Effect of Autogenous Tungsten Inert Gas (TIG) Welding of AISI 1010 Mild Steel on Mechanical Strength

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Abstract - Tungsten Inert Gas welding is likewise referred to as Gas Tungsten Arc Welding (GTAW), is an develop arc welding system end up a famous preference while a excessive stage of weld nice or giant precision welding is required. However, the primary issues of TIG welding system are its sluggish welding pace and constrained to decrease thickness cloth in unmarried pass. In this work, autogenous TIG welding has been executed on five mm thick AISI 1010 slight metallic plate without the use of any filler cloth. Wide variety of welding contemporary and experiment pace has been examined for acquiring a complete penetration welding. Activated flux has additionally been used to enhance the weld depth. After appearing welding via way of means of retaining extraordinary hole among the plates to be welded, weld bead geometry and tensile energy of the weld has been investigated. It is found that, via way of means of retaining the right hole complete penetration welding of plate is viable which offers energy nearly much like base cloth.

Keywords- Tungsten Inert Gas welding, Activated flux, Tensile test, TIG welding process.

I. INTRODUCTION

On-consumable tungsten terminal to deliver the weld. The weld region and terminal are shielded from oxidation or other environmental tainting by an idle safeguarding gas (argon or helium). A filler metal is typically utilized, however a few welds, known as autogenous welds, or combination welds don't need it. At the point when helium is utilized, this is known as heli arc welding. A consistent flow welding power supply produces electrical energy, which is directed across the curve through a section of exceptionally ionized gas and metal fumes known as a plasma. GTAW is most usually used to weld flimsy segments of hardened steel and non-ferrous metals like aluminum, magnesium, and copper composites. The cycle gives the administrator more noteworthy command over the weld than contending cycles, for example, safeguarded metal circular segment welding and gas metal bend welding, taking into consideration more grounded, more excellent welds. Notwithstanding, GTAW is similarly more perplexing and hard to dominate, and besides, it is essentially more slow than most other welding procedures. A connected interaction, plasma bend welding, utilizes a somewhat unique welding light to make a more engaged welding curve and subsequently is regularly computerized. Temperature circulations in the weldment are not uniform. Warming and cooling cycles initiate non-uniform warm strains in both the weld metal and the adjoining base metal. The warm strains delivered during warming then, at that point, produce plastic disturbing. These non-uniform warm burdens consolidate and respond to deliver inward powers that cause shrinkage and bending. Tseng and Chou ∗ Corresponding creator. Tel.: +886 8 7703202; fax: +886 8 7740552. Email address: tkh@mail.npust.edu.tw (K.- H. Tseng). (2003) showed a presence of the shrinkage and contortion thusly influences the manufacture, accuracy (shape and dimensional resilience), and capacity (unwavering quality and solidness) of completed items. Gas tungsten curve welding, otherwise called tungsten idle gas (TIG) welding, delivers a bend between a tungsten anode and the workpiece. An inactive gas safeguards the circular segment, anode, and liquid pool from barometrical defilement. When welding more slender materials, edge joints, and spines, welders by and large don't utilize filler metals. Notwithstanding, for thicker materials, welders fundamentally utilize remotely took care of filler metal. TIG welding is a famous method for joining slender materials in the assembling businesses. This kind of welding accomplishes a top notch weld for treated steels and non-ferrous amalgams. Contrasted and gas metal bend welding, the significant limits of TIG welding incorporate its mediocre joint infiltration, its powerlessness to weld thick materials in a solitary pass, and its helpless resistance to numerous material organizations, remembering cast-to-project varieties for the synthesis of specific contaminations, as depicted by Fujii et al. (2008) and Huang (2009). The limit for butt-joint entrance when welding treated steel plates utilizing a solitary pass TIG process is just 3 mm.

In this paper represent that the effect of tungsten arc welding on mechanical strength. It’s my knowledge this work done first time .

