A REVIEW: PARAMETRIC EFFECTS ON MECHANICAL PROPERTIES, MICROSTRUCTURAL CHANGES AND CORROSION MECHANISM OF ALUMINUM ALLOYS IN GAS TUNGSTEN ARC WELDING

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ABSTRACT -*The welding of aluminum alloys can be achieved by using Gas Tungsten Arc Welding process which is high quality and high precession process. The prevention of weld bead from air, dust and other contaminations can be done by using helium or argon as shielding gases. There are so many parameters in welding process that effect on the quality of weld in Gas Tungsten Arc Welding (GTAW). Welding current, gas flow rate, specimen thickness, heat input, arc voltage, gun angle, welding speed, and bevel angle are the significant process parameters which primarily influence the weld quality. Welding speed affects both on the depth of penetration and weld bead width. Welding speed is directly proportional to penetration depth and width of the weld bead. There have been a number of reports stresses that plastic deformation and heat associated due to welding influence on microstructures. The formation of wide precipitate-free zone as well as dissolution and coarsening of strengthening precipitates have been found in welding region. The amount of heat input causes mechanical failure of the welds in the heat affected zone (HAZ) which can be minimize by controlling welding parameters such as welding speed.This review attempts the recent understanding of the variation in mechanical properties, microstructures, HAZ and corrosion mechanism of aluminum alloys due to welding process parameters. The discussion highlights that microstructural changes and intermetallic phases due to different welding parameters play an important role on corrosion behavior of aluminum alloys. Corrosion mechanisms of aluminum alloys are specially discussed.*

Key Words: GTAW Parameters, Mechanical Properties, Microstructures, Heat Affected Zone, Corrosion.

1. INTRODUCTION

Welding is basically a joining process of materials carried out by the induction of heat between the electrode and base metal; usually on metals and thermoplastics. Welding has made a significant impact in many industries by increasing their operating frequency and the production rate of the plant. Welding of materials can be done in various positions to get desired results. It can be performed on flat, horizontal overhead and vertical positions [1].

In welding, work pieces and filler material are melted and then mixed to form pools of molten metal that becomes a strong joint when it solidifies by the application of pressure or by the application of heat, to produce the weld [2].

Welded joints are mostly dissimilar by nature that produces different properties of the base metal and the HAZ. So the welded joints are classified between the welded zone and the base metal on the basis of orderly and consistent relations. [3].

Welding of aluminum can be carried out by the gas or arc welding processes. But the arc welding process is more adequate and suitable for the welding of aluminum because the welding speed can be varied and this process act over very small area so that the heat generation is also very small.

Aluminum is a very remarkable metal having different properties. Aluminum has a very high thermal conductivity, five times higher than steel. Due to this tendency of crack propagation are reduced by arc welding process [4].

Gas tungsten arc welding (GTAW) is also used for the welding of aluminum alloys on alternating current. Many power sources have shown that when more than 50% AC cycle is applied on the negative polarity electrode, "max penetration" can be observed. Similarly "max cleaning" is noted when more than 50% of AC cycle is applied on positive polarity electrode [5].

Generally peak temperatures and flow ability of the material have strong influence on the weld zone and their microstructure [6,7]. In case of aluminum the effect of material flow is limited.

Electrochemical corrosion occurs in metals due to the electrochemical reactions. This corrosion is due to humid atmosphere, the wet soil as well as the electrolyte solution. In electrochemical corrosion two or more reactions take place at the same time onto the metal surface. An anodic reaction is one in which metal oxidizes in the solution while in cathodic reaction reduction occurs on the metal surface [8].

When Al-Cu-Li alloys are subjected to thermomechanical treatments, then the behavior of alloys becomes susceptible to different corrosion types [9,10]. So studies have shown that the Al-Cu-Li alloys prone to pitting and intergranular corrosion. Galvanic corrosion is also responsible for the pitting corrosion [11,12].

The microstructure of Al-Cu alloy having galvanic coupling shows the substantial corrosion properties between $CuAl_2$ dispersed in surrounding matrix phase. When the corrosion resistance of Al-Cu is attempted to improve then mechanical properties of the welds are badly affected [13].

2. GAS TUNGSTEN ARC WELDING PROCESS

It is necessary to define term welding process. According to American Welding Society, welding is a joining process of metals or non-metals with or without pressure and by consumption of filler metal or without filler metal or heating the material with welding temperature, (due to the high temperature the material melts) and join together [14]. Gas tungsten arc welding is also known as tungsten inert gas (TIG). This welding process produces an electric arc between part to be welded and non-consumable tungsten electrode. The detailed diagram and TIG welding process is shown in fig 1. Argon (which is a noble gas and chemically inactive) is usually used as shielding gas to prevent the HAZ, the electrode and the molten metal from atmospheric contamination because it creates a shielding blanket between surroundings and materials. TIG welding equipment and procedure is shown in fig 2. Helium is also used as shielding gas because it is also chemically inactive and do not react with other gases [15].

