IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE)
e-ISSN: 2278-1684,p-ISSN: 2320-334X, Volume 12, Issue 2 Ver. VI (Mar - Apr. 2015), PP 79-83
www.iosrjournals.org

Investigation of Effect of Electric Arc Welding Parameters on Welding Quality

Naresh kumar[1], Manish Kumar[2],Kamaljit Singh Saini[3],Himanshu Tripathi[4]
[1](Assistant Professor, Department of Mechanical Engineering, Arni University Kathgarh (H.P), India)
[2(]B.Tech Student(AAME045A/11) , Department of Mechanical Engineering, Arni University Kathgarh(H.P), India)
[3(]B.Tech Student(AAME018A/11) , Department of Mechanical Engineering, Arni University Kathgarh(H.P), India)
[4](Assistant Professor. Depatartment of Mechanical Engineering,Global Institute of Management and Emerging Technologies,Amritsar,Punjab,India)

Abstract: *Welding is process of joining the two pieces with the help of heat or pressure. Welding process is widely used in railway, aerospace, shipping, engineering industry because of its suitability. There are various parameters like welding width, depth, welding speed, current, chemical composition of weldment and welding method that affects the welding quality. In the present work electric arc welding is used on 1030 steel taking welding voltage, welding current ,welding speed as input parameters and hardness, depth of penetration as output parameters .These input parameters are optimized using Taguchi's L_9 orthogonal array. Analysis of variance reveals that variations in input parameters are affecting the penetration and hardness of welding.*
Key words: *Voltage, Current, speed, Hardness, Depth of Penetration, SN ratios.*

1. INTRODUCTION

Metal Arc welding is the method of joining the two pieces by the fusion occurred by heat produced between workpiece and electrode (filler material). Welding practice in industry is little hard because it requires high personal experience and the proper selection of welding process parameters to produce good welding quality. For good quality of welding, it must be known that which particular type of welding is to be used for which type applications .There are number of such parameters which affect the quality of weld [1].Commercial various types of materials like carbon steel ,aluminum ,magnesium ,cooper are welded by proper selection of welding process parameters like shielding gases ,welding conditions and appropriate welding method [2].Proper selection of shielding gases play a vital role in GMAW because the shielding gases not only protect the weld pool of being corroded but also helps in penetration of the metal ,which in directly improves the quality of the welding. Various types of shielding gases are used in GMAW like helium, argon, carbon dioxide and oxygen. Sometimes the mixture of different gases can also be used keeping in mind the easily ionization, effecting shielding of weld, greater penetration and smother profile of weld produced [3].Although numerical simulation of welding processes still face with numerous challenges after having been developed over past several decades, some detailed analytical solutions and several models have been suggested for simulating welding heat sources[4].Welding fusion width and penetration depth had directly linear relationships with heat source parameters, while peak temperature transformed by natural logarithm were precisely described by linear regression model[5].

2. EXPERIMENTAL PROCEDURE

In the present work the Electric Arc Welding with consumable electrode is used for experimentation which is available at Arni University Kathgarh (H.P.).The workpiece material 1030 Steel having size 150x100x10 mm is used .The material's chemical composition is C (.25-.35),Si (0-.35), Mg (.30-.90), P (.05), S (.5max.) percent by weight. Three input parameters voltage, current, speed are used. Taguchi's L_9 orthogonal array is used for optimization of the input parameters for hardness and depth of penetration. Table 1 shows the standard orthogonal array for the planned work.

Table 1 Standard L_9 Orthogonal Array.

Voltage(v)	Current (Ampere)	Speed(mm/min)
20	135	400
20	155	450
20	175	500

30	135	450
30	155	500
30	175	400
40	135	500
40	155	400
40	175	450

3. RESULTS AND DISCUSSIONS

The output result of hardness and depth of penetration of weld are observed .The analysis of the output results is done by using MiniTab-17 software.

3.1. HARDNESS (HRB)

The hardness of the weld is measured by using Rockwell Hardness tester on B-scale which is Available at Arni University. Table 2 shows the results for the hardness. Since greatest hardness is our requirement so larger is better criteria is taken for analysis. Table 3 ANOVA shows the significance and percentage contribution of different factor towards surface hardness of weld. Table 3 ANOVA for Hardness of shows that the welding voltage is most significant parameter for hardness while current and speed are insignificant. It is also clear that

Table 2 Results for Hardness (HRB).

