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Experiment on GTAW of AL 6061-T6 Material With SUS 304

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Abstract--- GTAW well known as tungsten inert gas welding (TIG) commonly used to join thin sections of non-ferrous metals like magnesium, copper and aluminium alloys. Allowing for stronger, higher quality welds the welding operator need great control on welding process. Because of short arc length, contact gap of filler electrode have to be maintain in a even way to maintain equal speed and depositing methods. Present work focuses on the TIG welding process and microstructure analysis of flaws in welding; also evaluate the mechanical properties of welded joints. The samples prepared as per ASTM weld samples, the extracted samples tested for microstructure, penetration and other mechanical tests. The results are showing good at the area of weld.

Key words — GTAW, dissimilar metal welds, SEM

I. INTRODUCTION

Welding is one of the most reliable techniques in preparing structures with metals in present era. Economically it is viable when compared with other types of manufacturing process. Most of the researches focused on the weld nature of metals which were similar in properties. Some applications need un-identical material attachments for their structures, most of it are aero and space structures and some automotives. The two materials are well known for aero applications.

II. LITERATURE REVIEW

Dissimilar metals weld getting immediate brittle because of its high temperature module of welding zone, inter metallic layer becoming less strength [1]. Welding of aluminium to steel becoming a challenging task, some researches worked on lap joint, T-joint but butt welds in this area have a lack of work, by application criteria the weld of these two metals will reduce fuel consumption in many sectors because of light weight structure without disturbing reliability, stability, operating texture[2-5]. To overcome the difficulty of weld these metals and to get optimum results researchers worked on many methods like laser welding[6], friction stir welding[7], metal inert gas welding[8], magnetic welding[9], diffusion bonding[10], pressure seam welding[11]. The weld ability characteristics have to study before we proceed with aluminium alloys and steels [12].

III. SCOPE OF WORK

Production needs in various sectors modifying in a economic way, to overcome most of the working hours most of the industries undergoing for automation. Some areas which needed economization to control assembling costs researches looking at the welding processes with high quality. Conventional welding techniques like MIG and TIG fulfilling most of the needs, dissimilar metal welding process give optimal solutions economically but the characterizations of welds are most important the work focuses on mostly available material of AL6061 T6 and SUS 304 butt weld.

IV. OBJECTIVES

- To check the method for TIG welding of ferrous and non- ferrous materials.
- To check the weld parameters of AL6061-T6 with SUS 304 in butt weld.
- To verify the strengthening properties as well as NDT tests for better conclusions.

V. MATERIALS AND METHODOLOGY

Metal plates of aluminium and SUS 150mmx 80 mm with a standard thickness of 6mm, the two plates are fixed to the base plate and brazing at the two ends. Welding rods of ϕ2.4mm aluma-steel used as filler metal. The welding process did at 140 to 170 amp voltages and recommended at initial temperatures, argon DCEN at 18-22 cfh a two step welding process has been taken place. Use filter gas lens 3/32 and #6 diffuser cup and 3/32 tungsten for the initial weld and bed formed towards steel side with no pulse, once weld bead formed attaching steel plate as a first layer, the adjacent layer weld on second step. Press foot control to starting temp, about 25-35 amps, deposit 1 full droplet (liberally). Move rod back a little but keep it in the coverage zone to prevent oxidation on rod. Rapidly press foot control all the way down to max amperage. Rapidly depress the foot control back to starting amps. A complete pulse cycle should be done quickly- about 4-6 seconds, less if possible. Direct torch angle towards aluminum and deposit weld puddle overlapping 1st pass midway and partially onto aluminum.

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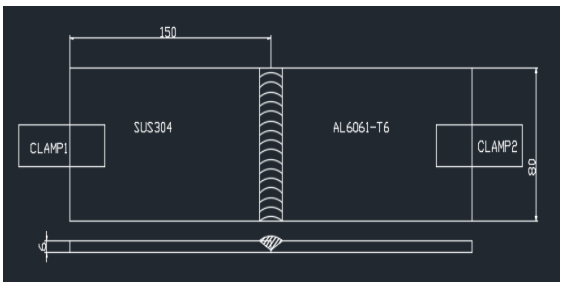
1. Set Temperature to 160 amps. (DC same as steel or stainless steel)
2. Watch for droplet to flatten out, should have smooth surface, medium height, and rounded edge.
3. Increase temperature 5-10 degrees. Continue process
4. When droplet no longer has smooth appearance, (The surface will appear like the moon or cauliflower) (It will also be too flat and will deform the aluminum along the outer edge) Then it is too hot!
5. Reduce temperature back to setting with best appearance. The cad layout for fixing job shown below



