

A RESEARCH PAPER ON METAL INERT GAS ARC WELDING OF MILD STEEL 1018 BY APPLYING TAGUCHI METHOD

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Abstract

Mild Steel 1018 has been widely used for machining applications like machine rod, parts, studs and bolts etc. shows that good weld ability and also used for carburized parts. Present research paper study the effect of different process parameters such as voltage, welding current, welding speed, gas flow rate and gas pressure on mechanical properties like tensile strength and percentage of elongation of MIG welded joints of MS 1018 plates. MIG welding is a high deposition rate welding process in which wire is continuous feed from a gun. MIG welding offers several advantages like all position capable, long weld can be made, no slag etc.

Optimization was done to find optimum welding conditions to maximize tensile strength and percentage elongation of welded joints. The confirmation test was also conducted to validate the optimum parameters settings. From the papers study, it is found that when the welding current, voltage, GFR increased, the tensile strength decreases, but when welding speed increases, the tensile strength also increases.

KEY WORDS- MS-1018, Tensile strength, Percentage of elongation, Taguchi Method, voltage, Current, Gas Flow Rate.

1. INTRODUCTION

Welding is a metallurgical fusion process. In this, interface of the two parts to be joined are brought to a temperature above melting point and then allowed to solidify so that permanent joining takes place. The consumable electrode is in the form of wire reel, which is fed at constant rate through the feed rollers.

Filler wire is used to join the metal in GMAW process with the help of spool gun. Welding is used for making permanent joints. It is used for the manufacturing of railway wagons, automobile parts, aircraft frames, machine parts, tanks, structural works, ship building, furniture boilers etc.

MIG is an arc welding process wherein coalescence is produced by heating the job with an electric arc established between a continuously fed metal electrode and job. The arc and the weld pool are shielded from atmospheric contamination by passing a suitable gas through the nozzle to form a protective shield around the welding area.

1.1 Process Parameters:

- Electrode Position
- Welding Voltage
- Welding Current
- Arc Travel Speed
- Electrode Extension
- Electrode size
- Gas Flow Rate and Types of shielding gases