Voltage (V)	Current (Ampere)	Speed (mm/Min)	Weld Hardness (HRB)	SNRA
20	135	400	163	44.2438
20	155	450	179	45.0571
20	175	500	182	45.2014
30	135	450	159	44.0279
30	155	500	169	44.5577
30	175	400	165	44.3497
40	135	500	179	45.0571
40	155	400	177	44.9595
40	175	450	179	45.0571

Table 3 ANOVA for Hardness.

Source	DF	Seq SS	Ad MS	F	P	%age contribution
Voltage	2	170.496	85.248	19.39	0.049	63
Current	2	78.276	39.1395	9.68	0.0936	29
Speed	2	13.853	6.927	1.714	0.3685	5
Error	2	8.079	4.0395			3
Total	8	270.672				100

the welding voltage and current are contributing most about 63 % and 29 % respectively toward hardness of weld , whereas speed is contributing least about 5% only. From Fig.1 is clear that the optimum parametric setting for weld hardness is welding at voltage 40,current 175 ampere, speed 500 mm/min. From counter plot

Fig. 2, it is also clear that high voltage is more contributing factor at high value of current towards the hardness of weld.

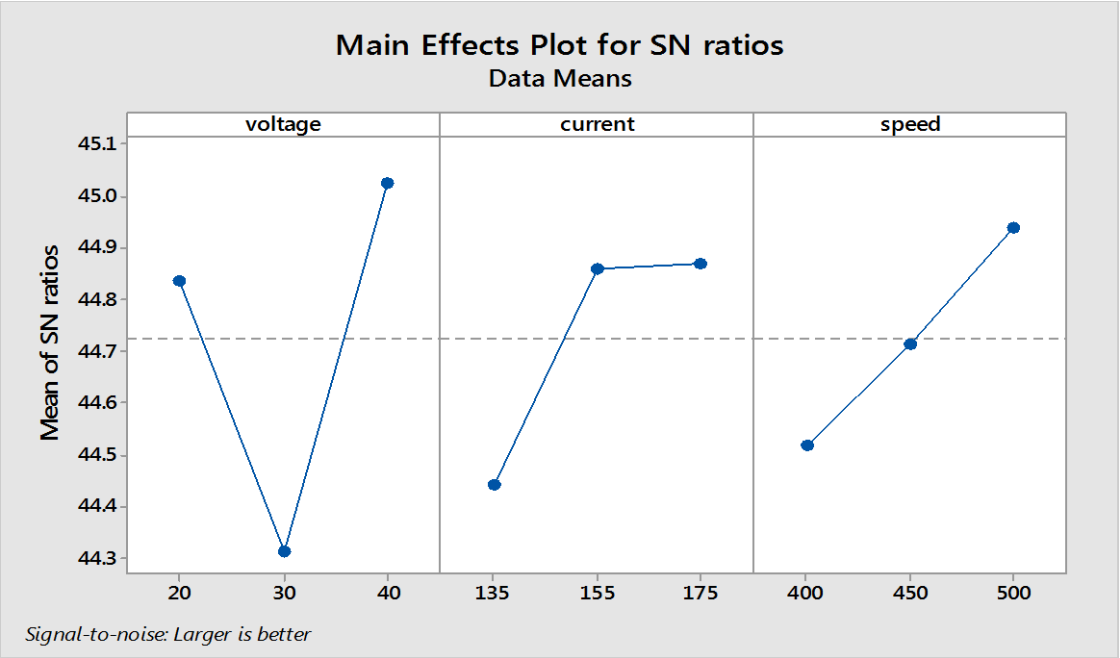

Fig. 1 Main Effect Plots for Hardness of Weld.

