IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE)
e-ISSN: 2278-1684,p-ISSN: 2320-334X
PP. 01-04
www.iosrjournals.org

Experimental Investigation On Tig Welded Butt Joints Of Aluminium Alloy 6061-T6 To Obtain Tensile Strength

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ABSTRACT:- *The Mechanical Properties Of Tungsten Inert Gas (Tig) Welded Joints Of Aluminium 6061-T6 Sheets Under Different Weld Angles, With Or Without Heat Treatment Processes Was Experimentally Investigated. Welding Aluminium Is A Special Attention To Many Researchers. Aluminium 6061-T6 Is A Solution Heat Treated Then Artificial Aged Alloy Widely Used In Structural Applications And Has Unique Mechanical Properties And Weldability. 04 Numbers Of Weld Sheets Were Produced By Using Tungsten Inert Gas (Tig) Welding Process At Different Welding Angle Ɵ Is At 0^0, 30^0, 45^0 And 60^0. The Tensile Specimens Were Extracted From The Weld Sheets And Undergone Tensile Testing Followed By After Weld Heat Treatment Processes Like Annealing, Water Quenching And Also Without Heat Treating.*

I. Introduction

Tungsten inert gas welding is a mostly preferable an arc welding process widely used for the welding of thin to medium sheet sections of base metals like aluminium, titanium, copper, magnesium, stainless steels, nickel and its alloys. The welding is produced by heating the workpiece with an electric arc which is getting strucked between a non consumable tungsten electrode and the workpiece. The welding arc is a high current (2000 amps) and low voltage (10-50 V) a sustained electrical discharge through an ionized gas. The electrical discharge that is emission of electrons from the hot cathode through the ionized gas produces sufficient heat energy to produce welding by means of fusion. The arc is initiated by the momentarily touching of the electrode upon the workpiece and taking it away which created a conducting path between the electrode and the job or by ionizing the gap between the two. DC or AC welding power supply is used to produce the weld. DC is preferred for the welding of stainless steel, nickel, titanium, copper and its alloys whereas AC is used to welding of magnesium, aluminium and its alloys. A filler metal can be added on requirement. Aluminium 6061-T6 a solution heat treated and artificially aged alloy widely used in structural frameworks of various automobile, aero engine parts and in civil structural frameworks as well. The wide use of this alloy is for its exclusive characteristics like good weldability, brazability, machinability and formability. N. Jeyaprakash et al. studied and reviewed the process parameters and equipments used in TIG welding in which the power sources, electrodes, nozzles and assembly of all accessories for the welding are presented [1]. C Prabaharan et al. used factorial design approach and optimized the process parameters of gas tungsten arc welding of Inconel 825 alloy in which the effect of weld angle θ on weld deposition area [2]. Hakem Maamar et al. investigated the effects of heat treatment on mechanical properties of TIG welded dissimilar joints 2024 T3 and 7075 T6 Aluminium alloys [3]. The objective of this investigation is to analyze the effects of weld angle and after weld heat treatment on the mechanical properties of the weld joints

