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Review TMET

Experimental Investigation of Weld Strength in Pulsed Current TIG Welding of AA 5052 Alloys–A Technical Review

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Abstract

TIG welding, also known as Gas Tungsten Arc Welding, is a method in which metal parts are welded together using heat or pressure. Inert gas is used to cover the electrodes and weld pools pulsed current TIG welding is the modern method of Tungsten Inert Gas welding method. It alternates between high and low level ampere. Here as we increases the current, the weld strength and the power output are also good. Pulsed current TIG welding is good for the aluminium alloys. Pulse welding is a type of welding in which the current is pulsed. It is a variation of the regular welding technique. High alloys such as stainless steel, aluminum, and magnesium alloys should be used to make high-quality welding connections. Pulsed TIG welding is typically regarded as the most complex of all the welding methods used in industry. In 1825, the aluminium metal was conceived and produced. This research is based on the 5052 aluminium alloy which is one of nine types of aluminium alloys. 5052 alloys are used in applications such as inter coolers, oil coolers, and radiators. Light weight alloys like aluminium are good for ships as it is good corrosion resistance. Aluminium alloy 5052 is also used in railroad cars applications because of its light weight. Because the welder must keep the arc length small, extreme caution and expertise are required to avoid electrode contact with the workpiece. Pulse TIG welding is often used to join thin sections of stainless steel, non-ferrous metals like aluminium, magnesium, and copper alloys. When compared to SPM (Special Purpose Machines) on the market, the cost of creating automated TIG is determined to be minimal.

Keywords: Pulsed TIG, AA 5052-H32, Base current, Peak current, Frequency, Tensile strength, Hardness

INTRODUCTION TO MATERIAL

Aluminum

A metal called aluminum (Al) was first proposed by Sir Humphrey Davy in the first decade of the nineteenth century, and the metal was isolated by Hans Christian Oersted in 1825. For the next 30 years, it remained a laboratory curiosity until limited commercial production began in 1886, when the extraction of aluminum from its mineral, bauxite, became a fully practical industrial process. The extraction method was developed simultaneously by Charles M. Hall and Paul Heroult in France, and the underlying process continues to be used today. Aluminum is not found in its metallic state in nature due to its reactive nature, but it is found in the earth's crust in many forms [1].

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Aluminum Alloy Grades

There are eight different sorts of aluminum alloy grade series, which are as follows:

1000 series: pure aluminum, 2000 series: copper as the main alloying element, 3000 series: manganese as the main alloying element, 4000 series: silicon as the main alloying element, 5000 series: magnesium as the main alloying element, 6000 series: silicon and magnesium as the main alloying element, 7000 series: zinc and magnesium as the main alloying element, 8000 series: lithium (tin) as the main alloying element [1].

Base Metal

5052 Al-alloy was chosen as the experimental material as shown in the Table 1, 2, 3.

Table 1. Chemical Compositions of 5052 Aluminum Alloy [1]

Material	Mg	Mn	Cr	Fe	Si	Cu	Zn	Al
5052	2.4	0.06	0.17	0.2	0.12	0.08	0.08	margin

Table 2. AA 5052 Mechanical Properties [1]

Mechanical Property	Value
Tensile strength	210–260 MPa
Proof Stress	130 Min MPa
Hardness Brinell	61 HB

Table 3. AA 5052 Physical Properties [1]

Physical Property	Value
Density	2.68 g/cm^3
Melting Point	605 ℃
Thermal Expansion	23.7*10^-6/K
Modulus Of Elasticity	70 GPA
Thermal Conductivity	138 W/m.K
Electrical Resistivity	0.0495*10^-6 Ω.m

INTRODUCTION TO PROCESS

Welding

Welding is primarily used for combining metal parts and is necessary when bigger lengths of standard sections are required or when numerous pieces must be put together to produce the desired structure. Welding is a method of combining metals and plastics that do not require the use of fasteners or adhesives [2].

Metal components are welded with or without heat, pressure, and filler metal, using welding as the method of joining them [2].

Weldability

Weldability is defined as the ability to be welded into inseparable joints with specified features such as determined weld strength and proper structural integrity [3].

Any metal's weldability is determined by five primary factors:

- Thermodynamic conductivity, melting point Thermodynamic expansion the state of the surface The microstructure of the organism changes [3].
- Weldability is defined by the American Welding Society as,
- The ability of a metal to be welded into a specific, adequately planned structure under the fabrication circumstances imposed and to function satisfactorily in the intended service [3].