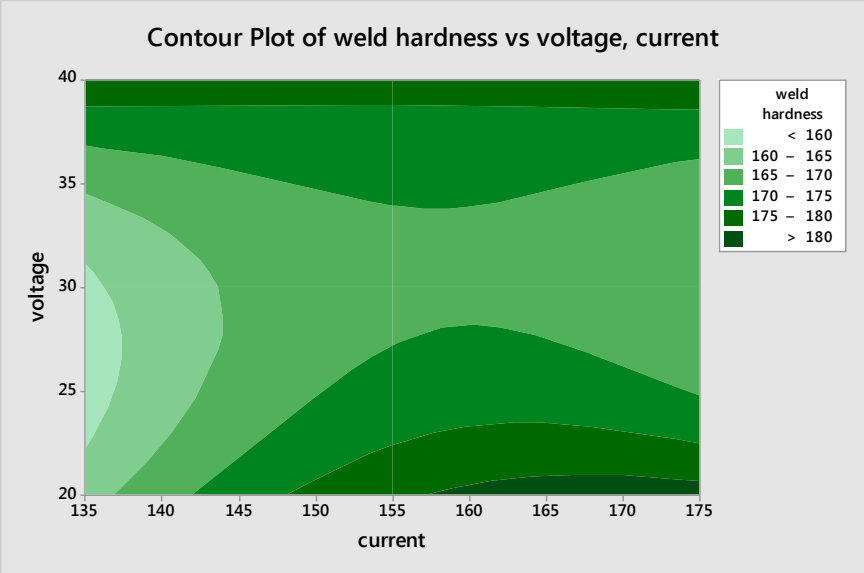

Fig. 2 Contour Plots of Hardness vs Voltage ,Current.

3.2. DEPTH OF PENETRATION

Table 4 shows the results for the Depth of penetration of weld. Since greatest depth of penetration is our requirement so larger is better criteria is taken for analysis. Table 5 ANOVA for depth of penetration shows that the speed of welding is significant factor for depth of penetration of weld while voltage and current seems to be insignificant for depth of penetration of weld. It is also clear from ANOVA table that the most contributing factor towards depth of penetration of depth of weld is welding speed which is contributing about 64% while voltage and current are contributing about 10% and 23% respectively. From Fig. 3 main effect plots for SN ratios shows that voltage 30 volt, current 155 ampere and speed 450 mm/min are the optimum level of parameters for depth of penetration. From the Fig. 4 contour plots for depth of penetration, it can be concluded that depth of penetration is more at 450 mm/min speed and 155 ampere value of current taken in this experimental work.

Table 4 Results For the Depth of Penetration.

Voltage(V)	Current(Ampere)	Speed(mm/min)	Depth of Penetration(mm)	SNRA
20	135	400	3.5	10.8814
20	155	450	6.0	15.5630
20	175	500	5.0	13.9794
30	135	450	5.5	14.8073
30	155	500	5.7	15.1175
30	175	400	4.0	12.0412
40	135	500	4.5	13.0643
40	155	400	4.8	13.6248
40	175	450	5.8	15.2686

Table 5 ANOVA for Depth of Penetration.

Source	DF	Seq SS	Ad MS	F	P	%age contribution
Voltage	2	6.25	3.125	2.942	0.2537	10
Current	2	15.125	7.562	7.120	0.1232	23
Speed	2	41.125	20.562	19.361	0.0491	64
Error	2	2.125	1.062			3
Total	8	64.625				100

