Effect of metal inert gas welding parameters to a dissimilar thin plate joint

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Effect of Metal Inert Gas Welding Parameters to a Dissimilar Thin Plate Joint

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Abstract : Using advantages properties of metals to gate an advantages product as objective in manufacturing industries. Dissimilar welding is a height light research issues. Thermal properties of every metal were difference. It is still as problem in the welding process. This study discussed dissimilar welding join between SS 304 and ST37 steel with wire steel as filler welded by Metal Inert Gas (MIG). Dissimilar welding joint could be produce with MIG weld technology however some weld parameters fail because of growing holes in weld pool. Failure weld joints used some welding parameters combination such as welding current 1.5 ampere with 27.5 m/mint, welding current 2 ampere with 25 m/mint, and 2.5 ampere with 27.5 m/mint. The highest peaks load of tensile tested could be achieved around 2.9 kN with welding parameter combination 2.5 ampere with 22.5 m/mint of wire speed. The lowest peaks load could be joined with welding current 2 Ampere and 22.5 m/mint. Fractures on dissimilar weld joint was on ST37 steel side, and 1 specimen a weld joint fracture on weld pool when welded used 1.5 Ampere and 22.5 m/mint as specimen 7 a.

INTRODUCTION

Some assembly industries have developed a construction with dissimilar metals in a joint. Advantages of menials were used to make a product with some requirement. For example, aluminum was joined with steel, aluminum has properties such as height elongation, height corrosion resistance and steel has height strength however weight. Each metal has different properties, they have advantages properties and also have disadvantages. The advantages of metals can be used in a product with joining process. Differential thermal properties of dissimilar metals are a problem in welding process. Many researchers study the dissimilar welding.

Some researcher have studied dissimilar welding such as Muzakki et al studied mechanical properties of Aluminum Alloy with Stainless Steel, between aluminum and steel were inserted zinc sheet [1]. Baskoro et al improved this investigation with analyze microstructure, fracture condition. They state that zinc layer affected to elongation [2]. Resistance spot welding was used to this study. Dinda et al studied the effect of beam oscillation on DP600-steel to Al 5754-alloy join welded by beam weld. They investigate intermetallic and porosity [3].

Laser Welding was used by Meco et al for T joining between steel and aluminum[4]. Thermal cycle and intermetallic were investigated by Filliard et al, they develop aluminum-steel angle joins with high speed laser weld-brazing[5]. Program Logic Control (PLC) was used for control welding process of dissimilar metals by Yufeng et al, they studied properties and microstructure developed [6].

Gas Metal Arc Welding was used by Ghosh for AISI 409 ferritic stainless steel to AISI 316L austenitic stainless steel joint with AISI 308 as filler wire[7]. The thickness of both metals is 3 mm. This study analyzed the dissimilar metal with thin metal with difference thickness and dissimilar steel. Thermal properties of both materials is difference,

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it is a problem for dissimilar welding process. Thin plate is also easy to make hole on weld joint. These are not many researchers studied this problem.

MATERIALS AND METHOD

Stainless steel 304 with the thickness 0.7 mm and carbon steel with 0.8 mm. Both metals have difference chemical compositions and properties. Chemical composition and mechanical properties of both metals were presented in Table 1.

TABLE 1. Chemistry typical and mechanical property

	SS 304	ST 37
Chemistry Typical		
Element	**Weight (%)**	**Weight (%)**
Ni	9.25	0.011
Cr	19	-
Fe	Balance	Balance
Si	1	0.15 - 0.35
Mn	2	0.35 - 0.75
C	0.08	0.2
P	0.045	0.05
S	0.03	0.05
Mechanical property		
Tensile strength, MPa	505	360 - 460
Yield point, min, MPa	215	235
Elongation, min, δ, %	70	25

SS 304 stainless steel and carbon steel plate were cut with 150 mm and 100 mm. both metals were washed by acetone and then welded with Metal Inert Gas (MIG) Millernmatic 180 Auto-set machine. Specification of machine was wire filler diameter from 0.6 to 0.9 inc, flux cored type 0.8 – 1.2 mm and filler speed between 1.5 and 13.7 m/min. This machine can supply welding current between 30 and 180 A. Figure of welding machine was presented by Fig. 1.

