

Study of MIG Welding Process with Different Type Technique: A Review

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Abstract

Metal inert gas welding (MIG) is a joining and fabrication process which is used extensively in 25 years due to its advantages such as low heat input, less arc, production efficiency, less heat effective zone and environment friendliness. MIG welding can be used to join different types of ferrous metals and non-ferrous metals that cannot be welded by non-traditional welding processes. This welding process parameters was used during joining of metal and parameter such as welding current, welding voltage, welding speed, nozzle distance, wire feed rate, gas flow rate and torch angle. Result The various technique used in optimization of welding parameter such as regression techniques, taguchi s technique and statistical process in this paper are study of all aspect to relative in improvement for welding quality and strength.

Keywords: MIG welding, Taguchi method, Mild steel, parameter, but joint, tensile test

I. INTRODUCTION

Welding is a process for joining two similar or dissimilar metals by fusion. It joins different metals/alloys, with or without the application of pressure and heat or combination of both. The welding is very less cost. And the process is strong joint and use for making permanent joints. The heat may be generated either from combustion of gases, electric arc, electric resistance or by chemical reaction. The welding is widely used as a fabrication and repairing process in industries. Some of the typical applications of welding include the fabrication of ships, machine frame, automobile bodies and chassis, railway wagons, aircraft and ships, welded pipes, etc.

II. CLASSIFICATION OF WELDING

Welding process may be classified on the basis of fusion process which is shown in figure 1. All the detail of classified the welding with type of welding use manufacturing works.

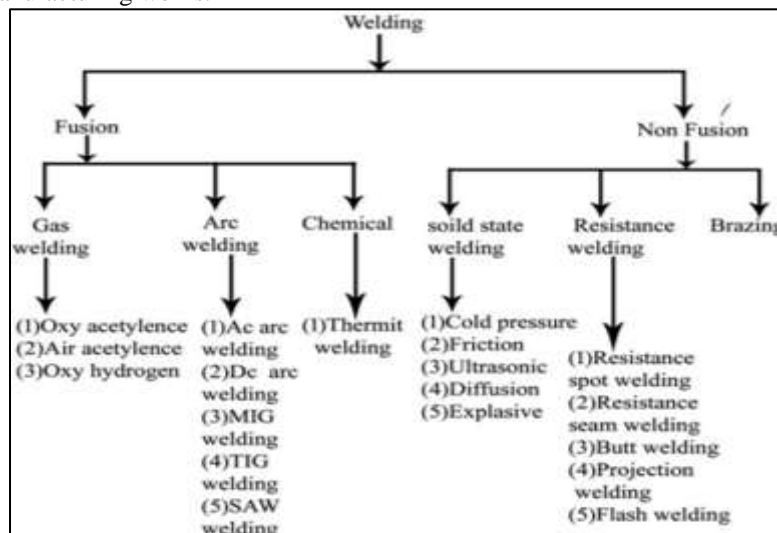


Fig. 1: Type of Welding Process

A. Metal Inert Gas Welding (MIG)

Metal inert gas welding is one of the most significant arc welding processes which is used to fabrication of structure. It is better knowledge and input control of the MIG welding process. Because of the good heat input control, MIG can be used for nonferrous welding. It is a semi-automatic process which is used to continuous welding with helps of wire, high metal depositions rate and high welding speed. The most important gases which have been used in shielding the weld pool are Argon (Ar), Helium (He), CO₂. Shielding gases are also use to cool down the gun. MIG welding process is shown in figure 2.

Main component of MIG welding process-

- 1) MIG Welding machine setup
- 2) Filler wire
- 3) Cable of wire feed
- 4) Negative cable
- 5) Gas cylinder CO₂

