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Parametric optimization of MIG Welding

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Abstract**—***The Hot Rolled Low Carbon steel is widely use material in automobile industry. Joining of metal for different parts is done by GMAW. Process parameter greatly affects the welded joint strength. This paper presents the case study to investigate the ongoing MIG welding process carried out by industrial firm in its welding protocol, by suggesting alternative effective method to achieve better strength with improved process parameters. These suggestions are achieved by investigating parameters like welding voltage, current and shielding gas.*

Keywords— MIG, low carbon steel, optimization, parameters.

I. INTRODUCTION

Welding is most important methods of joining of two similar or dissimilar metals with or without application of pressure. In Gas metal Arc Welding (GMAW) also known as Metal Inert Gas welding an electric arc is established between the workpiece and consumable wire electrode.[1] The arc melts the wire as it is fed to the weld puddle. The weld metal is shielded from the atmosphere by an inert gas like argon, helium or an argon-helium mixture. No external filler metal is required because the metallic electrode provides arc as well as filler metal. MIG welding is semi-automatic process in which arc length of electrode and feeding of wire is automatically controlled.

II. PROBLEM STATEMENT

GMAW is currently one of the most popular welding methods, especially in industrial environments. It is used extensively by the sheet metal industry and, by extension, the automobile industry.[2] There, the method is often used for arc spot welding, thereby replacing riveting or resistance spot welding. It is also popular for automated welding, in which robots handle the work pieces and the welding gun to quicken the manufacturing process. A wide range of materials joined by Gas metal arc welding:-similar metals, dissimilar metals, alloys, and non-metals. In the present scenario demand of the joining of similar materials continuously increases due to their advantages, which can produce high yield strength, deeper penetration, continuous welding at higher speed and small welding defects. Taguchi method has been acknowledged by some literature for optimization of MIG welding process parameter.There is not much research done on joining of hot rolled low carbon steel (IS 1079 HR2) by MIG welding. As this material is widely use in Automobile industry for manufacturing of small essential component.[3][4][5] The different combination of process parameters gives different strength to joints. The scope of case study is to evaluate the effectiveness of welding process parameters on the ultimate strength of joints

III. MATERIAL AND METHOD

Optimization of process parameters is the key step in the Taguchi method for achieving high quality without increasing cost. This is because optimization of process parameters can improve quality characteristics and the optimal process parameters obtained from the Taguchi method are insensitive to the variation of environmental conditions and other noise factors.The S/N ratio in Taguchi's method is calculated by giving formulas.[6]:

(i) Smaller the better

$$\eta = -10 \log [(\Sigma Yi2)/ n] \quad (1)$$

(ii) Larger the better

$$\eta = -10 \log [(\Sigma 1/Yi2)/ n] \quad (2)$$

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3.1 Material used

In current case study the IS 1079 HR 2 (hot rolled low carbon steel) material is use to find effectiveness of parameters.

TABLE 3.1
CHEMICAL COMPOSITION IS 1079 HR2 STEEL

C	Mn	Si	S	P	N
%	%	%	%	%	%
0.1200	0.500	0.150	0.040	0.040	90

3.2 PROCESS VARIABLE AND THEIR LIMITS

The working range of the parameters for subsequent design of experiment, based on Tagchi's L9 orthogonal array (OA) design have been selected.[7] In the present experiment study, welding current, welding voltage and gas flow rate(CO2) have been considered as process variables. The process variables with their units are listed in table 3.2

TABLE 3.2
PROCESS PARAMETERS AND THEIR LEVEL

FACTORS	UNIT	LEVELS OF FACTOR		
		0	1	2
WELDING CURRENT	AMP	75	100	150
WELDING VOLTAGE	VOLTS	24	27	30
GAS FLOW RATE	L/MM	12	20	25

IV. RESULT AND DISCUSSION

All the experimental results are analyzes by statistical tool MINITAB software of latest version 18. First of all the input parameters are defined in the software as per their corresponding value and then give the responses data to optimize. here, the main objective of the problem to maximize the Tensile Strength. So, the criterion of Larger-the- better is adopted for the optimization of Tensile strength.

4.1 Analysis of Tensile strength

Observing all the nine experiments and the applying Taguchi method on the result using MINITAB 18, We can draw the following table describing the S/N ratio and mean for the tensile strength. Effect of Welding current on Tensile strength:- From the table 4.5 & 4.6 we observe that Tensile strength shows pattern on the range from 75 amp to 150 amp. We get maximum strength of welding joint at 150 amp. From the s/n ratio we see that the value increases gradually at the range of 100 to 150.It lies between the 31-32**.**

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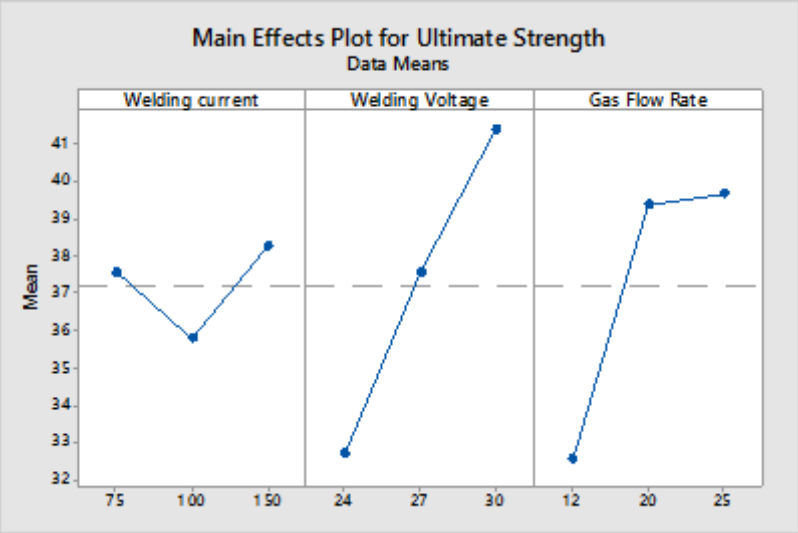

Figure 4.1 Process parameters VS Mean of Tensile strength

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