FIGURE 1. Welding Machine

Arm robotic welding was used to move troche of welding or welding speed. This moving can be controlled to constant so Scorbot Er 9Pro was used as mover of welding process. Welding process of dissimilar metal with arm robotic as an operator was presented by Fig. 2.

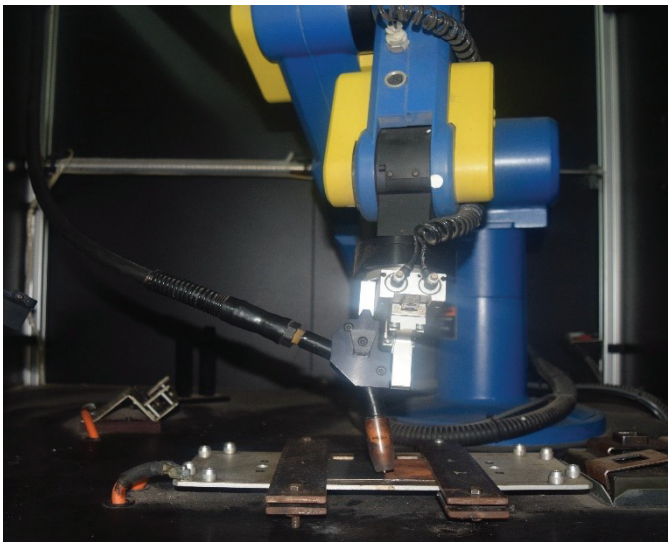

FIGURE 2. Welding Process

Some welding parameters were used to join between stainless steel thin plat and steel thin plat. Steel wire was used as filler. A movement of arm robotic as a welding speed parameter was 12. The wire filler and voltage or welding current were adjusted from the welding machine. Values of welding parameters were presented with Table 2.

TABLE 2. Levels of welding parameters

Welding Parameters	Values
Welding Current (A)	1.5, 2, 2.5
Wire Speed (m/min)	22.5, 2.5, 27.5

Combination of welding parameters used as welding process and the result of welding were represented Fig 3. Some of both plates were succeed to joint, and some of the join fail because of rise some holes on the weld join.

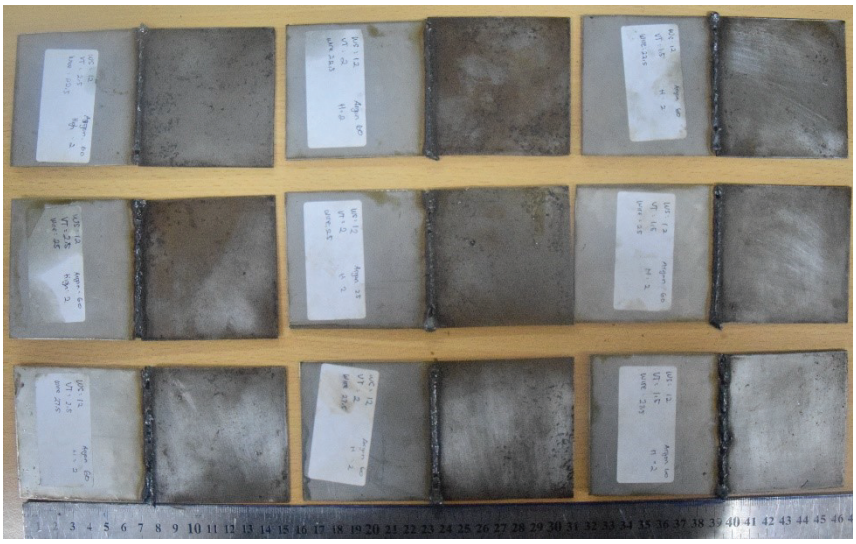

FIGURE 3. Dissimilar Joining of MIG process

The success full joins were cut as the tensile test specimen. The tensile test specimens were presented by Fig 4.