II. EXPERIMENTAL PROCEDURE

For the present project work an autogenous welding set up has been developed to perform welding with a fixed velocity without the application of filler material. A movable vehicle is used to hold TIG torch. The distance between workpiece and torch tip will remain constant the welding process. The speed of movable vehicle is controllable and can be varied according to the requirement of the welding speed and amount of heat required. Figure 3 shows experimental setup for present work. The welding setup for autogenous TIG welding process consists following components:

- Welding torch
- Electrode
- Power supply
- Inert gas supply unit
- Work holding device
- Movable vehicle holding the welding torch
- Rail Track

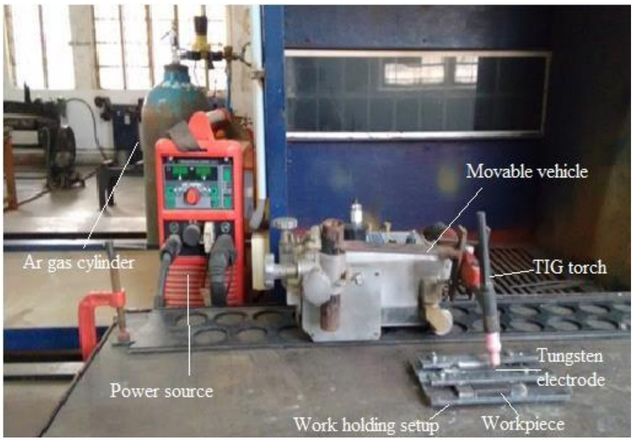


Fig.1 Experimental setup of TIG welding

2.1 Single pass autogenous TIG welding on Mild steel plate

In this phase of experiment, to study the feasibility of autogenous welding on 5 mm mild steel plate, TIG welding has been performed without using any filler rod. 5 mm thick mild steel plates were cut in 50 mm x 50 mm dimension with the help of band saw.

Table:1 Welding parameters for autogenous TIG welding of mild steel

Dimension of mild steel	50mmx50mmx5mm
Weldingspeed	2.33mm/s, 2.96mm/s and 3.5 mm/s
Arcvoltage	14 –15 V
Weldingcurrent	170A, 190 A&210A
Gasflowrate	12 l/min
Current type	DC (positive work piece & negative electrode)
Distance between tip and weld center	3 mm
Shieldinggas	Argon

The edges to be welded were grinded with surface grinding machine, so that proper contact is possible between the plates to be joined. Other surfaces were also polished with emery paper (silicon carbide) to remove all impurities from the surface and to provide require surface finish.

After the sample preparation mild steel plates were fixed in the work holding device with proper clamp through bolts. Direct Current (DC) with direct polarity (negative electrode and positive workpiece) was used to perform welding. Zirconiated tungsten electrode of 2.4 mm diameter was used as electrode. Three different current value and scan speed has been selected as shown in the table 5 and total 9 experiments were performed.

Table 2. Experimental planning for autogenous TIG welding of mild steel

Exp. No.	Welding current(A)	Welding speed(mm/s)
1	170	2.33
2	170	2.96
3	170	3.5
4	190	2.33
5	190	2.96
6	190	3.5
7	210	2.33
8	210	2.96
9	210	3.5

