PREDICTION OF WELD STRENGTH OF METAL ACTIVE GAS (MAG) WELDING USING ARTIFICIAL NUERAL NETWORK

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Abstract:

Welding is a manufacturing process, which is carried out for joining of metals. Metal Active Gas (MAG). This is a variation of MIG welding, in which identical equipment is used but the inert gas is replaced by carbon dioxide, which is chemically active. Shielding gas CO_2 is used and consumable electrode is used which also plays role of conductor. MAG-CO_2 welding is versatile, gives very little loss of alloying elements and can be operated as semi as well as fully automated. Artificial Neural Network (ANN) is a powerful empirical modeling tool, suitable for problems which are not amenable to exact analytical solutions, or, where interrelationships between variables are not fully understood but which provide an abundance of data from which ANN can learn and predict. All welds will be prepared by MAG-CO2 welding and TIG welding techniques. We studied Design of Experiments for this work and by use of the experimental data have performed ANN (Artificial Neural Network) prediction and make comparison with experimental data. Where inputs parameters for MAG-CO2 welding are welding current, wire diameter and wire feed rate and for TIG welding are welding current, wire diameter output parameter is weld strength for both MAG-CO2 welding and TIG welding techniques.

Keywords: MAG-CO_2; ANN; Welding current; NeuroXL Predictor.

1. Introduction:

Welding is used as a fabrication process in every industry large or small. It is a principal means of fabricating and repairing metal products. The process is efficient, economical and dependable as a means of joining metals. This is the only process which has been tried in the space. The process finds its applications in air, underwater and in space.

MAG stands for metal-active-gas arc welding. This is a variation of MIG welding, in which identical equipment is used but the inert gas is replaced by carbon dioxide, which is chemically active The American Welding Society refers to the process as Gas Metal Arc welding and has given it the letter designation GMAW.

All the major commercial metals can be welded by the MIG- CO_2 process, including carbon steels, stainless steels, aluminum, copper, titanium, zirconium and nickel alloys. Gas metal arc welding (GMAW or MIG welding) is an electric arc welding process which joins metals by heating them with an arc established between a continuous filler metal (consumable) electrode and the work. Shielding of the arc and molten weld pool is obtained entirely from an externally supplied gas or gas mixture.

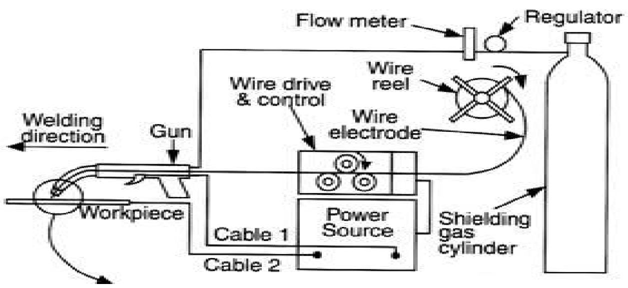


Fig:1 MAG-CO_2 welding arrangement

1.1 Statement of the problem:

All welds will be prepared by MAG-CO2 welding technique. We studied Design of Experiments for this work and by use of the experimental data have performed ANN (Artificial Neural Network) prediction by using NeuroXL Predictor and make comparison with experimental data. Where inputs parameters for MAG-CO2 welding are welding current, wire diameter and wire feed rate weld strength for both MAG-CO2 welding technique.

1.2 Objective of the study:

The objective of the project is to analyze and compare experimental data and predicted data in MAG-CO_2 welding technique.

1.3 Scope of the study:

The welding parameter and effect of these parameter can be predict so if want to varies input the parameter can directly predict the effect of output by using the Artificial Neural Network.

2. Experimental set up and procedure:

MAG-CO_2 welding experiment were carried out for following parameter by using Design Of Experiment (DOE) by Minitab-15 software combination for experiment were carried out.

2.1 Parameter and their values MAG-CO_2 welding

Table:1 Parameter and their values MAG-CO_2 welding

Sr. No.	Input Parameter	Value		
1	Welding current (Amp)	100	140	180
2	Wire Diameter(mm)	0.8	1	1.2
3	Wire feed rate(m/mim)	2	3	4

2.2 DOE Result for MAG-CO_2 welding

Table: 2 DOE Result for MAG-CO2 welding

Sr No.	Welding Current In Amp	Wire Diameter In mm	Wire Feed Rate(m/mim)
1	180	1	3
2	100	0.8	3
3	100	1	4
4	100	0.8	4
5	100	1.2	2
6	180	1.2	3
7	180	0.8	3
8	140	1.2	2
9	140	0.8	4
10	140	1.2	4
11	100	1	2
12	180	0.8	4
13	140	1	3
14	100	1.2	3
15	140	1	4
16	180	1	4
17	140	1.2	3
18	180	1.2	4
19	140	0.8	2
20	100	0.8	2
21	140	0.8	3
22	100	1	3
23	100	1.2	4
24	140	1	2
25	180	1	2
26	180	1.2	2
27	180	0.8	2

Now by above combination MAG-CO_2 welding has been carried out and Hardness test is done and result data was found.