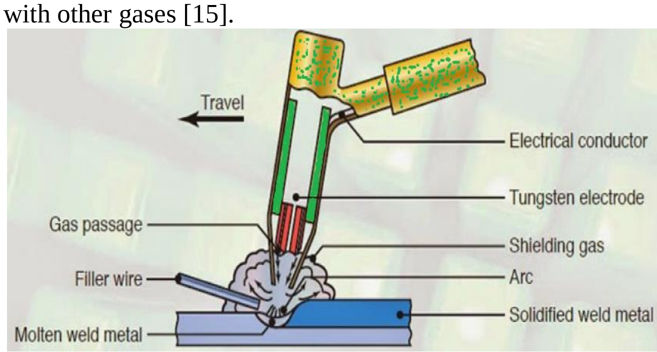

Figure 1: Gas Tungsten-arc Welding Process [16].

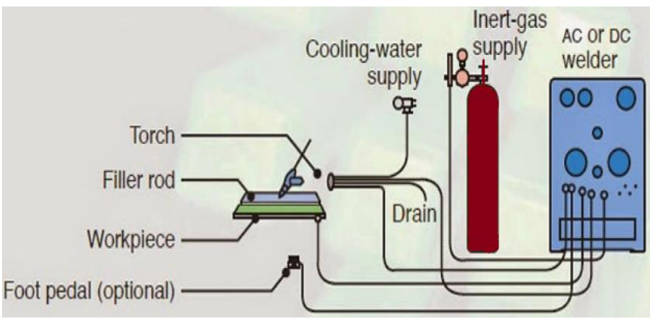

Figure 2: Schematic diagram of Operation and Equipment (TIG) welding [16].

Studies have shown that the mechanical strength of metals decrease due to application of welding process because it affects the HAZ and fusion metal zone by creating stresses in to their areas [17]. During the welding process the properties and design of the materials are influenced, so to minimize these effects and produced stresses, aging is done in the applied stress direction on the welded material [18].

3. LITERATURE REVIEW OF WELDING PARAMETERS

Here it is important to discuss some variables like welding current , voltage, welding speed ,and shielding gases(either it is argon or helium) play a major role in GTAW and their effects on the geometry of weld bead, microstructures, heat affected zone, corrosion resistance and mechanical properties as well as residual stresses. Mathematical models have been developed to study the following relationships and some experimental models are used to solve these problems during welding processes for further improvements [19].

3.1 Parametric Effects On Weld Bead Geometry

Raveendra A. attempts to explore the weld bead geometry (Front width, Back Width, Front Height and Back Height as per figure 3) on different GTAW process parameters like welding current, Gas flow rate and welding speed. Aluminum alloy 5052 were welded by Gas Tungsten Arc Welding process with ER 404 filler wire on different parameters like welding current (205 – 240 *Amp*), Gas flow rate (11 – 14.5 *Lt/min*) and welding speed (81 – 99 *mm/min*). From the analysis with the help of Traveling microscope, it has been found that the front width as well as back width increase with increase in welding current. As for as concern for gas flow rate front width and back width increased by increasing gas flow rate. Similarly front width and back width decreases as welding speed increases [20].

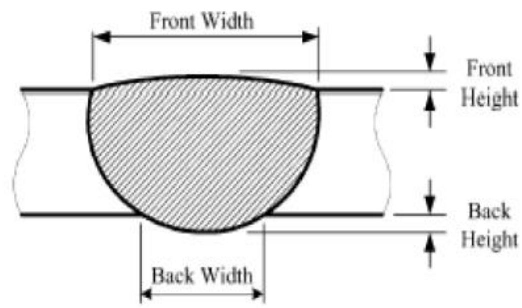

Figure 3: Geometry of weld bead [20].

Lakshman Singh. In this study, author investigated the influence of gas tungsten arc welding parameters on weldability in term of depth of penetration. Aluminum alloy 5083 samples with dimension of 50 *mm* x 50 *mm* x 5 *mm* was welded by gas tungsten arc welding process with use of 5356 filler wire. The welding parameters were taken into account were welding speed (128.20 – 189.87 *mm/min*), gas flow rate (10.35 – 14 *Lt/min*) and heat input (1494.73 – 2213.73 *J/mm*). In this work,welding speed and Heat Input were calculated by mathematical formula as under.