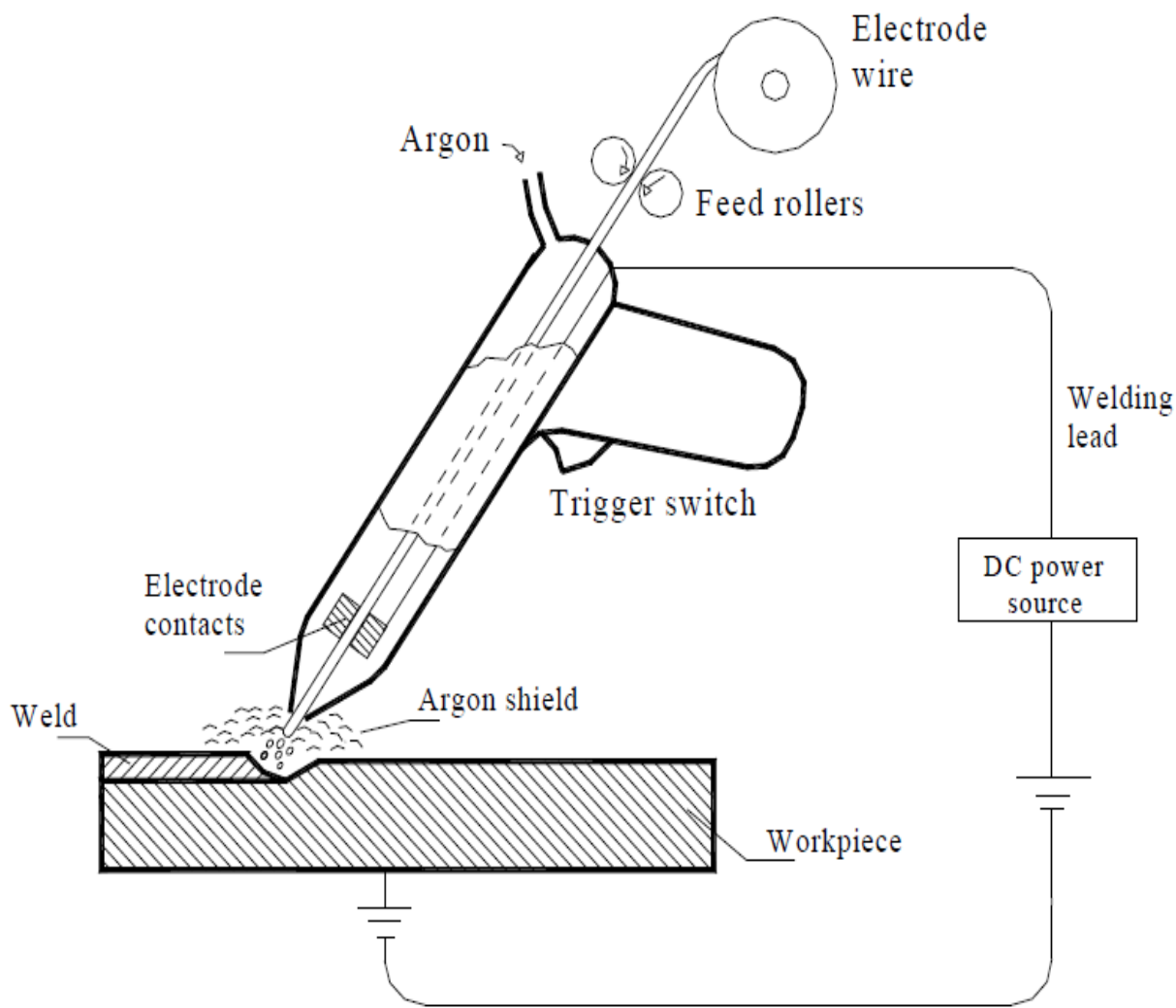


Figure 1.1: Metal Inert Gas Arc Welding Process [1]

1.2 Types of Welding Joint

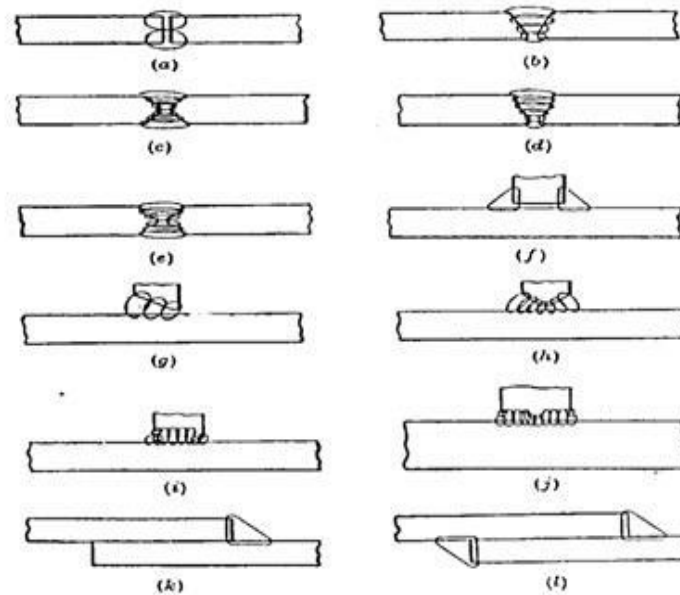


Figure.1.2: Types of welding joints [2]

(a) Square butt joint; (b) Single-v butt joint; (c) Double-v butt joint; (d) Single-u butt joint; (e) Double-u butt joint; (f) Square-t joint; (g) Single-bevel t-joint; (h) Double-bevel t-joint; (i) Single-u t-joint; (j) Double-u t-joint; (k) Single-bead lap joint; (l) Double-bead lap joint.

1.3 The Chemical Composition of MS 1018

Sr. No.	Element	Content
1.	Carbon, C	0.14 - 0.20 %
2.	Iron, Fe	98.81 - 99.26 %
3.	Manganese, Mn	0.60 - 0.90 %
4.	Phosphorous, P	≤ 0.040 %
5.	Sulphur, S	≤ 0.050 %

1.4 Advantages of GMAW

The advantages of GMAW welding are as follows:

- MIG Welding process is much faster as compared to TIG.
- It can produce joints with deep penetration.
- Welding is possible in horizontal, vertical and overhead position.
- The arc and the weld pool are clearly visible.
- Thick and thin, both types of work pieces can be welded effectively.
- Large metal deposition rates are achieved by MIG Welding processes.

1.5 Disadvantages of GMAW

Some of the disadvantages of GMAW welding are as follows:

- Welding equipment is more complex, more costly and less portable.
- Since air drafts may disperse the shielding gas, MIG welding may not work well in outdoor welding applications.
- The necessary, but costly, shielding of the welding place at outdoor jobs.
- High investments in welding equipment and high expenses to maintenance to the welding equipment.