2.3 Sample Preparation:

For 5mm double V-groove weld joint design is selected.

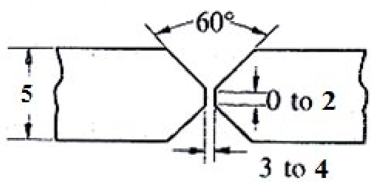


Fig:2 Job Preparation for welding

2.4 Material Selection:

Base material for welding

AISI 1020 OR C20 low carbon steel.

Table:3 Chemical composition report of the material

Elements	C	Mn	S	P	Si	Al	Ni
Wt %	0.123	0.9	0.008	0.013	0.013	0.045	0.004

2.5 Power Source For MAG-CO_2 welding

ESAB make Auto K 400 THYRISTORISED MIG/MAG power source have been used. For MAG-CO_2 welding constant voltage power source is used.

Fig:3 Welding machine arrangement

MAG-CO_2 welding machines specifications are as-

Make-ESAB; Code-AUTO K 400; Volatge-17-34 volts; Curent-100-350 Amp; DCEP; Standard-AWS/SFA 5.18: ER 70 S-6-Mild steel copper coated.

Welding torch

12 watt, 275 Amps; Forced Air cooled cooling system; Make: ESAB,

Wire feeder

Wire Feeder type Servo-I; Drive system – DC motor; Length, m (Standard) – 5

Welding electrode

Standard-AWS/SFA 5.18: ER 70 S-6-Mild steel copper coated.

After completion of experiment by using NeuroXL Predictor software the Hardness for each workpiece is predicted by software and change in experimental hardness and predicted hardness is compared.

3 RESULT AND DISCUSTION FOR MAG-CO2 WELDING

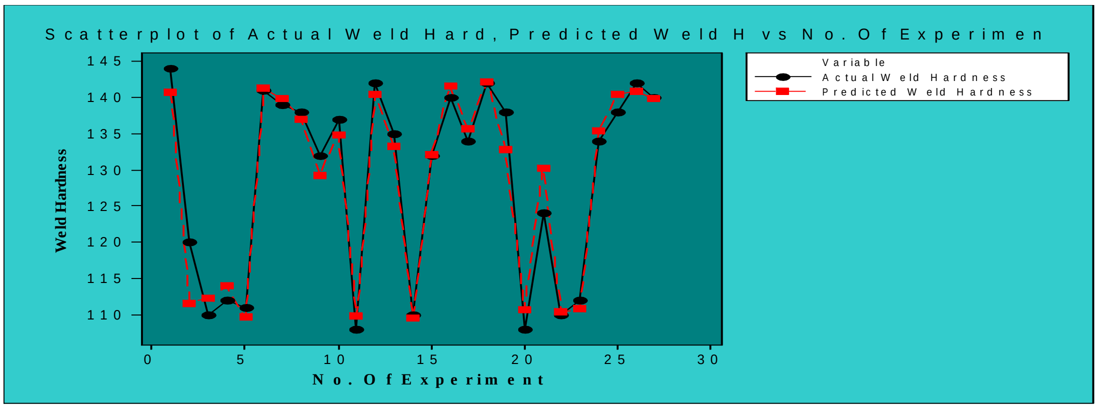
The Following table shows comparison of experimental hardness and predicted hardness.

Table:4 Experimental and Predicted result for MAG-CO2 WELDING

Sr No.	Current in Amp	Wire Diameter In mm	Wire Feed Rate(m/mim)	Experimental Weld Hardness (BHN)	Predicted Weld Hardness (BHN)	% Change Error
1	180	1	3	144	140.69	2.30
2	100	0.8	3	120	111.64	6.97
3	100	1	4	110	112.24	2.04
4	100	0.8	4	112	114.00	1.79
5	100	1.2	2	111	109.70	1.17
6	180	1.2	3	141	141.22	0.15
7	180	0.8	3	139	139.91	0.65
8	140	1.2	2	138	137.01	0.72
9	140	0.8	4	132	129.27	2.07
10	140	1.2	4	137	134.85	1.57
11	100	1	2	108	109.91	1.77
12	180	0.8	4	142	140.47	1.08
13	140	1	3	135	133.23	1.31
14	100	1.2	3	110	109.57	0.39
15	140	1	4	132	132.07	0.05
16	180	1	4	140	141.50	1.07
17	140	1.2	3	134	135.67	1.25
18	180	1.2	4	142	142.16	0.11
19	140	0.8	2	138	132.86	3.73
20	100	0.8	2	108	110.69	2.49