Welding speed = (Traveling distance / Arc time in)*mm/min*
Similarly

Heat input = (60 *VI / S*) in *Joule / mm*
Where V = Arc voltage in *volt*
I = Welding current in *Amper.*
S = Welding Speed in *mm / min.*

Depth of penetration was obtained by cutting each welded specimen perpendicular to the weld direction and concluded that the depth of penetration increase with increase in welding speed up to the optimum value where maximum penetration of 4.59 *mm* at a speed of 146.48 *mm/min* were recorded. As far as concern gas flow rate the depth of penetration increase up to an optimum value and linearly decrease after this value so maximum penetration of 4.59 *mm* was recorded at gas flow rate of 12.45 *Lt/min.* Similarly with increasing Heat input the depth of penetration increases until an optimum value reaches and then decreased linearly. This optimum point shows the maximum depth of penetration in this case 4.59 *mm* depth of penetration were obtained at heat input of 1937.47 *J/min* [21].

Ahmed Khalid. Investigated the effect of welding speed, bevel angle and bevel height on depth of penetration. Aluminum alloy AA6351 was gas tungsten arc welded by using 6063 filler metal. To weld (4x50x200) *mm* plate author uses welding speed (0.3, 0.6, 0.9, 1.2 *cm/sec*), Bevel Height (1, 1.5, 2, 2.5 *mm*) and Bevel angle (30^0, 40^0, 50^0, 60^0). From the experimental results it was revealed that the joints having less depth of penetration ultimately having low strength. There was a sudden drop of strength of welding speed of 1.2 *cm/sec* because of low depth of penetration. Moreover, the author concluded that the depth of penetration decreases with the increase in bevel height [22].

Parthiv T., did experiment on aluminum alloy AA6063 to investigate the weld bead geometry on different parameters like welding speed, welding current and gas flow rate. In this study the author applied Design of an experiment, DOE method with CCD (central composite design). The Design of experiments was performed in MINITAB16 software. Gas tungsten arc welding was done with semi-automatic welding machine to control welding parameters such as welding speed (22.5 – 25*cm/min*), welding current (259 – 274 *Amp*) and gas flow rate (15 – 17.5 *Lit/min*). The experimental investigation concluded that the increase in welding speed bead height, bead width as well as depth of bead penetration decreases. With the increase in welding current Bead height increased, bead width decreases while the depth of bead penetration remains almost constant. Similarly the gas flow rate caused little decreased in bead height, bead width almost constant and depth of bead penetration decreased on gas flow rate increasing [23].

3.2 Paremetric effects on heat affected zone

Amir Hadadzadeh investigated the HAZ softening behavior of Al-6.7Mg Alloy Gas tungsten Arc welded by various parameters like welding speed (4.39 – 5 *mm/s*) and welding current (120 – 150 *Ampere*). In first stage welding procedure were conducted on 350*mm* x 150*mm* x 2.7*mm* plate with AA5356 filler metal. In this study the current – voltage relationship and heat input were calculated by following equations.

$$Q = \mu(V.I/S\text{x}1000)$$

$V = 0.0403I + 19.88$ (where V is voltage in *volts* and I is current in *Ampere*).

Q is welding heat input in *Kj/mm*

μ is welding efficiency

V is welding voltage in *Volts*

I is welding current in *Ampere* and

S is welding speed in *mm/s*

In the second stage HAZ softening was carried out by pulse current (peak current (*IP*), base current (*IB*) and peak time (*TP*)). Upon characterization it was revealed that the softest part of the weld was heat affected zone and the size of HAZ and precipitates were affected by increasing heat input. Moreover, when pulse current was employed on gas tungsten arc welding process the overall width of Heat affected Zone come to be narrower which ultimately improved the HAZ softening [24].

Prachya Peasura analyzed the effect of shielding gas on microstructure of heat affected zone and fusion zone. Aluminum alloy AA5083 plate of 6mm thick was welded by gas tungsten arc welding process with 12 *mm/sec* as welding speed and tungsten electrode of 2.4*mm* was used. In this study Argon and helium was used as a variable parameter with the flow rate of 6, 10, and 14 *liters / minute*. The author in this study focused on the microstructure of heat affected zone. The results concluded that the helium have high thermal conductivity resulting in a large amount of high heat distribution resulting in large grain size in HAZ and fusion zone. Moreover nominal properties of Heat Affected Zone were achieved with organ at 14 *lit/min* [25].

Mayur.S Revealed HAZ (structural and mechanical) properties of aluminum alloy AA-5083 single pas gas tungsten arc welded. In this study the 125x60x3 *mm* plate weld was obtained by 99.9% pure argon, V grove of 45^0 and filler wire of AA-5356. The variable process parameter was welding current (70*A*, 75*A* and 80*A*) from which the investigation of HAZ carried out. The results showed that the finer particles of silicon formed in the interdendritic aluminium alloy which make HAZ blend of weld having recrystallized structure as shown in fig 4 a & b. At the end it was concluded that the optimum finer grains in HAZ can be achieved at 75*A* compare with 70*A* and 80*A* [26].

