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Taguchi Approach-Based Variable Optimization of Mild Steel MIG welding (MS2062)

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Abstract: This study examines how mild steel MS2062 material's highest tensile strength and hardness are affected by wire feed rate and bevel angle during MIG welding. To examine the welding properties of the material and optimize the welding parameters, an experimentation strategy based on the Taguchi technique was adopted. The calculated result takes the form of an effect from each parameter, using which the best parameters for producing the highest tensile strength and hardness are determined.

I. INTRODUCTION

Metal inert gas is referred to as MIG. Gas metal arc welding, or GMAW, is the formal name for this technique; it is also referred to as wire welding on occasion. MIG welding is a type of arc welding technology that joins two base components together by using a persistent solid wire electrode that is supplied by a welding gun and into the weld pool. The welding gun is used in MIG welding to pass a shielding gas that guard against contamination of the weld pool.

Controlling the input process conditions to produce a satisfactory welded junction with the appropriate weld quality is the manufacturer's key challenge. To begin with, a time-consuming trial-and-error development process called for studying the weld input variables for welded products in order to produce a welded junction with the desired quality. Finally, weld settings can be selected to create a welded junction that satisfies the fundamental requirements after welds have been assessed in accordance with the requirement. Although there are frequently combinations of more perfect welding input settings that might be applied. Therefore, a number of optimization techniques may be applied to this issue to specify the connection among the input parameters and the output variables and to describe the desired output attributes through mathematical models. Techniques from design of experiments (DoE) have been used to carry out this optimization.

II. EXPERIMENTAL SPECIFICS

2.1 The Materials

For this experiment, MS2062 was used as the foundation material. It comes in the shape of a sheet that is 16 mm thick and has the chemical makeup listed in Table 1. In order to prepare the welding for the current study, another MS2062 sheet was joined using metal inert gas welding. 18 specimens with the dimensions 150 mm x 270 mm x 16 mm were created, sized and cleaned using a gas cutter. For welding, the sheets were beveled at angles of 15, 30, and 45 degrees. Table 2 is a list of the MIG parameters that were employed in this study. E-2062, an electrode with a 1.2mm diameter, was the one employed in this study. After that, the examples were welded at three separate wire feed rates—50, 60, and 70 mm per minute—and three distinct bevel angles—15, 30 and 45 degrees. Results from testing for tensile strength and hardness were collected. Tensile test samples were sectioned in accordance with ASTM E-8 specifications (Fig. 2) in order to establish the tensile capacity of the weld zone [2]. Three pieces, each measuring 300 mm x 30 mm x 16 mm, were cut from each welded specimen. Nine samples from each group were sent to the appropriate labs for a variety of testing. The table below summarizes the chemical make-up of the base metal MS2062.

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Table 1: Chemical Makeup of MS2062

Material	C	P	S	Mn	Si	Al
MS2062	0.18	0.017	0.01	0.79	0.18	0.026

Table 2: Welding Particulars

S.No.	Process Parameters	Values
1	Welding Voltage (Volts)	34
2	Bevel Angles	15°, 30°, 45°
3	Wire feed rate (mm/min)	50, 60, 70

Table 3: Prerequisites for Welding

Electrode	E2062
Electrode diameter	1.2mm
Shielding Gas	Carbon Dioxide (CO_2)
Operation type	Semi Automatic

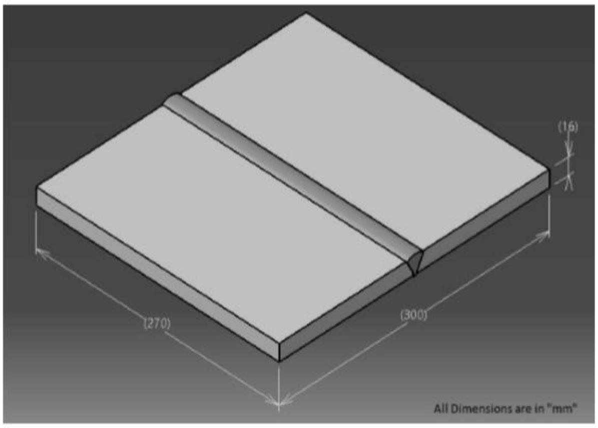

Figure 1: An edge-prepared 3-D representation of the specimen

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Table 4: Hardness and Tensile Strength values

Base Metal: UTS=467.675N/mm^2 Hardness=94 RHN				
S. No.	Wire Feed Rate (mm/min)	Bevel Angle (degrees)	Ultimate Tensile Strength (N/mm^2)	Hardness (RH_B)
1	50	15	353.89	86
		30	365.06	58
		45	392.13	57
2	60	15	390.23	85
		30	405.11	81
		45	429.42	50
3	70	15	375.41	89
		30	386.16	78
		45	391.61	68

Note: Reprinted from "Effect of Bevel Angle and Wire Feed Rate in MIG Welding", by Prashant Kumar, M., Naresh Kumar, K., Narayana K.S., 2013 *International Journal of Research and Technology,* ISSBN 2278-0181 Volume 3 Issue 8 p.985

2.2 Experimentation Design
Industries frequently have to ensure that their procedures are not only up to specifications but also constantly improving to fulfill the aforementioned market shift because of the very characteristics of market conditions. These improvements may come in the form of defect elimination, cycle time enhancement, lead time advancement, cost savings, etc. as a result of process technical advancements or as a result of changes made to a number of process variables, whether they are under our control or not.