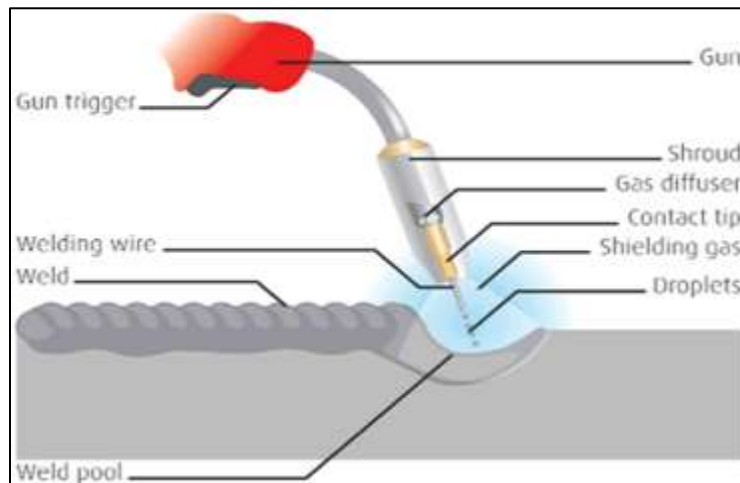


Fig. 2: MIG Welding Process with Workpiese

III. LITERATURE REVIEW

Table - 1

S.No.	Author Name	Matraial	Techigne	Conclusion
1.	S. R. Patil et.al.	AISI 1030 mild steel	Taguchi method L9	This was observed that welding current and welding speed are major parameters which influence on the tensile strength of welded joint.
2.	S.Utkarsh et. al.	low alloy steel material st-37	L9 orthogonal Array	It was found that an optimal rate of current, voltage speed and gas flow rate which is control the weld quality strength.
3.	Sindiri Mahesh et.al.	AISI 1050 mild steel	L9 orthogonal Array	It have a worked on welding parameters like welding current, welding voltage, welding speed on ultimate tensile strength (UTS) .
4.	Pradip Kumar Pal et.al.	Austenitic Stainless Steel AISI 316L	L9 Taguchi design	This was observed that influence of the process parameters current, gas flow rate and nozzle to plate distance has been examined visually and also through X-ray radiographic tests.
5.	Vikas Chauhan et.al.	Stainless steel (SS-304) and low carbon steel.	L9 Taguchi method	It have a worked on dissimilar metals are plates a joined by MIG welding successfully. Find out the analysis of signal-to-noise ratio was done using MINITAB-13 software for higher-the-better quality.
6.	Gaurav Kumar et.al.	AISI Grade 304 Steel	L9 orthogonal array	It was found that An orthogonal array of Taguchi's design is used to find out the Signal to Noise ratio which is then followed by analysis of variance (ANOVA).
7.	A. RoyChoudhury et.al.	mild steel	statistical methods	In this paper, relationship between input-output in MIG welding process through regression analyses carried out both globally well as cluster-wise.
8.	Amol Chavan et.al.	mild steel material	L9 Taguchi method	Presented on various response parameters like depth of penetration, bead width, bead height, micro-hardness, microstructural study.
9.	T. Anand kumar et. all	mild steel	L16Taguchi method	It was found that. MIG welding is performed on the different mild steel pieces are butt joint welded and check the tensile strength on workspaces

10.	prof. s. d. ambekar et.al.	Martensitic Stainless steel AISI 410	L16orthogonal array	It Have a parameters optimizing. It was found that the results closer to the optimize results.
11.	jiahun Liu et.al.	aluminum alloy/stainless steel	Mathematical	It was found that. X-ray diffraction (XRD) analysis & Microstructure and with a tensile strength of the lap joint reaching.
12.	M.suban et.al.	-----	Mathematical modal	It is type of sidling gas use MIG welding and it is found that TIME, RAPID, LANFAST PROCESS from high productivity welding. And that the quality of welding joint does not become impaired.
13.	Farhad Kolahan et.al.	-----	statistical method	The experiment design to Regression modelling and next stage selected model is implanted into a Simulated Annealing (SA) optimization algorithm.
14.	B. Mishra et.al.	AISI 1020 steel	Taguchi's design of experiment (DOE)	It was found that optimal process parameters for effectiveness in the analysis of penetration & S/N ratio.
15.	P. Chavda et.al.	medium carbon stee	Design of Experiment (DOE)	It have a technique use Finite Element Analysis and Design of experiment (DOE) method .from optimizing parameter.
16.	Priti Sonasale et.al.	Mild steel	Taguchi method	It is fund that confirmation test is carried out to compare the predicated values with the experimental values confirm its effectiveness in the analysis of bead width, dilution and depth of HAZ.
17.	G hargupal at.al.	Aluminium alloy (Al65032)	Taguchi method L9	It was found that. Parameter optimizing with S/N ratio analysis and mean response analysis and ANOVA.
18.	E. Hayati at.al.	Steel AISI 1020	Taguchi method DOE	It Have a work on Parameter optimizing Regression Analysis, Signal-toNoise Ratio(S/N).

IV. PARAMETER OPTIMIZATION TECHNIQUES

The optimization of welding process.

A. Taguchi's Design Method

Taguchi design recognizes the control factors to minimize the effect of Noise factor. Orthogonal array helps to reduce the time and cost of the experiment. The Signal-to-Noise (S/N) Ratio which are log function of required output which is the objective function to be optimized.

Larger is better

$$S/N = -10 \cdot \log \left(\frac{\sum (1/Y^2)}{n} \right)$$

Smaller is better

$$S/N = -10 \cdot \log \left(\frac{\sum (Y^2)}{n} \right)$$

Where

y = responses for the given factor level combination

n= no of responses in the factor level combination

B. Statically approaches-This is method step in depend following as.

1) Approach 1:

Linear regression analysis- Linear regression analysis considering all the terms.