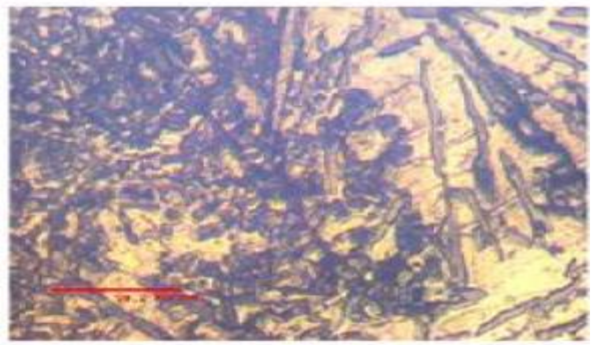

Figure 4a: Microstructure of HAZ for 80A [26].

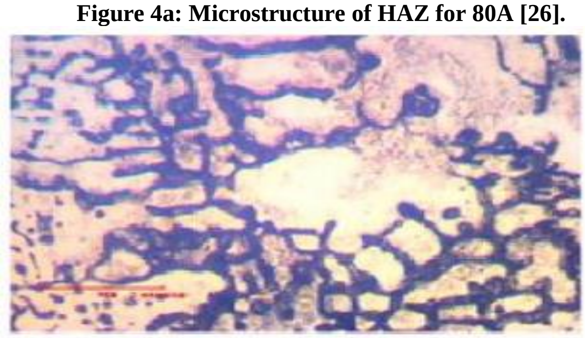

Figure 4b: Microstructure of HAZ for 75A [26].

Rong-Hua Yeh investigate the effect of welding parameters like heat input preheating of plate and moving velocity of the heat source with the help of mathematical models. Finite difference method was employed to solve the temperature profile of the weld plat. An experiment was performed on (250x200x3.2) *mm* long plate of aluminum alloy 5456 welded by Gas tungsten arc welding process with variable parameters like welding speed (3 – 7.4 *mm/sec*) and welding current of (86 – 125 *A*) to verify the theoretical results. It was clear from experiment that the temperature of plate increased with increase in welding current. Moreover, with increase in welding speed the temperature of welded plate decreased because of lower effect of preheating due to faster movement of the electrode [27].

3.3. Paremetric effects on mechanical properties

Gurjinder Singh In this paper, aluminum 6082 was preferred for Gas Tungsten arc welding. The different welding parameters were applied for analyzing the microstructure and hardness. The filler metal wire of 4043 was selected for this process. The samples that investigated were taken from the butt joints. It had been seen that by varying the alternating current the hardness value changes and showing maximum values of 98 *VHN* at low current. The results had shown that at 140 *Amperes* ultrafine grain structure was obtained and high tensile strength was observed.

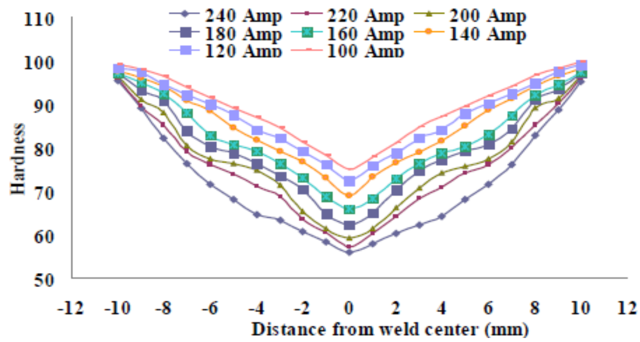

Figure 5: Microhardness profile effected by AC (100 – 240A) [28].

Figure 5 is representing the hardness value of the weld by applying different values of current. These values show decreasing trend when they moved from edge to center of weld [28].

M.Nagaaravindaraj in this investigation the mechanical properties and effects on strength of Aluminum alloy 7075 were examined. The different process parameters like current, welding speed and gas flow rate were applied and their effects were studied. Current directly influences the quality of weld, welding speed and the shape of the weld bead. If the welding speed is increased by keeping the voltage and current constant, that will reduce the heat input. The plates of 75*75 *mm* dimensions were taken and at 30^0 double V edge was prepared. It had been seen that at lower welding speeds maximum tensile strength was achieved. In aluminum alloy AA7075 case, tensile strength of 230 *Mpa* was observed at 0.6 *cm/sec* weld speed. Welding speed is also influenced by the gas flow rate which place an important role in the material tolerance. In figure 6 graphs showing the tensile strengths of different samples [29].

