 - 1373 - 0.