Thus, in order to make these modifications, businesses must repeatedly run the same experiments that involve altering one or more of the process's parameters, fine-tuning the outcomes along the way, and finally arriving at the ideal settings that are the best ones for the technology that is currently in use.

It might sometimes take an astounding amount of experiments to even make minuscule changes, both in terms of effort and money spent. The Designs of Experiments (DOE) method aids in minimizing the overall number of experiments. By definition, DOE is an analytical process that involves effectively designing experiments so that the maximum amount of information is obtained from carrying out the smallest possible number of tests. It accomplishes this by changing the variables over a specific range that we are looking for in. This improves our ability to obtain systemic data.

2.3 Taguchi Approach
The design of experiments approach frequently fails because it does not always provide the best possible outcomes for the control parameters, especially when the goal of the studies is to arrive at the ideal value for the parameters.

This flaw is illustrated with a very well-known football match example. Assume that there is a football competition that is about to begin. While it is obvious that DOE makes sure that every match is properly scheduled with advance knowledge of what team will face which team at what venue on what date, all of this scheduling fails to take into account the results of the particular matches. Because of this, DOE may claim that a game among two teams that were both relegated in the initial round is necessary when it is not.

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When we think about the best values for the parameters using the "Orthogonal Array" method, Dr. Genichi Taguchi of Japan developed his own variation of the DOE methodology that aims to significantly reduce the variance for the experiment. Therefore, by integrating the DOE technique with the optimization of control settings, the Taguchi method provides better results.

The Taguchi Signal to Noise Ratio(S/N), which is a logarithmic of the intended output and is provided by the orthogonal arrays, serves as our target function, which we may then optimize. It provides an optimal number of tests that are well balanced, cover a wide range of parameter values, and have well-balanced experimental designs. Utilizing these two makes it simpler to forecast ideal parameters and analyze data.

The signal to noise (S/N) proportion has three different values, and corresponds to three different techniques:

1. Smaller is Better: This is used for unwanted traits like flaws, etc., for which zero is the optimum value. n=-log (average of the sum of the squares of the information).
2. Greater is better: This strategy is applied when we wish to maximize the significance of the attribute. n = - log (average of the total squares of inverses of information).
3. Neutral the Better: In this situation, a preferred value is one that is neither tiny nor large. n = - log (sqrt (mean/variance)).

2.4 The choice of an orthogonal structure

It is necessary to compute the degrees of mobility in order to choose an acceptable orthogonal array for carrying out the tests.

This information is provided below:

Degrees of Mobility: 1 for the Average Value, 8 = (2 x 4) for the other components, and 2 for each. Overall, there are 9 degrees of mobility.
L9 array is thus the orthogonal array that is best suited for exploration.

Table 5: Control variables for the L9 orthogonal arrangement (used in Minitab 17)

S. No	Angle of Bevel (in degrees)	Feed rate for wire (mm/min)	The maximum tensile strength (N/mm2)	Value of hardness (HRB)
1.	15	50	353.89	86
2.	15	60	390.23	85
3.	15	70	375.41	89
4.	30	50	365.05	58
5.	30	60	405.11	81
6.	30	70	386.16	78
7.	45	50	392.13	57
8.	45	60	429.42	50
9.	45	70	391.61	68

III. FINDINGS AND DISCUSSIONS

The experimentation's findings are listed below.
The S/N ratio was computed using the objective functions UTM and Hardness, which are examples of larger-is-better control functions. All of the experiments' S/N ratios were determined and summarized, as follows:

Table 6: Experimentation matrix

S No	Angle of Bevel (in degrees)	Feed rate for wire (mm/min)	The maximum tensile strength (N/mm2)	Value of hardness (HRB)	S/N Proportion
1.	15	50	353.89	86	41.4511
2.	15	60	390.23	85	41.3974
3.	15	70	375.41	89	41.7606
4.	30	50	365.05	58	38.1706
5.	30	60	405.11	81	41.0098

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6.	30	70	386.16	78	40.6785
7.	45	50	392.13	57	38.0370
8.	45	60	429.42	50	36.9312
9.	45	70	391.61	68	39.5315

Note: The larger the better technique is used to determine the S/N ratios (SNRA2) in the table, where SNRA2=-log (average of the total squares of inverses of information).

In light of the testing settings taken into consideration, we discover that the bevel angle and wire feed rate must be 15 degrees and 70 millimeters per minute, respectively, to obtain the weld's optimal values of tensile strength and hardness.