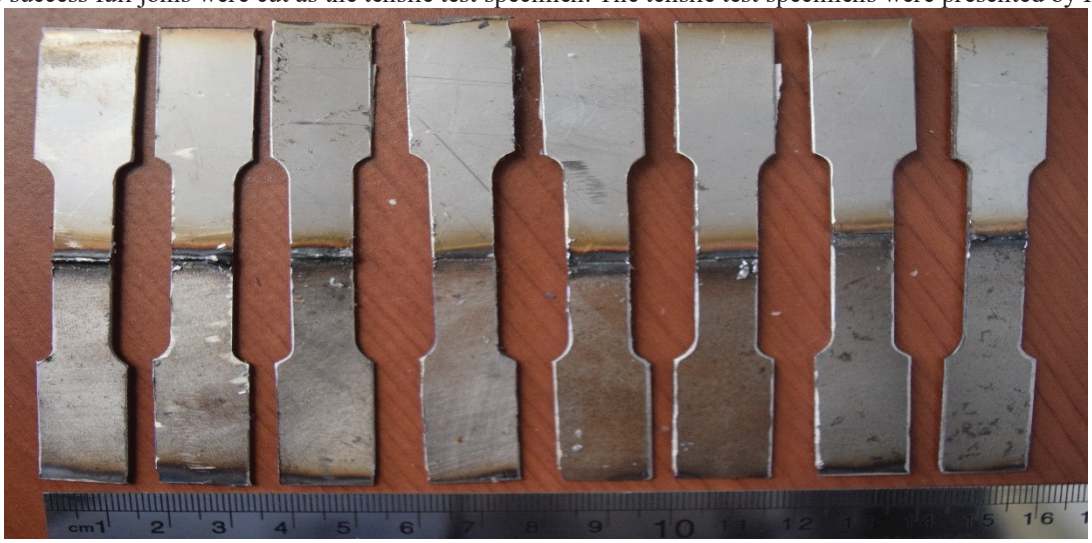

FIGURE 4. Tensile tested specimens developed

Specimens were tested with universal test machine and the testing results were analyzed and presented in result and discussion of this study.

RESULTS AND DISCUSSION

Weld joint analysis

Stainless steel with thickness 0.8 mm and steel with thickness 0.7 mm could be welded completely however some welding parameters were fail joined because between weld joint developed some holes. The defect specimen was shown in Fig 5.

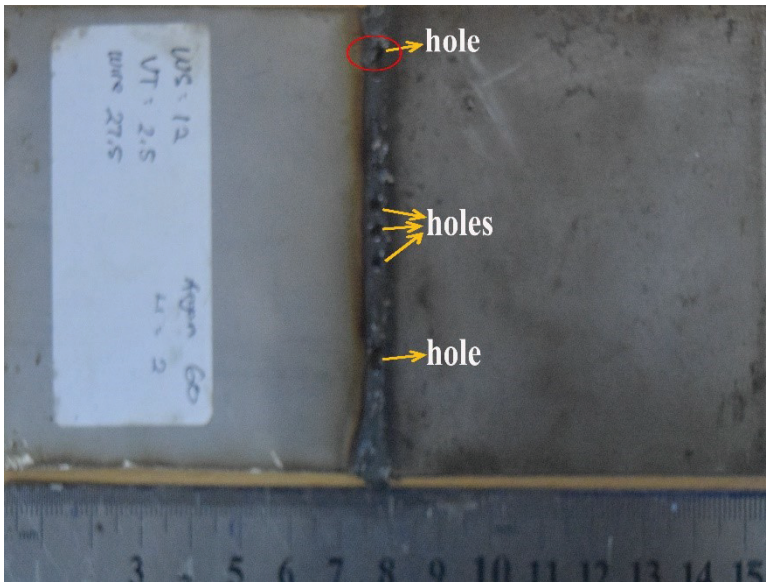

FIGURE 5. A fail weld joint

The specimen welded with welding current 1.5 A and wire speed 22.5 m/mint has succeeded to joint dissimilar welding. Welding current 1.5 A with wire filler speed 25 m/mm could weld completely. Welding current 1.5 A with wire speed 27.5 m/mint affected four holes on the welded joint. Welding current 2 ampere and wire speed 22.5 m/mint could make completely joint. Welding current 2A and wire speed 25 m/mint affected three holes with in right and two holes on left side. Welding current 2 A and wire speed 27.5 m/mint also developed two holes in the first welding and the last weld joint. Welding current 2.5 A and wire speed 22.5 m/mint produced succeed weld join and wire speed 25 also affected completely weld joint however wire speed 27.5 developed five holes.