TUNGSTEN INERT GAS WELDING

Tungsten inert gas welding is often known as gas welding. Tungsten arc welding gets its name from the fact that it uses a tungsten electrode and an inert gas to shield the weld pool from atmospheric gases, this is particularly crucial when welding high-strength reactive metals and alloys such as stainless steel, aluminium, and magnesium alloys, as well as when high-quality weld joints are required for critical applications such as nuclear reactors and aircraft. Because none of the previous techniques (SMAW and Gas welding) could successfully weld these reactive metals at the time, the introduction of this technology in the mid-twentieth century gave a huge boost to fabricators of these reactive metals. mostly because of two drawbacks: a) contamination of welds by atmospheric gases and b) weld strength. Furthermore, by solving the issues associated with Al_2O_3, halide flux coated electrodes can be used to weld aluminium and its alloys with shielded metal arc welding. However, because halides are highly corrosive, welding of aluminium is best done in inert shielding conditions utilising procedures like GTAW and GMAW. Despite all of the advancements in welding technology, the TIG technique is still the preferred method for attaching thin aluminum sheets with a thickness of less than 1 mm [1]. Figure 1 shows the TIG welding machine.

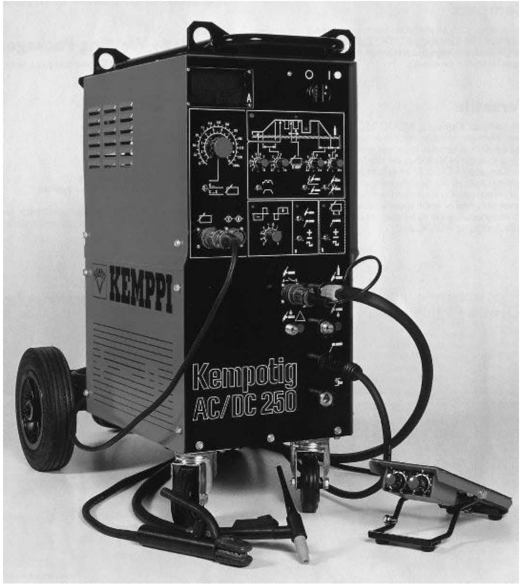

Figure 1. TIG welding machine [1].

Development

TIG welding was invented by Russell Meredith, a welder at Northrop Aircraft Corporation in Southern California, in the 1940s. Because the methods at the time were insufficient for welding on aluminium and magnesium alloys, he invented the process. It was a huge success, allowing American industry to manufacture ships, planes, and other things at a rate never seen before in human history. President Roosevelt boasts about the procedure in a letter to Winston Churchill. The Linde Division of Union Carbide obtained the patent on the process, and the business developed and sold numerous torches, parts, and consumables for the technology until their patents on the process and TIG-related products expired in the 1960s and 1970s. Helium was utilized in Linde torches [3].

Pulsed Current TIG Welding Process

In the pulsed-current mode, the welding current cycles rapidly between two levels. The bigger current level is referred to as pulse current, whereas the lower current level is referred to as background current. During the pulse current phase, the weld site is heated, and fusion takes place. After reducing the current to the background, the weld zone is allowed to cool and solidify. Current that is pulsed TIG welding has a number of advantages, including lower heat input, which reduces distortion and warpage in thin-walled components. It can also improve weld penetration, welding speed, and quality by allowing for improved weld pool control [3].

Development of Pulsed Current TIG Welding Process

Pulsed current tungsten inert gas (PC TIG) welding is a type of TIG welding that involves cycling the welding current from a high to a low level at a specified frequency. It was developed in the 1950s. The high peak current is typically used to ensure correct penetration and bead contour, while the low background current is used to keep the arc stable [3].

Pulsed Current TIG Welding Process Parameters

Welding Current, Welding Voltage, Inert Gases, Welding speed, Pre-Heat Treatment, Post Weld Heat Treatment, Included Angle [3].

LITERATURE SURVEY

Gou, W., & Wang, L. (2020, February) [4], the microstructure, mechanical properties, and corrosion resistance of welded joints obtained under various currents ranging from 100 to 120 A were investigated, and the microstructure, mechanical properties, and corrosion resistance of welded joints obtained under various currents ranging from 100 to 120 A were discussed. The results showed that when the welding current is 100120 A, the strength of the welded connection (made of 5052 aluminium alloy TIG) rises while the plasticity decreases.