III. RESULTS AND DISCUSSION

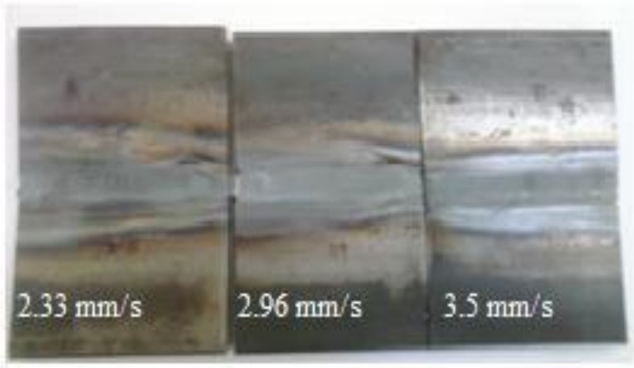
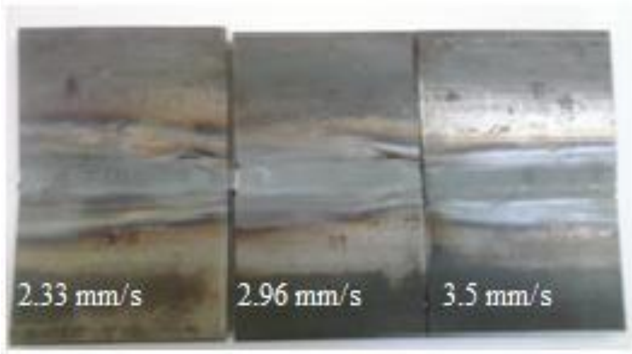
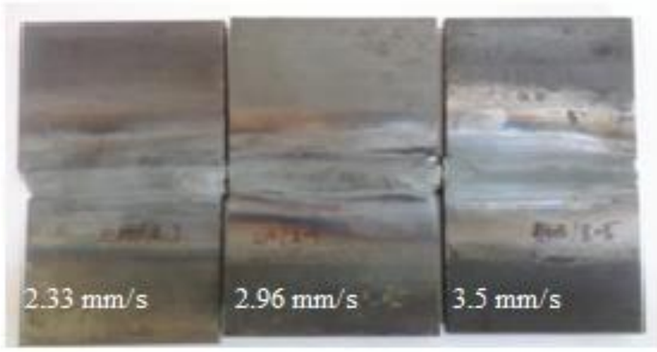
Welded specimens performed with 3 different speed and current setting by conventional autogenous TIG welding process

3.1 Welded specimen performed by conventional autogenous TIG welding

Table: 3 Width and depth of weld zone of TIG welded sample by conventional TIG welding

Sl. No.	Current (A)	Speed (mm/s)	Width (mm)	Depth (mm)
1	190	2.33	6.3	2.34
2	190	2.96	5.75	1.28
3	190	3.5	5.88	1.59
4	210	2.33	7	2.47
5	210	2.96	5.85	2.09
6	210	3.5	6.17	1.91

Table. Weld bead geometry at cross section of weld zone by conventional autogenously TIG welding

Sr. No.	Welding Current	Welded sample at different speed
1	170A	
2	190A	
3	210A	

3.2 Variation of Weld depth vs Weld speed

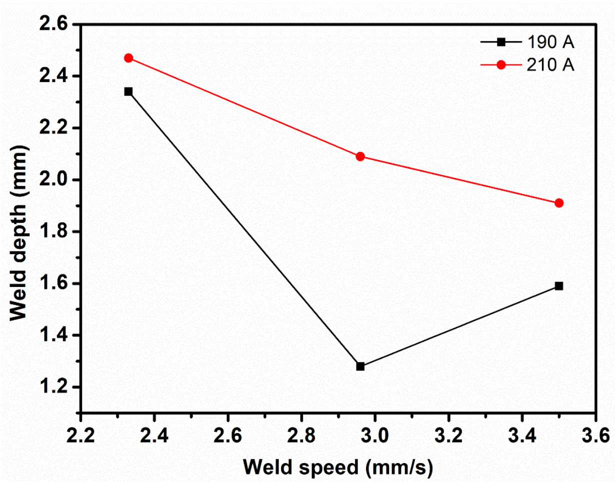


Fig. 2 Variation of weld depth against scan speed for different welding current

Fig shows the variation of weld pool depth against scan speed for different welding current of TIG welded specimen. Low welding speed and high current provide high heat input to the workpiece, so the depth of penetration was maximum at this condition. The maximum weld pool depth was 2.47 mm, obtained at 210 A welding current and 2.33 mm/s scan speed.