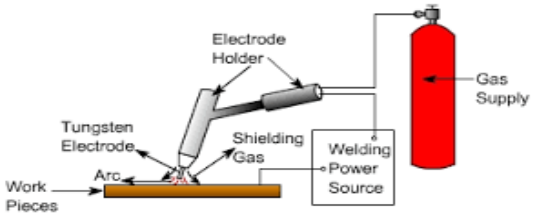


FIG. 1 TIG WELDING SYSTEM SETUP

II. Experimental Details

The rolled sheets of aluminium 6061-T6 alloy of size (l×b×t) 400×150×3 (mm) is chosen for the TIG welding. The typical chemical compositions and mechanical properties of the aluminium 6061-T6 alloy used in this experimentation is given below in table 1 and 2 simultaneously. The four sheets of aluminium 6061-T6 alloy are cut in the different weld angle θ is at 0^0, 30^0, 45^0 and 60^0. And then edges are polished and single side 1mm V-groove is prepared on the aluminium 6061-T6 sheets. The two sheets are properly aligned in the welding fixture and tack welded to avoid mismatch of the sheets during the full length welding. The square butt weld in a single pass is produced by the tungsten inert gas welding process. Four TIG weld coupons are prepared at different weld angle θ is at 0^0, 30^0, 45^0 and 60^0. The high pure argon (99.996%) is used as shielding gas to prevent the weld pool from the atmospheric contaminations. Filler metal of equal compositions with the aluminium 6061-T6 alloy is added. Non consumable thoriated tungsten electrode of diameter 2mm is used to produce the weld. The weld current 245 Amps, AC voltage, gas flow rate 5mmHg, welding speed 5.88mm/sec are kept constant for the welding of all sheets. Six tensile specimens total (24 numbers) are extracted from each TIG welded coupons as per the standard ASTM E8/E8M-09. Two tensile specimens from each weld angle θ at 0^0, 30^0, 45^0 and 60^0 is followed for solution after weld heat treatment annealing, water quenching and without heat treatment simultaneously and then followed for tensile testing in universal testing machine UTK-60 Krystal Elmec of maximum capacity 600KN. The solution heat treatment cycle is followed as 475-495-510-525 ºC with 20 minutes soaking time. 08 numbers of specimens is processed for water quenching in which the heated specimens cooled rapidly by immersing water on the hot part.

III. Result And Discussions

The tensile results obtained from the tensile testing are given below in tables. The tensile strength obtained under solution heat treated annealing conditions in different weld angle at 0^0 is 67 MPa, at 30^0- 90MPa, at 45^0- 66 MPa and at 60^0- 109 MPa. Whereas under water quenching the tensile strength obtained as 52, 77, 82 and 87 MPa at weld angle 0^0, 30^0, 45^0, and 60^0 respectively. While under without heat treatment the tensile strength obtained as 75, 100, 59 and 78 MPa at weld angle 0^0, 30^0, 45^0, and 60^0 respectively. The graph below in fig. 3, it shows the variations in tensile strength with respect to weld angles. There is an increase in tensile strength under water quenching heat treatment process from 52 MPa to 87 MPa welded at varying the weld angle. Under solution heat treated annealing condition the strength of the weld increased from 67 MPa to 90 MPa and decreased at weld angle 45^0 to 66 MPa again increased to 109 MPa at weld angle 60^0. While without going for heat treatment the strength increased from 75 to 100 MPa at weld angle 0^0 to 30^0 but further decreased to 59 MPa at weld angle 45^0 which increased to 78 MPa when weld angle is 60^0. This shows there is an effect of heat treatment and weld at different angle θ on the strength of the weld joint.

Table 1 Chemical Compositions of Aluminium 6061-T6 (Wt %)

Al	**Mg**	**Si**	**Cr**	**Cu**	**Fe**	**Mn**	**Ti**	**Zn**
95.8-98.6	0.80-1.2	0.40-0.80	0.04-0.35	0.15-0.40	<=0.70	<=0.15	<=0.15	<=0.25

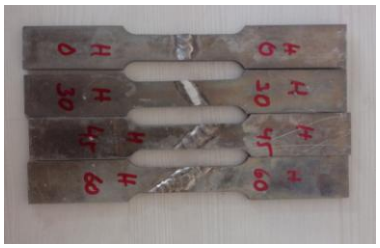
Table 2 Mechanical Properties of Aluminium 6061-T6

Yield strength	Ultimate strength	Modulus of elasticity	Poisson's ratio	Elongation	Hardness (HB)
276 MPa	310 MPa	68.9 GPa	0.33	17%	95

Table 3 Mechanical Properties Results under Solution Heat Treated Annealing Condition

S. No.	Test parameters	Unit of measurements	0^0	30^0	45^0	60^0
1	Tensile strength	MPa	67	90	66	109
2	0.2% Proof strength	MPa	58	61	62	93
3	Elongation	Percent	1.7	2.2	2.0	5.6
4	Failure location	Visual	Broken at weld	Broken at weld	Broken at weld	Broken at weld