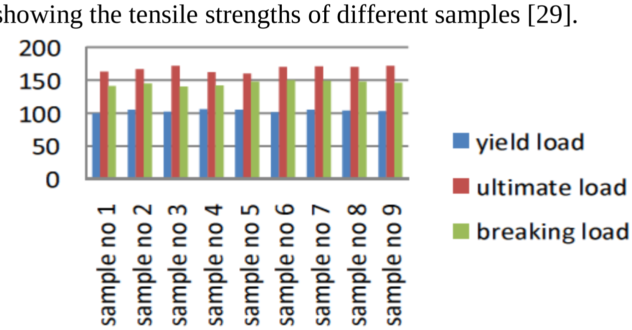

Figure 6: Effect of Tensile properties on differnet samples [29].

Prachya Peasura in this research article the influence of shielding gases, i.e. argon and helium on the microstructure and mechanical properties were investigated on aluminum alloy 5083 GTAW weldments. Different flow rates of shielding gases were used. The samples were 6*mm* thick and 50x50 *mm* in dimension. Alternating current and welding current of 100 *Amps* was used. Welding speed of 12 *mm/sec* was applied. Shielding gases (argon and helium) were selected and the flow rate varied from 6, 10 and 14 *liters/min*. Samples were taken from fusion zone and heat affected zone to examine the mechanical properties and microstructure. It had been observed that the argon flow rate is very effective to heat affected zone and fusion zone. The hardness value at HAZ 74.27 *HV* and 68.97 *HV* at FZ was detected with argon flow rate of 14 *liters/min*. The microstructure produced with the argon flow rate was ultrafine as compared to helium flow rate. Due to this the hardness value of the helium flow rate was lower [25].

Ahmed Khalid in this paper used aluminum AA6351 for investigating tensile properties of welded joints by varying the welding speed. Specimens were taken having a single V joint with different bevel angle and bevel heights. The base metal was having dimensions of 4x50x200*mm*. Aluminum 6063 was used as filler metal and a mixture of M21 (8% CO_2 and 82% Argon) was used as shielding gas. Welding speed was varied to 0.3, 0.6, 0.9 and 0.12 *cm/sec*. It had been seen that the max tensile strength of 230 *MPa* was achieved at 0.6 *cm/sec* welding speed. When the welding speed was lower, then tensile strength was higher. Bevel angles (30^0 and 45^0) were suitable for achieving high tensile strength. By reducing the heat input, strength of HAZ can be increased. Figure 7 shows graph of tensile strength at a welding speed of 0.6 *cm/sec* with different bevel angles [22].

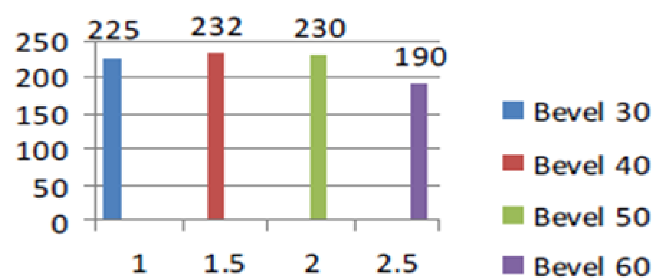

Figure 7: Tensile graph of different benel angle at 0.6 cm / sec welding speed [22].

Mayur.S in this article, the effect of welding current on TIG welded aluminum AA5083 was studied. Welding current parameters were varied to investigate the mechanical properties like hardness and weld strength. To characterize the microstructural properties, optical microscopy had been used. The plate's dimension 125x60x3*mm* was taken from aluminum AA5083 and the double V edge was prepared at an angle of 45^0. Filler metal AA5356 and pure argon as shielding gas were selected for this research. Welding currents, i.e. 70*A*, 75*A* and 80*A* were adopted. At 75*A* maximum *UTS* was observed. Due to presence of finer grains of silicon, tensile strength was increased almost 37% at 75*A* welding current. Table 1 represents the value of *UTS* of weld at 70*A*, 75*A* and 80*A* [26].

Table 1: Tensile Properties on different current [26].

Current *A*	Ultimate Tensile Strength (N/mm^2)	Elongation (on 25mm gauge length) %
80	112.1	2.8
75	150.4	2.7
70	109.6	2.7

Sanjeev kumar in his research did an experimental investigation of GTAW process. Aluminum Plates of thickness 3*mm* were welded by using Pulsed Tungsten Inert Gas Welding process. Welding current in the range 48-112 *A* and gas flow rate 7 -15 *l/min* used. Shear strength of weld metal (73*MPa*) was observed, which less than the parent metal (85*MPa*) is. The analysis of micrograph of welded specimen it has been observed that, weld deposits shows co-axial dendritic micro-structure towards the fusion line and tensile fracture occur near to fusion line of weld deposit [30].

Indira Rani investigated the mechanical properties of the weldments of AA6351 using the TIG welding process with pulsed and non-pulsed current at variable frequencies Welding by using with current (70-74)*A*, arc travel speed (700-760)*mm/min*, and pulse frequency (3 - 7)*Hz*. The experimental results showed that the tensile strength and Yield Strength of the weldments is near to a base metal. Location of weldments failures occurred at HAZ hence it is concluded the strength of weld joint [31].