3.3 Variation of Weld width vs Weld speed

Fig shows the variation of weld bead width against scan speed for 190 A and 210 A welding current of welded specimen. The maximum welding width obtained at minimum welding speed and maximum current. It was normally observed that weld bead width increases as current increases but decreases with increment in welding speed.

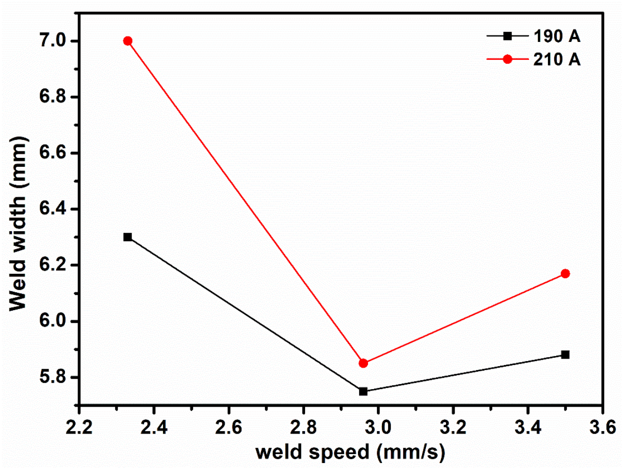


Fig:3 Variation of weld width against scan speed for different welding current

IV. TENSILE TESTING

In order to compare the strength of the welding joint at different welding conditions, tensile testing of welded specimen was performed using UTM.

TIG welded specimen provide better strength. The results of the test suggest that weld joint obtained are not strong enough which motivated the experiments.

Fig: 4 Taking data during tensile testing with UTM machine

Table : 4 Tensile strength at weld joint by TIG welding of varying gap between workpiece

Sl. No.	Welding current (A)	Gap between workpiece (mm)	Tensile strength (MPa)
1	180	0.5	115.95
2	180	0.75	225.21
3	180	1	264.54
4	190	0.5	319.10
5	190	0.75	346.38
6	190	1	01.173
7	200	0.5	442.98
8	200	0.75	395.45
9	200	1	617.22

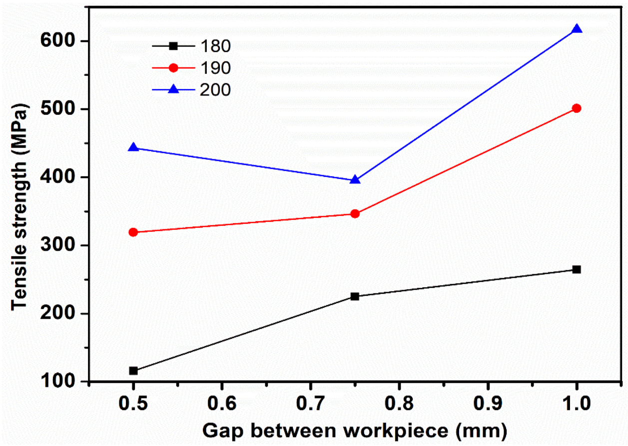


Fig: 5 Variation of Tensile strength against gap between workpiece

Fig shows the variation of tensile strength against gap between workpiece to be weldedfor different welding current of weld sample. It has been observed that the increase in gap between workpiece to be welded, tensile strength of weld workpiece increases. This is mainly due to the higher penetration of welding for higher welding gap maintain between workpiece.

V. CONCLUSION

- Findings of the present investigation can be summarized into following points
- The results of the conventional TIG welding process performed show that, maximum depth of penetration was obtained with parametric combination of minimum welding speed and maximum current.
- With constant welding speed, another set of experiments were done by maintaining a gap between workpiece to be welded. It is observed that, with a gap of 1 mm, defect free welding with proper material flow obtained throughout the joint for higher welding current.
- Comparing the three methods of TIG welding, depth of penetration and tensile strength of weld joint is maximum when adequate gap is maintained between the components to be welded.
- From the graphs plotted, it can be inferred that welding width and depth increases with increase in welding current and gap maintained between the components to be welded.

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