1.6 Applications of MIG

- MIG is usually used with Copper and Copper alloys, Aluminium, ordinary mild steels, Stainless steels.
- In addition to the above metals this method is suitable for nickel, magnesium and a number of other metals and their alloys.
- MIG has applied for welding tool steels and dies.
- It has been used successfully in industries like air craft, automobile, pressure vessel and ship building.

1.7 Mechanical Properties of MS- 1018

Sr. No.	Mechanical Properties	Range
1.	Brinell Hardness	126
2.	Knoop Hardness	145
3.	Rockwell Hardness	71
4.	Vickers Hardness	131
5.	Tensile Strength, Ultimate	440 MPa
6.	Tensile Strength, Yield	370 MPa
7.	Elongation	15.0%
8.	Reduction of area	40.0%
9.	Modulus of Elasticity	205 GPa
10.	Bulk Modulus	140 GPa
11.	Poissons Ratio	0.290
12.	Machinability	70%
13.	Shear Modulus	80 GPa

2. LITERATURE REVIEW

1. Patil et al. (2014) researched that the among main input welding parameters the influence of the welding speed sufficient. If enhance the welding speed reducing current influences also enhance the ultimate tensile strength of the welded joint. In this paper work done it was observe that voltage did not contribute such as to weld strength. Regardless of the set of the quality characteristics, greater S/N ratio relates to better the quality characteristics [7].

2. Kumar et al. (2013) this work shows that the result of the analysis of variance(ANOVA) for the hardness(HAZ,BM,WZ). Variance's analysis was carried out at 94% confidence level. ANOVA is carried out to investigate the influence of the design parameters on hardness by indicating that which parameter is significantly affected the quality characteristics. In this authors have generated results for S/N ratios of Hardness(HAZ,WZ and BM)[8].

3. Anoop (2013) The research has discussed an application of the Taguchi technique for investing the effects of the process parameters on the weld microhardens; HAZ and grain size width in the GTA welded aluminium alloy of 7039. From the result's analysis using the S/N ratio approach, analysis of variance and Taguchi' optimization method, the following can be concluded: Out of the selected parameters, peak current has the highest contribution i.e.61.57%[9].

4. Chhabra et al. (2013) in this work the process parameters are optimized by using Taguchi technique based on Taguchi's L9 orthogonal array. Many experiments have been conducted based on three process parameters, by name three shielding gases, travel speed and welding current and three level of each parameters were carefully selected. Micro hardness has been predicted for the optimum welding parameters and parameters percentage of contribution in producing a better joint is calculated, by applying the effect of the S/N ratio and analysis of variance. Based on the study, shielding gas was found to be the most significant variable over the other process parameters while the welding current and arc travel speed took the second and third rank respectively. Shielding gas(Ar+CO₂) was most significant with 68.36% contribution, followed by welding current or 16.30% and arc travel speed of 12.78% [10].

5. Kurt and Samour et al. (2013) evaluated the process parameters of welding voltage, welding current, welding speed to investigate their influence on (UTS) for GMAW welded specimen of mild steel by using Taguchi method. They concluded that welding speed was most influencing parameter with 88.15% contribution followed by current of 10.76% and voltage of 0.69%. [11]

6. Kurt and Samour et al. (2013) studied the mechanical properties of 304 stainless steels joined by GTAW by using 308 stainless steel filler wire. They concluded that the hardness value of welding zone was less than parent metal and higher than HAZ. It was concluded that the ductile fracture was carried out in HAZ [12].

7. Patel and Chaudhary et al. (2013) evaluated parameters considered wire diameter, welding current, wire feed rate to investigate their affect on weld bead hardness for GMAW and GTAW by Grey Relational Analysis. By use of GRA optimization technique, optimal process parameter combination was found to be welding current 100 Amp, wire diam. 1.2 mm and wire feed rate 3m/min for GMAW and welding current 80 Amp and wire diameter 0.8mm for GTAW [13].

3. CONCLUSION

From this paper, it is found that when the voltage, welding current, GFR increases tensile strength decreases, but when welding speed increases, the tensile strength also increases. In the case of elongation is also same to tensile strength.

Optimization was done to find optimum welding conditions to maximize tensile strength and percentage of elongation of welded joints. This study presented the optimization of MIG parameters of Mild Steel 1018 by Taguchi's experimental design. The process was applied using a specific set of controllable parameters Current, Voltage, Gas Flow Rate for the response variables of Tensile Strength. L9 orthogonal array, S/N ratio analysis of variance were used for this study. The Study found that the control factors had varying effects on the response.

4. REFERENCES

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