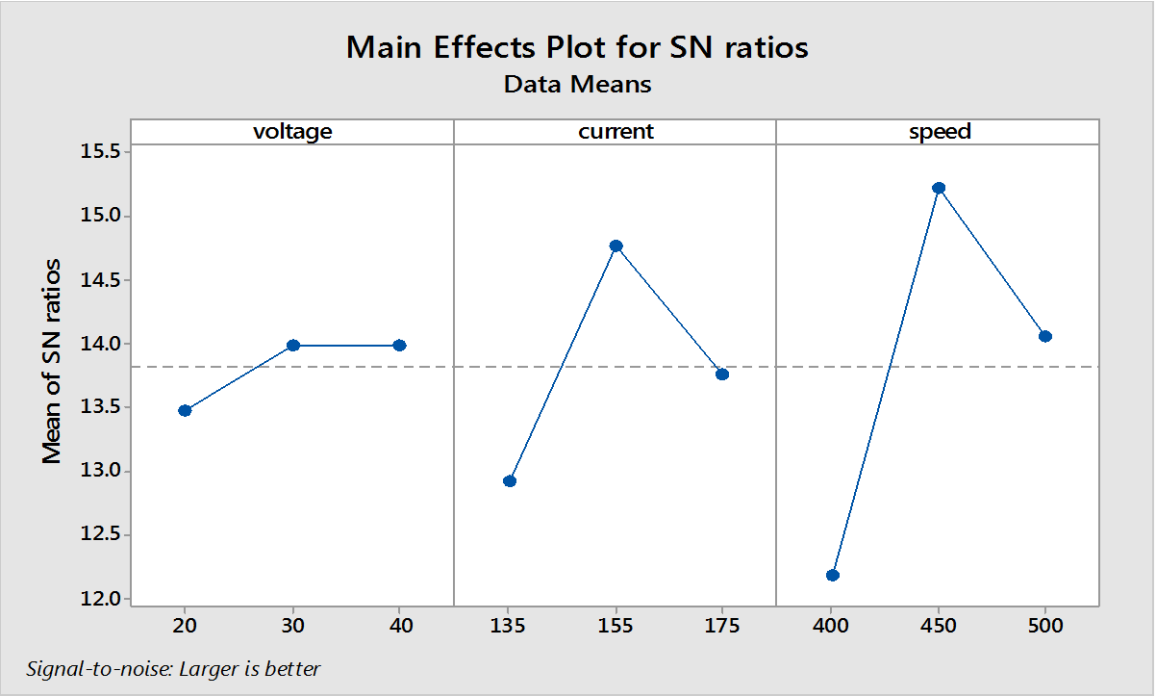

Fig. 3 Main Effect Plots of Depth of Penetration.

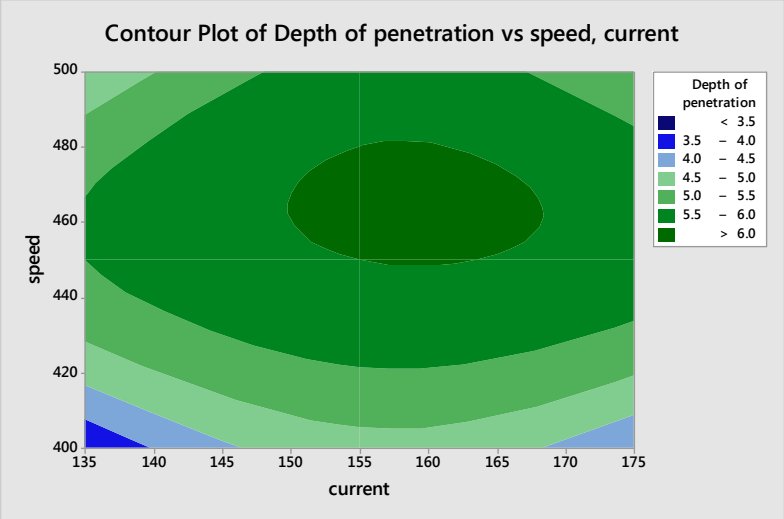

Fig. 4 Contour Plots of Depth of Penetration vs Voltage ,Current.

4. CONFORMATION TEST

Conformation tests for the predicted values are conducted selecting the optimum level at voltage 40 volt, current 175 ampere, speed 500 mm/min. and voltage 30 volt, current 155 ampere and speed 450 mm/min for weld hardness and depth of penetration of weld respectively.

5. CONCLUSIONS

Based on the experimental work and analysis of variance the following conclusions can be drawn:

- Welding voltage and current are contributing most towards hardness of weld ,while speed contributes least.
- Optimum parametric setting for weld hardness is welding at voltage 40 volt, 175 ampere current, 500 mm/min speed.
- Welding speed and current are contributing most towards hardness of depth of penetration of weld ,while voltage contributes least.
- Welding voltage 30 volt, 155 ampere current and 450 mm/min speed are the optimum level of parameters for depth of penetration.

References

[1]. K.L. Moore, D.S. Naidu, R. Yender, J. Tyler, "Gas Metal Arc Welding Control: Part I- Modeling And Analysis" Theory, Methods & Applicarions, Vol. 30, No. 5. pp. 3101-3111, 1997, Proc. 2nd World Congress of Nonlinear Analysts.

[2]. Welding handbook welding processes-arc and gas welding and cutting, brazing and soldering, vol. 2, 7th ed. Miami, FL: American Welding Society; 1978. p. 114–6.

[3]. Han JM, Han YS," Welding technology and strength of GT membrane type LNG ships". J Korean Weld Soc 1993;11(4):7–15.

[4]. T.N. Nguyen, M.A. Wahab, The effect of weld geometry and residual stresses on the fatigue of welded joints under combined loading, J. Mater. Process. Technol. 77 (1998) 201–208.

[5]. X. Jia , J. Xua,, Z. Liua, S. Huanga, Y. Fana, Z. Sun, "A new method to estimate heat source parameters in gas metal arc welding simulation process" Fusion Engineering and Design 89 (2014) 40– 48.