Properties of AL6061-T6

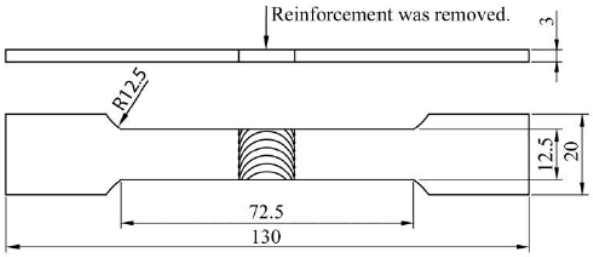
Component	Wt. %	Component	Wt. %	Component	Wt. %
Al	95.8 - 98.6	Mg	0.8 - 1.2	Si	0.4 - 0.8
Cr	0.04 - 0.35	Mn	Max 0.15	Ti	Max 0.15
Cu	0.15 - 0.4	Other, each	Max 0.05	Zn	Max 0.25
Fe	Max 0.7	Other, total	Max 0.15		

Properties of SUS400

Material	Fe	Ni	C	Si	Mn	Cr	P	S	O
SUS304	Bal.	8.19	0.06	0.04	0.96	18.22	0.027	0.002	0.002

Properties of electrode materials

Material	Cu	P	Al	Si	Fe	C	O	Ca
Aluma-Steel	Bal.	5.0	0.4	0.7	0.2	13.2	3.3	0.1



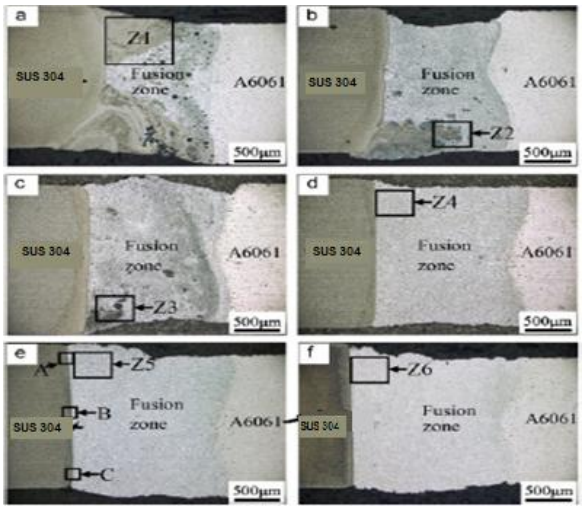
Above figure shows the preparation drawing for tensile test

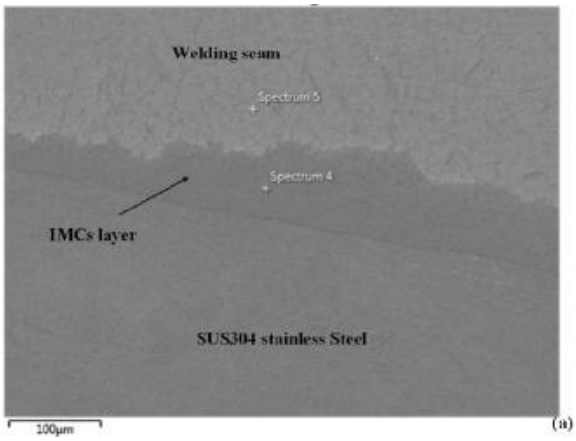
Figure showing welding rod- filler rod

VI. RESULTS AND DISCUSSIONS

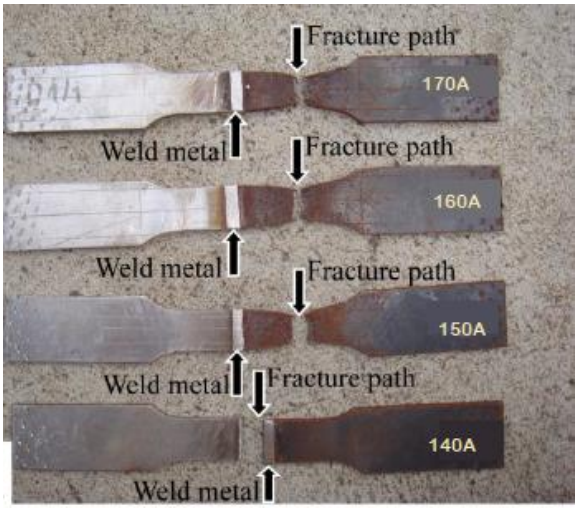
Above figure showing the welded zone of GTAW between SUS304 and AL6061-T6

