Experimental Investigations to Amend Deposition Rate in Welding Mild Steel by MIG Welding Process

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Abstract - With the increase of mechanization and automation in the arc welding, the selection of welding procedure must be more specific to ensure that the adequate quality of weld bead is obtained. When arc welding is chosen as a method of fabrication, suitable welding procedure must be established. In many instances, especially in manual welding, these are based on establish practice, and are no more systematic than reference manual. Since arc welding began due to its worldwide importance, there have been many attempts to predict the effects of the inputs of controlled variables (elements of a welding procedure) on the output characteristics (weld bead geometry dimensions). These have ranged widely from theoretical studies, based on classical heat flow theory, to empirical studies of actual welding.

Keywords: MIG welding, weld parameters

I. INTRODUCTION

Until the 1970s, manual metal arc was the most dominant method of welding. Today MIGIMAG is the obvious leading contender in most industrial countries. Gas metal arc welding (GMAW) can also be referred to as MIG (metal inert gas) if the shielding gas is inert as for example argon or MAG (metal active gas) if the gas has a content of an active gas such as C02.[2]

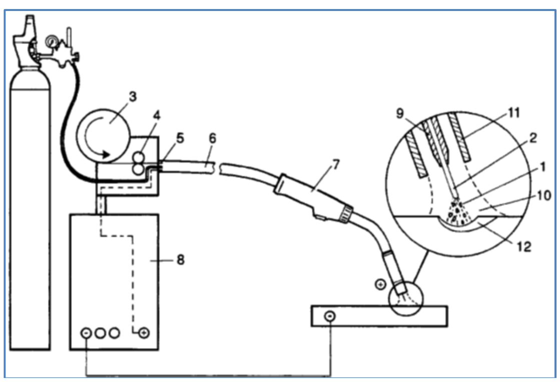

Figure 1: MIG welding components.

Figure 1.1 shows the principle of MIGMAG welding. The arc (1) is struck between the workpiece and a metal wire electrode (2) that is continually fed forward into the arc. The wire is supplied on a reel (3), and is fed to the welding gun by the drive rollers (4), which push the wire through a flexible conduit (5) in the hose package (6) to the gun (7). Electrical energy for the arc is passed to the electrode through the contact tube (9) in the welding gun. This contact tube is normally connected to the positive pole of the power source, and the workpiece to the negative pole. Striking the arc completes the circuit. The gas nozzle (1 1) that surrounds the contact tube (9) supplies shielding gas (10) for protection of the arc and the weld pool (12).

II. EXPERIMENTAL SETUP

In MIGIMAG welding, the welding torch, the wire feed unit and the power source all need to be more powerful due to the higher current density and the thicker wire. Welding is usually carried out using DC, with the filler wire connected to the positive pole. [10, 11]The power source characteristic is generally slightly drooping, which gives a self-regulating arc. When carrying out cored wire welding without a shielding gas (self-shielding), the same power source and wire feed unit are usually used as would be used for welding with shielding gas.[4] However, the welding torch can be simpler, as there is no need for a gas supply - Fume is a problem when welding with high current, not least when using self-shielded flux cored wires.[8] One solution to this problem is to use a welding torch with an integral extraction connection.

Table 1: Chemical composition of AISI 1018 mild steel.

Base Material	Chemical composition (%)				
	C	Mn	P	S	Carbon equivalent
Mild Steel	0.20	0.60	0.042	0.045	0.30

Table 2: Properties of cold drawn AISI 1018 mild steel

Sr. No.	Property	Value
1	Density	7870 kg/m3
2	Thermal Conductivity	51.9 W/m C
3	Young's Modulus of Elasticity	205 GPa
4	Poisson's Ratio	0.29
5	Specific Heat	486 J/kg/C

Selection of Parameters

Three parameters selected for the Experiment are Arc voltage, Travel speed, Wire feed rate which are considered most important in hard facing. [1]Three Level of each parameter are selected which are as under. The ranges are selected by trial and error so that there are no defects occurred.

Table 3: Range of each process parameter

Sr. No	Symbol	Parameters	Levels			Units
			I	II	III	
1	A	Voltage	25	30	35	V
2	B	Welding speed	55	60	65	cm/min
3	C	Wire feed rate	12	13	14	m/min

Some of the parameters which are made constants with their values are: [9]
Electrode to Work Angle: 75º with work piece
Gas flow rate: 18 lit. /min
Nozzle to plate distance: 15 mm

Selection of Taguchi's Orthogonal Array

In this study the interaction between the welding parameters is neglected. Therefore there are six Degrees of freedom owing to three sets of three level parameters. The Degree of Freedom for the orthogonal array should be greater than or at least equal to those for the process parameter. So L_9 orthogonal array is selected with three column and nine rows.[5] The experimental layout for welding process parameter using L9 Orthogonal array is shown:

Table 4: L9 Orthogonal array in terms of actual values

L-9 Orthogonal array			
Experiment no.	**Voltage**	**Welding speed**	**Wire feed rate**
1	25	55	12
2	25	60	13
3	25	65	14
4	30	55	13
5	30	60	14
6	30	65	12
7	35	55	14
8	35	60	12
9	35	65	13

III. EXPERIMENTAL OBSERVATIONS

After conducting the experiments with different setting of the input parameters and the value of the output variable were recorded and plotted as per DOE methodology. Table 5 shows the response obtained in terms of deposition rate in MIG welding experiments obtained with parameters matrixed in Table 4.