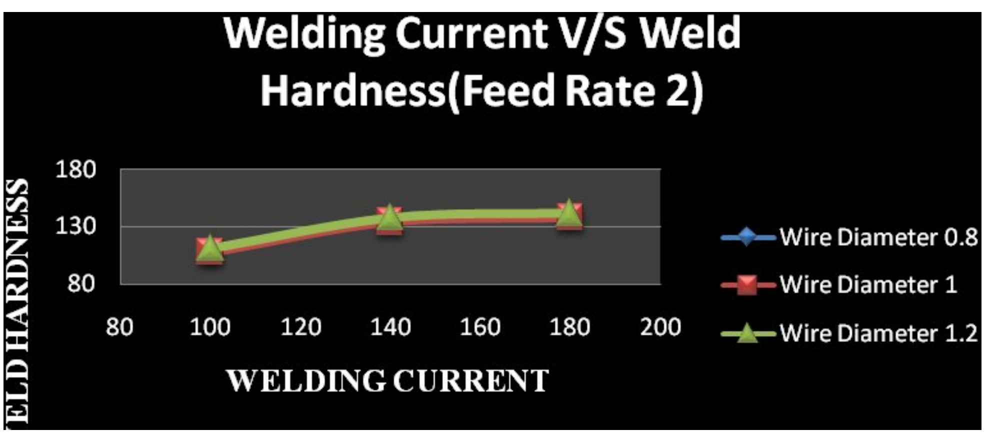
21	140	0.8	3	124	130.19	4.99
22	100	1	3	110	110.37	0.33
23	100	1.2	4	112	110.79	1.08
24	140	1	2	134	135.39	1.04
25	180	1	2	138	140.41	1.75
26	180	1.2	2	142	140.86	0.80
27	180	0.8	2	140	139.80	0.14

Using Above data graph shown in fig is plotted by Minitab-15 software



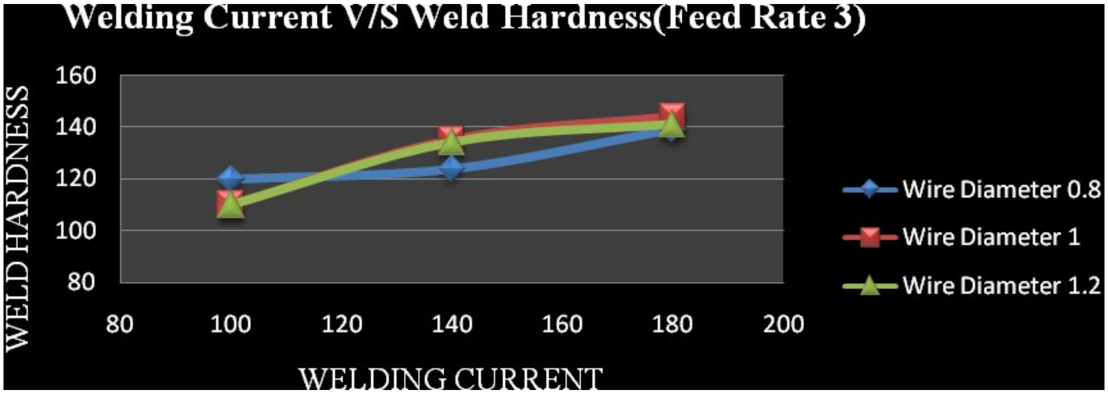
Graph: 1 Actual Weld Hardness, Predicted Weld Hardness v/s No. Of Experiment

Percentage change of error comes within allowable limit hence here we assume allowable margin is 5 %. The only exception is reading no:2 the percentage change of error is 6.97 % which may be due to error in experiment.



Graph: 2 Welding current V/S Weld hardness at feed rate 2 for different wire diameter

From the above graph it can be seen that as the welding current increase, weld strength will be increased at Wire Diameter of Electrode and is highest for Wire Diameter 1.2 mm. at Feed Rate 2 mm/mim.



Graph: 3 Welding current V/S Weld hardness at feed rate 3 for different wire diameter

From the above graph it can be seen that as the welding current increase, weld strength will be increased at Wire Diameter of Electrode and is highest for Wire Diameter 1 mm. at Feed Rate 3 mm/mim.

Graph: 4 Welding current V/S Weld hardness at feed rate 4 for different wire diameter

From the above graph it can be seen that as the welding current increase, weld strength will be increased at Wire Diameter of Electrode and is highest for Wire Diameter 1.2 mm. at Feed Rate 4 mm/mim.

4 Conclusion:

With the above studies of MAG-CO_2 welding technique and their test reports, conclusion can be drawn as follows:

- Welding Current has great impact on Hardness of Weld joint but other parameter like wire diameter of electrode and wire feed rate of electrode also play role in Weld Hardness.
- The tool use in this work NeuroXL Predictor proves as very handy tool for Different Welding Technique.
- The Artificial Neural Network has shown its effectiveness as a tool to predict various parameters in both MAG-CO_2 and TIG welding technique.

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