3.4. Parametric effects on microstructures

Gurjinder Singh in this research TIG welding was employed on aluminum 6082. Different parameters were selected and samples were extracted from suitable portions, polished and then etched by using Keller's reagent. Microstructure of each sample taken from different current inputs was analyzed by using Optical microscopy. It had been observed that heat input directly influence on the dendritic formation in the weld metal as shown in figure 8. If heat input is large then cooling rate will be slow and there is enough time for the dendrite formation otherwise vice versa [28].

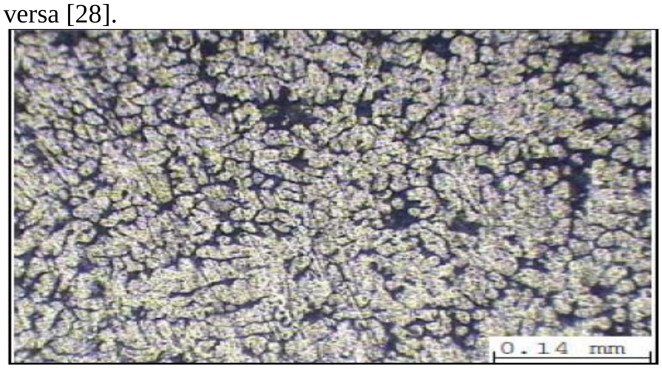

Figure 8: microstructure of weld metal at 140A [28].

Prachya Peasura studied the effect of shielding gases (argon and helium) on the microstructure of TIG welded aluminum 5083 plates. Samples were extracted from different zones and were analyzed by using Optical microscopy. It had been found that helium affects more than argon due to its high thermal conductivity which produces heat lose. Due to this the grain size became coarse and the hardness of weldments was decreased as shown in figure 9a and 9b. Besides coarse grain formation, Mg2Al3 precipitate also formed on grain sites. So these both factors effect on the hardness of welded sample [25].

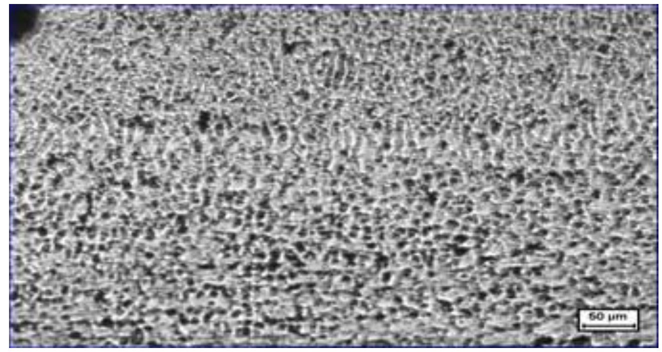

Figure 9a: Heat Affected zone microstructure using argon at 14 L/min flow rate [25].

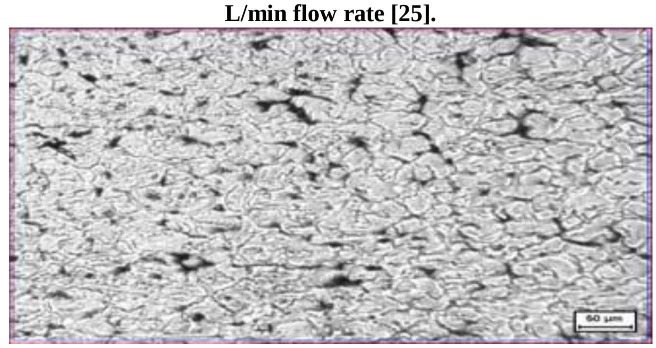

Figure 9b: Heat Affected Zone microstructure using Helium at 6 L/min flow rate [25].

Mayur.S investigated the effect of welding current on the microstructure of TIG welded aluminum AA-5083 plates. Specimens were extracted from different portions and examined under microscopy. Microstructure analysis had shown in figure 10 that α and β dendrites also increased the hardness of weldments. So the blend of elements like Si, Mg etc. enhances the mechanical properties and microstructural characteristics [26].

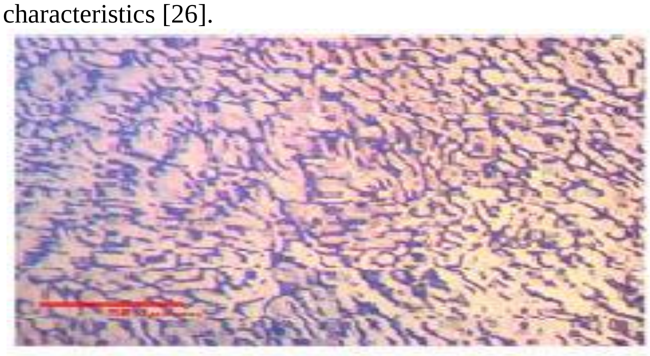

Figure 10: Microstructure of weld zone at 75A [26].