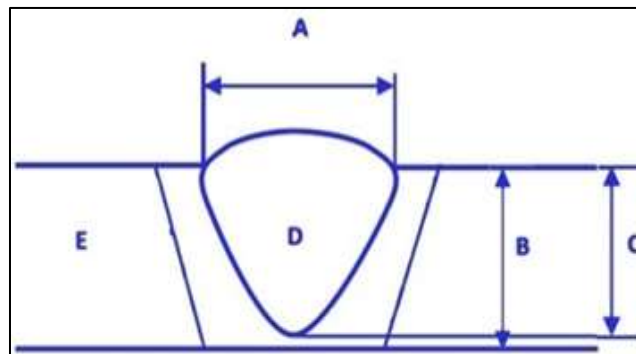
A: Bead width (BW)

B: Bead high (BH)

C: Bead penetration (BP)

D: Weld metal

E: Base metal



$$\hat{Y} = f(x_1, x_2, x_3, x_4, x_5, x_6) b_0 + b_1 x_1 + b_2 x_2 + b_3 x_3 + b_4 x_4 + b_5 x_5 + b_6 x_6 + b_7 x_1 x_2 + b_8 x_1 x_3 + b_9 x_1 x_4 + b_{10} x_1 x_5 + b_{11} x_1 x_6 + b_{12} x_2 x_3 + b_{13} x_2 x_4 + b_{14} x_2 x_5 + b_{15} x_2 x_6 + b_{16} x_3 x_4 + b_{17} x_3 x_5 + b_{18} x_3 x_6 + b_{19} x_4 x_5 + b_{20} x_4 x_6 + b_{21} x_5 x_6 + b_{22} x_1 x_2 x_3 + b_{23} x_1 x_2 x_4 + b_{24} x_1 x_2 x_5 + b_{25} x_1 x_2 x_6 + b_{26} x_1 x_3 x_4 + b_{27} x_1 x_3 x_5 + b_{28} x_1 x_3 x_6 + b_{29} x_1 x_4 x_5 + b_{30} x_1 x_4 x_6 + b_{31} x_1 x_5 x_6 + b_{32} x_2 x_3 x_4 + b_{33} x_2 x_3 x_5 + b_{34} x_2 x_3 x_6 + b_{35} x_2 x_4 x_5 + b_{36} x_2 x_4 x_6 + b_{37} x_2 x_5 x_6 + b_{38} x_3 x_4 x_5 + b_{39} x_3 x_4 x_6 + b_{40} x_3 x_5 x_6 + b_{41} x_4 x_5 x_6 + b_{42} x_1 x_2 x_3 x_4 + b_{43} x_1 x_2 x_3 x_5 + b_{44} x_1 x_2 x_3 x_6 + \dots \dots \dots (1) \text{eq.}$$

Where is-

X_i is the coded value corresponding to the i th input parameters, and \hat{Y} is the estimated response (output) value. The coefficients (i.e., $b_0, b_1,$ and $b_2 \dots b_{44}$) of the above equation can be estimated by using a least-square technique.

2) Approach 2:

Linear regression analysis considering significant terms only.

In this approach, the insignificant terms are dropped from Eq. (1). For each response, the significant and insignificant terms will be identified with the help of Pareto charts included in the next section. Regression analysis is carried out and predictions are attempted with the help of the resulting equations.

3) Approach 3:

Linear regression analysis using main factors only.

In this approach, each response is expressed as a function of the main factors only (without considering their interaction terms).

$$\hat{Y} = f(S, V, F, G, D, A)$$

$$\hat{Y} = \alpha_0 + \alpha_1 S + \alpha_2 V + \alpha_3 F + \alpha_4 G + \alpha_5 D + \alpha_6 A$$

Where- $\alpha_1; \alpha_2; \dots \dots \dots \alpha_6$ are the coefficients to be obtained by using a least-square technique discussed in the subsection given below. Regression analysis is carried out for each response by considering only the main factors.

4) Approach 4:

Non- linear regression analysis.

Non-linear regression analysis is also carried out to determine the responses - weld bead height (BH), bead width (BW), and penetration (BP), in case of the MIG welding process.

$$\hat{Y} = f(S, V, F, G, D, A)$$

$$\hat{Y} = \alpha_0 * S^{\alpha_1} * V^{\alpha_2} * F^{\alpha_3} * G^{\alpha_4} * D^{\alpha_5} * A^{\alpha_6}$$

After taking log on both the sides, we get

$$\ln(Y) = \ln(\alpha_0) + \alpha_1 \ln(S) + \alpha_2 \ln(V) + \alpha_3 \ln(F) + \alpha_4 \ln(G) + \alpha_5 \ln(D) + \alpha_6 \ln(A).$$

Where- $\alpha_0, \alpha_1, \alpha_2, \alpha_3, \alpha_4, \alpha_5, \alpha_6,$ are the coefficients of the non-linear model.

V. CONCLUSIONS

The objective of this study was to establish the influence of the MIG welding process, which is used to good quality of joint and high productivity rate. Based on this study of MIG welding the following conclusion may be observed.

- 1) The welding parameter are the input role of welding process which is control the weld quality and strength
- 2) Shielding gas is preventing the oxidization during the welding process.
- 3) The optimization parameter is set on the behalf of different optimization technique like Taguchi method, statistical method, Mathematical method.
- 4) Design of experiment can be used the important software based in MINI TAB, MATA LAB, and ANSYS.

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