The microstructure analysis at fusion zone has been observed in different areas of weld





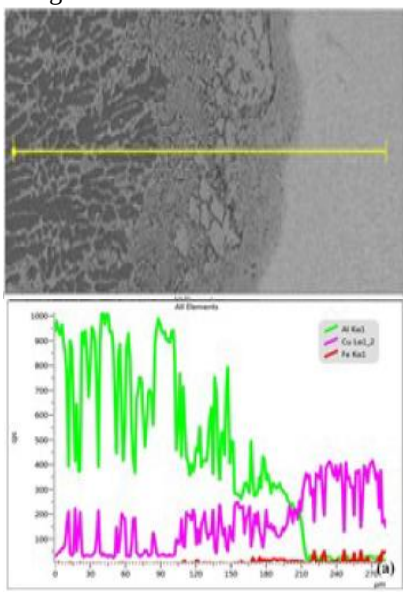
Above figure shows the seam layers of weld structure



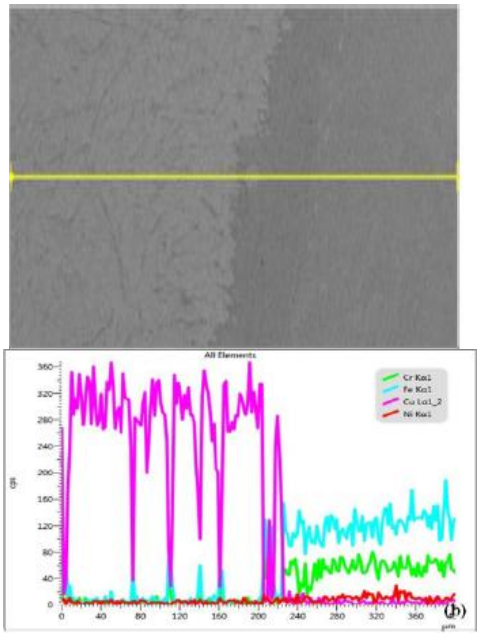
Above figure shows the tensile test samples observed for weld strength, 4 samples tested at different power input of ranging from 140A to 170A.

	Hardness value HV												
Distance mm	-6	-5	-4	-3	-2	-10	C	1	2	3	4	5	6
140A-Sample1	150	156	152	164	210	305	282	254	220	178	150	135	121
150A Sample2	152	150	160	171	214	308	275	238	218	180	155	134	119
160A Sample3	155	148	154	162	206	290	272	230	21	172	146	136	118
170A Sample4	150	136	142	150	202	286	262	228	207	166	141	133	120

By observing the results obtained from the samples



Welding seam and SUS304 stainless steel interface layer with EDS for scanning interfaces to check the gaps in weld zone and 304, the observation is clearly showing a mild input between both connected layers.



EDS line scanning interface results between welding seam and A6061 alloys, results showing that at the contact region of low temperature its found to be good at weld.

VII. CONCLUSIONS

The dissimilar joining between SUS304 stainless steel and A6061-T6 alloys by TIG welding process using Aluma-Steel welding rods. The micro structural characteristics and strength of welds were investigated. The observations are as follows

The main conclusion and aim to control the weld defects in dissimilar metal welds, the percentage of Ti with 0.15 control the thermal defect in aluminium, the procedure followed for TIG weld should be in a continuous manner. The temperature should be down to 30to 60^0c after each layer formed to reduce thermal cracking for next addition. By observing micro structures and mechanical properties some copper atoms found between weld layers to both materials, such diffusion of atoms given good welding process. A maximum weld strength of 320MPA found at low current status of weld. Cr, Fe, Cu, and Ni, Si and Zn found in aluminium and weld bead Fe, Cu atoms found more in 304 and weld bead. The process should be developed in an economic manner to get more successful results.

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