A.F. Norman studied the microstructures by using autogenous TIG welded Al-Mg-Cu- Mn alloy for a different range of welding parameters. Welding current in the range 100-190 *A* and welding speed 420-1500 *mm/min*. The fine microstructure was investigated at the center of the weld because of the higher cooling rate at the center of weld respect to the fusion boundary. It was also observed that if the welding speed increases, the cooling rate at the center of the weld also increases, which will produced a small size dendrite structure [32].

3.5. Parametric effects on corrosion mechanism

G. Venkatasubramanian investigated the general corrosion behavior of aluminum alloy AA2219 – T8 condition Gas tungsten arc welded by ER2319 filler wire. In this study, author focused on characterization of BM, WZ and HAZ by Potentiodynamic polarization and EIS techniques. Potentiodynamic polarization test was conducted by following ASTM G3 – 89 in Chennai electrolyte, standard calomel electrode and curve was obtained by stepping scan rate of 0.5 *mV / sec* from –250 *mV* (SCE) to +250 *mV* vs (SCE). In sea water by using a potentiostat coupled to a frequency response analyzer system the (EIS) electrochemical impedance spectroscopy was carried out in the frequency range 100 *k Hz*. to 100 *m Hz*. Electrochemical evaluation in a current study revealed that HAZ is more prone to corrosion than BM and WZ and is evident in figure 11 that the presence of main alloying element copper and second phase intermetallic particles $CuAl_2$ caused predominance of cathodic Tafel slope.

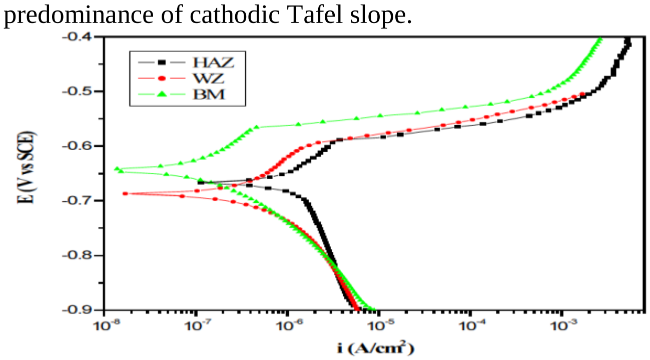

Figure 11: Polarization curves (Anodic and cathodic) for Aluminum Alloy 2219-T87 in seawater [33].

EIS measurement also proved that more corrosion resistance of the base metal is due to the presence of homogeneous $CuAl_2$ intermetallic compound distribution. Moreover, in figure 12 clearly shows the segregation of $CuAl_2$ intermetallic compound along the grain boundries [33].

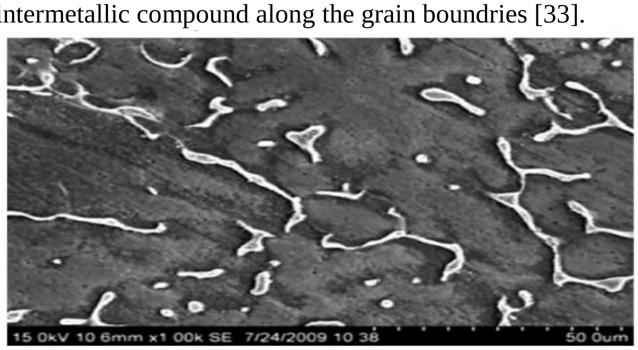

Figure 12: SEM image of Heat Affected Zone [33].

N. Ramanaiah discussed the corrosion behavior of Gas tungsten Arc welded aluminum alloy AA6061 6*mm* thick plate in T6 tempers condition. Mainly focused of this study was on the fusion zone produced as a result of gas tungsten arc welding techniques such as pulsed current, continuous current and role of different refining agents (scandium, zirconium and Tibor) in the filler. Characterization of pitting corrosion was carried out by Potentiodynamic polarization testing by SCE and carbon as reference electrodes, in 3.5 NaCl solution, pH adjusted to 10 and potential scan at 0.166 $mV\ s^{-1}$ with an initial potential of 20.25*V*. This investigation reveals that the composition of the filler metal effect the pitting potential of fusion zone and was found in rage of (690 -580) *mV*. It was also found that the pit density with Zr addition were high as compared to Tibor. Highest pitting corrosion resistance was found with 0.5%*Sc* containing AA5356 filler material and containing 0.5%*Sc* was used in pulsed arc GTA welding. Moreover AA6061 were more prone to pitting corrosion when welded by continuous current as compared to pulsed current [34].