Table 5: Experimental observations for Deposition rate

Experiment no.	Deposition rate(Kg/hr)		
	Set 1	Set 2	Average
1	5.201	5.181	5.191
2	5.019	4.925	4.972
3	4.914	4.812	4.863
4	5.401	5.351	5.376
5	5.326	5.315	5.3205
6	4.154	4.228	4.191
7	5.569	5.695	5.632
8	4.608	4.507	4.5575
9	4.674	4.701	4.6875

Table 6 represents the Analysis of Variance for Deposition Rate in MIG Welding. The ANOVA table clearly indicates that voltage parameter is not significant parameter for defining the deposition rate. Welding speed and wire feed rate parameters are significant, means that these terms influence the model to a great extent. Welding speed has the greatest effect on deposition rate and is followed by wire feed rate and voltage.

Table 6: Analysis of Variance for Deposition Rate in MIG Welding.

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Voltage	1	0.00370	0.00370	0.40	0.553
Speed	1	1.00655	1.00655	109.87	0.000
Feed Rate	1	0.58656	0.58656	64.03	0.000
Residual Error	5	0.04581	0.00916		
Total	8	1.64262			
DF - degrees of freedom, SS - sum of squares, MS - mean squares(Variance), F-ratio of variance of a source to variance of error, P < 0.05 - determines significance of a factor at 95% confidence level					

Regression Equation

Deposition Rate = 5.976 - 0.00497 Voltage - 0.08192 Speed + 0.3127 Feed Rate

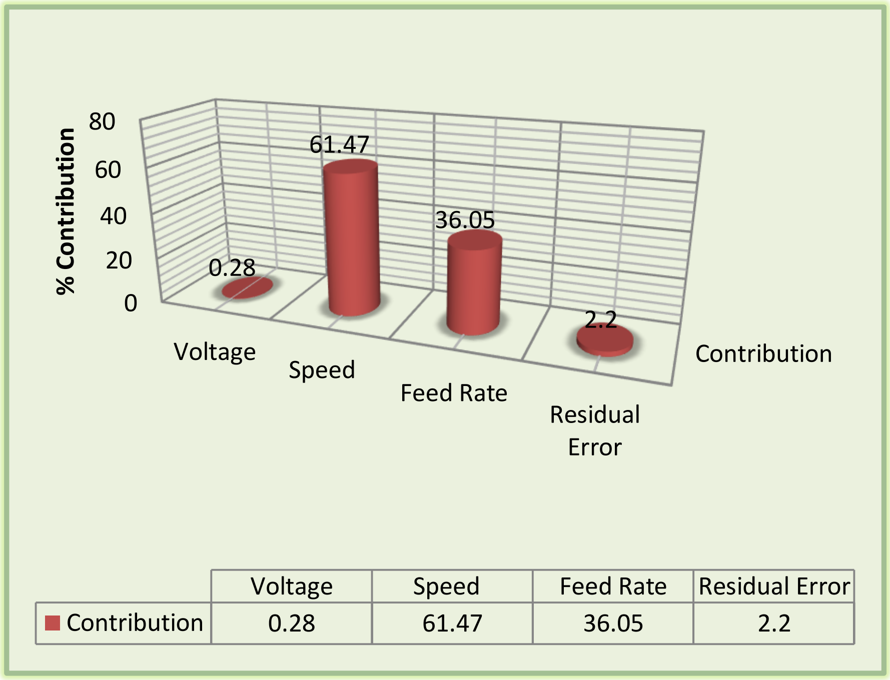

Figure 2 Contribution graph.

Figure 1 shows the contribution of various parameters mentioned in Table 1. Based on the all the experimental observations conclusions have been drawn for MIG welding process under specific selected parameter.

IV. CONCLUSION

- Voltage does not affect the maximizing weld bead width, minimizing weld reinforcement and maximizing deposition rate significantly with in the design limits of parameters.
- Wire feed rate and welding speed is found to significantly affect the maximizing weld bead width, minimizing weld reinforcement and maximizing deposition rate significantly with in the design limits of parameters.

V. REFERENCES

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