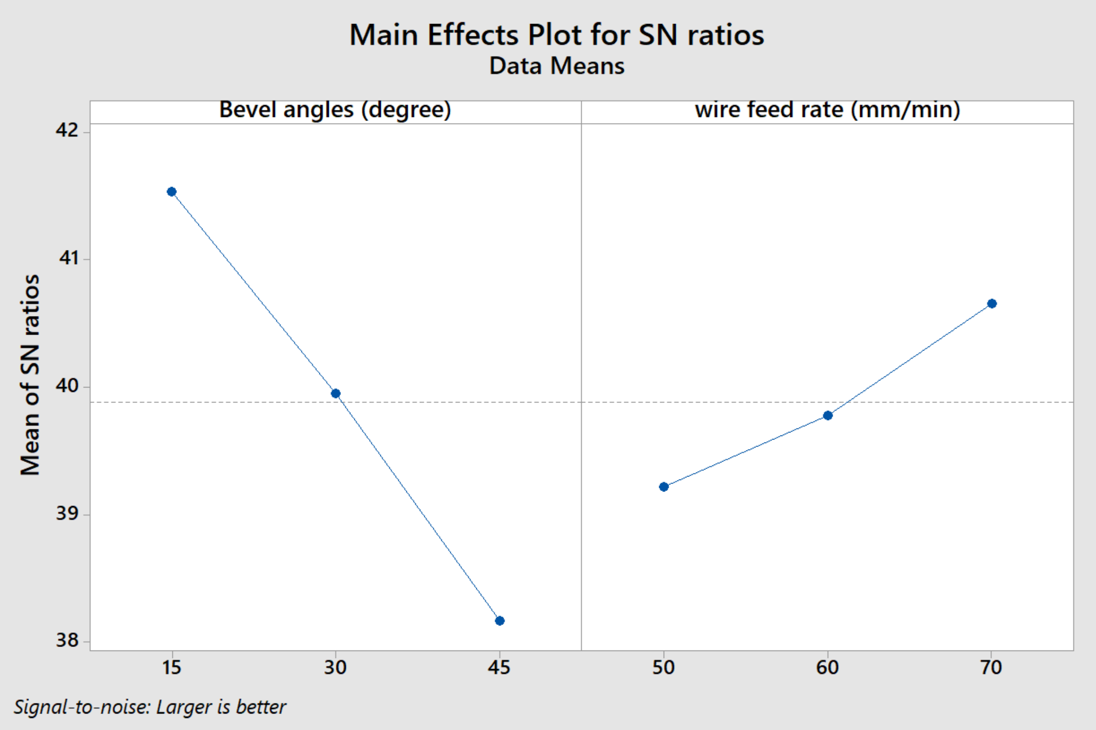

Figure 2: Main Effects Plot for S/N Ratios

IV. CONCLUSIONS

In this work, the maximum tensile strength and hardness of the mild steel MS2062 sample were examined in relation to wire feed rate and bevel angle during MIG welding. To analyze the welding attributes of the material and optimize the welding parameters, an experimentation strategy based on the Taguchi technique and signal to noise, or S/N, ratios were applied. The result computed was in the form of an effect from each variable, and it was via this process that the best parameters for achieving the highest tensile strength and hardness were determined.

1. The wire feeding rate and bevel angle have been discovered to have a significant impact on the hardness and maximum tensile strength of welded joints. Experimental results show that the maximum tensile strength improves together with the bevel angle. The hardness gradually increases from the sides and decreases towards the weld when the bevel angle is increased, which has a significant effect on the hardness.

2. The maximum tensile strength rises with increasing wire feed rate, reaches its highest point at the ideal wire feed rate, and then begins to fall. The hardness follows a similar pattern to the bevel angle.

3. This study can be further enhanced by adding new variables, such as welding speed and gas flow rate, and by taking into account an L27 or L81 group of orthogonal structures to obtain an even more precise assessment of the governing variables.

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REFERENCES

[1] Edip Çetkin, Yahya Hışman Çelik, Şemsettin Temiz. (2017) Effect of welding parameters on microstructure and mechanical properties of AA7075/AA5182 alloys joined by TIG and MIG welding methods.
[2] Joo Yong Cheon, Vijeesh Vijayan, Sivaprasad Murgun, Yeong Do Park, Jae Hun Kim, Ji Young Yu and Changwook Ji (2017) Optimization of pulsed current in resistance spot welding of Zn-coated hot-stamped boron steels.
[3] S Darshan, Nasare Praveen kumar, S Jyothi Prasanna (2016) Optimization of Pulsed Current MIG Welding Parameters for Ultimate Tensile Strength and Hardness of ASTM A106 Pipes using Taguchi Technique.
[4] Hiren Padhiyar, Manhar S. Kagathra, G. D. Acharya (2015) A Review on Process Parameter Optimization of TIG Welding of SS316.
[5] K.Sivasakthivel, K.Janarthanan, R.Rajkumar (2015) Optimization of Welding Parameter in MIG Welding by Taguchi Method.
[6] S. R. Patil, C. A. Waghmare (2013) Optimization of MIG Welding Parameters for Improving Strength of Welded Joints.
[7] M. Prasanth Kumar, K. Naresh Kumar, K. S. Narayana (2013) Effect of Bevel Angle and Wire Feed Rate in MIG Welding.
[8] Srinivas Athreya, Dr Y.D.Venkatesh (2012) Application Of Taguchi Method For Optimization Of Process Parameters In Improving The Surface Roughness Of Lathe Facing Operation.