Mussa Abdul RahimKhudadad studied the effects of sea water (at different velocities) on corrosion behavior of Aluminum alloy 6061 – T6 condition. The (100x50x4) *mm* plate was gas tungsten arc welded using ER4030 as a filler metal and argon as a shielding gas. Welding speed of 20 *mm/min*, gas flow rate of 20 *L/min*, Filler rot diameter of 1.2 *mm*, welding current of 180 *Amperes*, and voltage of 20 *Volts* were other welding parameters. The results of potential static polarization measurements in seawater 3.5%*NaCl* at a temperature of 25°C, and different velocity (1, 2, and 3) *m/min* were illustrated in table 2.

Table 2: Rate of corrosion of different samples

Sample ID	Temp in ^0C	Velocity in *m/min*	E*corr* [*mV*]	I*corr* [$\mu A/cm^2$]	Corrosion Rate (*Mpy*) = 0.43 I*corr*
A	25 ^{0}C	1	-636.5	105.32	45.28
	25 ^{0}C	2	-720.9	89.74	38.58
	25 ^{0}C	3	-709.6	58.7	25.2
B	25 ^{0}C	1	-768.9	18.99	8.615
	25 ^{0}C	2	-773.6	16.86	7.25
	25 ^{0}C	3	-758.1	10.29	4.42

A = samples without welding
B = samples gas tungsten arc welded.

In this study corrosion rate was calculated by the following relationship.

C.R (*m.p.y*) = 0.13 x *Icorr* x eq.wt / *ρ*(10)

Where

m.p.y = Mille – inch per year

Icorr = Corrosion rate density

E.W = equivalent weight of the corroding metal = 27/3

ρ = Density of corroding metal in g/cm^3 =2.7

The polarization curves of base metal and weld metal shown in figure 13a and 13b showed that the weld metal had greater corrosion potential as compared to base metal. It is due to high silicon in the weldments had the tendency to increase dissolution potential.

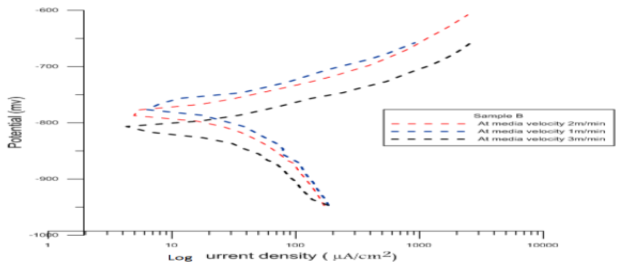

Figure 13a: Electrochemical Behavior for specimens A at different velocity [35].

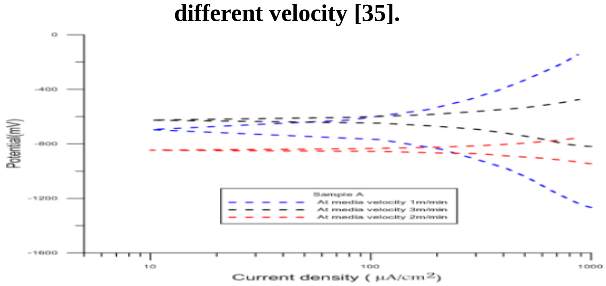

Figure 13b: Electrochemical Behavior for specimens B at different velocity [35].

Likewise this investigation concluded that with controlling filler material corrosion rate can be controlled and increasing in media velocity decreased corrosion rate [35].

4. CONCLUSIONS

From literature survey GTAW process parameters like Arc voltage, welding current, shielding gas, gas flow rate, bevel angel, plate thickness and heat input plays an important role on the Quality of aluminum alloy weldments.

The influence of varying welding parameters specially welding current and voltage on the amount of heat dissipation on HAZ and WZ therefore effect microstructure, weld bead geometry and metal deposition rate. Increasing the heat input influence both the size of HAZ and precipitates hence growth of precipitates is a reason of low strength. Moreover, it is also evident that the shielding gas and gas flow rate effects the mechanical properties, microstructure of HAZ and fusion zone.

It has been seen that by varying AC, hardness value changes and it is maximum when low ampere current is applied in TIG welding. Similarly welding current plays important role in tensile strength value of the weld material. The experimental trend shows that UTS is also maximum when welding speed is lower. The gas flow rate of shielding gases has strong influence in determining the mechanical and structural properties of weld metal.

The results showed Electrochemical behavior of HAZ is more prominent to corrosion than WZ and BM. The higher rate of corrosion of HAZ in seawater is due to copper rich intermetallic particles dissolution followed by redeposit ion of copper. The presence of copper in a matrix and micro pores is responsible for the higher rate corrosion in Weld Zone if compared to BM. The corrosion may also major impact at the heat affected zone which may weaken the microstructure.

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