Tensile test

Tensile test used to know a tensile strength of specimen. Not all weld joint were tested with tensile test only completely weld joint tested. From 9 paces weld joint only 6 succeed and were cut become 12 specimens. Each specimen has difference a tensile tested value. A tensile tested of the highest peak load was presented in Fig. 6.

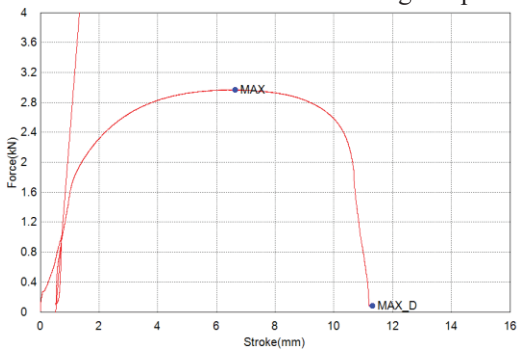

FIGURE 6. Specimen 7 b welded with welding current 2.5 A and wire speed 25 m/min

Figure 6. represented that peak load more than 2.8 and stroke or elongation more than 11 mm, it represented that weld join was a ductile joint. Each specimen has different tensile tested value although same welding parameter used so average of specimen was presented in Fig 7.

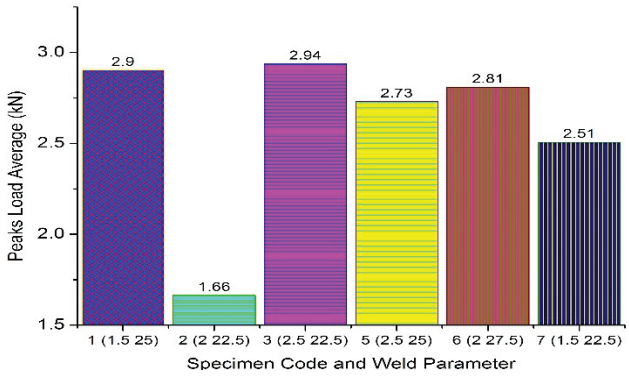

FIGURE 7. Peaks load average from tensile tested results

Figure 7. shown that dissimilar weld joints from SS 304 with ST 37 and used wire a filler steel could be joint by metal inert gas. The all joint could hold the 2 kN peak load, only average of peak load welded using 2 A welding current and wire speed 25 m/mint effected the peaks load average 1.66 kN. The highest peak load average could be achieved with welding current 2.5 ampere combined with wire speed 22.5 kN. The highest peak load average was 2.94 kN.

Fracture Analysis

Effect of tensile tested was a fracture at weld join or specimen. It also represented a performance of specimen. A fracture condition can become information about a weld joint performance. Fracture condition was also used by Ario et al to analysis a micro resistance spot welding joint[8].

Elongation in tensile tested diagram represented that the weld join has ductile properties, when fracture on weld joint or in weld pool and or around Heat Affected Zone it represent that weld joint has brittle joint. The fracture condition on weld join was represented in Fig 8

FIGURE 8. Fracture condition of weld joint

Figure 8. show two fracture condition from two weld joints, specimen 7A was fracture condition on weld joint so it called brittle joint. Fig. 8 also presented the ductile joint because of fracture position not in the weld pool. Fracture position was on ST 37 steel side. Fracture position of dissimilar weld joint was on ST 37 it represented that tensile strength of SS304 was higher than ST 37 plat in this dissimilar weld joint.

CONCLUSION

Metal inert gas (MIG) could joint dissimilar metal between SS 304 and ST 37 with a steel wire as filler, however using some welding parameters composition also affected holes or weld failure. Welding parameter combination produced 6 good weld joints.

Dissimilar weld joint between SS304 and ST37 with wire steel as filler could resist the load more than 1.5 kN. Welding current 2.5 Ampere and 22.5 m/mint of wire filler could joint Stainless steel and Steel with load 2.9 more. 1.6 kN was the lowest tensile strength in this study. This welding parameter combination welding current 2 Ampere and 22.5 m/mint for wire filler speed.

Dissimilar weld joint broke on ST37 side it was represented that ST37 steel in this study more brittle than stainless steel. Only a specimen facture condition was on weld pool.

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