Table 4 Mechanical Properties Results under Water Quenching Condition



S. No.	Test parameters	Unit of measurements	0^0	30^0	45^0	60^0
1	Tensile strength	MPa	52	77	82	87
2	0.2% Proof strength	MPa	48	72	73	82
3	Elongation	Percent	2.2	4.6	4.6	3.0
4	Failure location	Visual	Broken at weld	Broken at weld	Broken at weld	Broken at weld

Table 5 Mechanical Properties Results under Without Heat Treated Condition

S. No.	Test parameters	Unit of measurements	0^0	30^0	45^0	60^0
1	Tensile strength	MPa	75	100	59	78
2	0.2% Proof strength	MPa	73	94	54	70
3	Elongation	Percent	1.0	3.9	2.4	3.9
4	Failure location	Visual	Broken at weld	Broken at weld	Broken at weld	Broken at weld

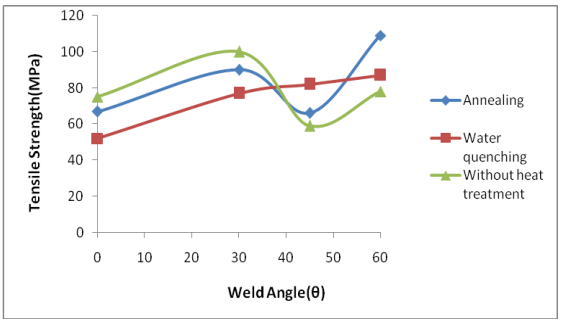


Fig. 2 Tensile specimens under annealing (A), water quenching (WQ) and without heat treatment (WH)

IV. Conclusion

The Tungsten Inert Gas welding process was successfully used for the joining of aluminum 6061-T6 alloy sheets. The welding is accomplished by varying the weld angle θ. The tensile specimens was undergone tensile testing in different heat treatment processes like annealing, water quenching and also without heat treatment. The highest strength obtained 109 MPa and the % elongation obtained as 5.6% shows the higher ductility under annealing, welded at an angle 60^0. The strength obtained 100 MPa while welded at an angle 30^0 under without doing heat treatment. Thus there is an effect of heat treatment processes and weld angles on the strength and ductile properties of the weld joint.

REFERENCES

[1] N. Jeyaprakash, Adisu Haile, M. Arunprasath, "The parameters and equipments used in TIG welding: A review", The International journal of Engineering and Science (IJES), vol. 4, issue 2, pp.11-20 (2015), ISSN(e): 2319-1813, ISSN(p):2319-1805.

[2] C Prabaharan, P Venkatachalam, K Suresh Kumar, K Lenin, "Parametric Optimization of Gas tungsten arc welding processes by using factorial design approach", Journal of Scientific & Industrial Research, vol. 73, June 2014, pp.415-420.

[3] Hakem. Maamar, R. Rabah Otmani, T. Fahssi, N. Debbache, D. Allou, "heat treatment and welding effects on Mechanical properties and microstructure evolution of 2024 and 7075 aluminium alloys", Metal 2008, 13-15.5 2008 Hradec and Moravici.

[4] Gurdev Singh, Amman Bansal, Dr. Amit Kumar Gupta, Amandeep Singh, "Study the parametric optimization of TIG welding", International research journal of Engineering and Technology (IRJET), vol. 03, Issue: 05, May 2016, ISSN(e): 2395-0056, ISSN(p): 2395-0072.

[5] Mukesh, Sanjeev Sharma, "Study of mechanical properties in Austenitic Stainless Steel using gas tungsten arc welding (GTAW)" International journal of Engineering research and applications (IJERA), ISSN: 2248-9622, vol. 3, issue 6 Nov-Dec 2013, pp.547-553.

[6] S.A.A. Akbari Mousavi, R. Miresmaeili, "Experimental and numerical analyses of residual stress distributions in TIG welding process for 304L stainless steel", vol. 208, pp (383-394), (2008).

[7] Khanna O. P. A textbook of welding technology 19th edition (2010), Dhanpat rai publications (P) Ltd, New Delhi.

[8] Davies A.C., The Science and practice of welding volume 1 & 2, 8th edition, (1984), Cambridge University press Cambridge, London.