Yelamasetti, B., & Vardhan, V. (2021) [5], **t**he weldability and mechanical behaviour of bimetallic welds made from AA5052 and AA7075 using the gas tungsten arc welding technique were investigated. To link the different metals, two filler wires, ER4043 and ER5356, were used. Both filler weldments employed the same process parameters and welding circumstances. The weldability of dissimilar joints with the fusion welding technique was confirmed through non-destructive testing. To evaluate the weld qualities, mechanical tests such as tension, hardness, and impact were performed according to ASTM standards. Weldments made using ER4043 filler have a UTS of 182 MPa, indicating exceptional quality. It was discovered that the welds of ER 4043 had a higher impact strength of 62 J, whereas the welds of ER 5356 had a toughness value of 24 J. When ER5356 filler was used, the weld zone became microporous and voids appeared.

Chandra, K., & Kain, V. (2013) [6], explains the failure study of an aluminium alloy 5052 "tray piece" utilised as a specimen holder in a research reactor. Before it was put into operation, the centre rod of alloy 5052 was found to have a fracture. At the point where the rod was welded to the stopper plate, the fracture occurred in a brittle mode with no excessive plastic deformation. The microstructure was studied using optical and scanning electron microscopy. The weld fusion zone, particularly along the inter-dendritic zones, has high porosity and eutectic phases. During the solidification of these low melting temperature eutectics, which were rich in Si and Fe, weld cracking occurred along the dendritic grains.Welding using pure aluminium filler wire changed the composition of the welds, resulting in a peak cracking sensitivity of 1.5 wt% Mg, which caused solidification cracking of alloy 5052. Welding flaws, such as high porosity and solidification cracks, were found to be the cause of the tray section's failure. There are various suggestions for avoiding this type of failure.

Vykunta Rao, M., Rao, P.S., & Babu, B.S. (2019) [7], studied Vibratory welding can be used to eliminate residual stresses in non-thermal applications. During vibratory welding, the specimen is subjected to a mechanical mode of vibration. This study looks at the impact of mechanical vibrations (voltage input to the Vibro motor) on the toughness of aluminium alloy weldments. Vibratory Tungsten inert gas welding is used to connect alloy weldments. The hardness values of aluminium alloy weldments are examined for various vibrator voltage inputs while maintaining other parameters constant, such as gas flow rate, welding speed, weld current, and specimen vibration time. As the voltage provided to the Vibro motor grows from 50 V to 160 V, the hardness of aluminium alloy weldments increases. When the voltage supplied to the Vibro motor is greater than 160V, the hardness of an aluminium alloy weldment is also reduced.

Yoshie, S., & Hiraishi, E. (1995) [8], with the rising demand for aluminium, hardfacing techniques for aluminium goods have received a lot of attention. Even this research reveals that current aluminium hardfacing procedures are insufficient. As a result, more appropriate procedures will be required in the future, and it is regarded to be critical to design materials that match the needs of users.

Cho, J., Lee, J.J., & Bae, S.H. (2015) [9], studied The effect of direct current electrode positive (DCEP) duty ratio in variable polarity (VP) arc welding of aluminium was investigated in this study. VP arc uses alternate current (AC) of DCEP and direct current electrode negative (DCEN) as PowerSource, and the duty ratio represents the polarity's durational part of the current pulse. Although there was some fluctuation due to an increase in arc instability caused by the tungsten electrode tip wearing out, the experimental results show a proportional link between heat input and DCEP duty ratio. This observation contradicts the traditional arc theory of anode heating, prompting the development of a novel theoretical approach combining the tunnelling effect and the random walk of the cathode spot. During the DCEP period, the arc is concentrated on a thinner oxide cathode spot, melting and breaking the spot's oxide layer. This procedure is repeated at a high frequency at another cathode location. As a result, the greater the DECP duty ratio, the more cathode spots are formed, and the arc concentration time is lengthened. As a result, the heat input was larger with a longer DCEP polarity length. The proposed mechanism, which combines the tunnelling effect and the random walk of the cathode point, can explain not only the atypical results of this investigation, but also the equivocal results of prior studies with deeper penetration through thicker oxide.

Hinata, T., Yasuda, K., & Igawa, M. (1989) [10], studied the shape of the molten component at the electrode's tip and the arc's stability are closely related in balanced wave TIG arcs. The use of tungsten electrodes of high-emission-capacity oxides boosts arc concentration, however the effect varies depending on the kind and amount of oxide utilised. The following observations concerning the characteristics of individual electrodes can be made from the standpoint of practical use. Tungsten creates a stable arc, but it lacks concentration unless the current is low. The arc state produced by 0.2 percent zirconiated tungsten is identical to that produced by pure tungsten, but the concentration improves. As the amount of additive is increased, the fluidity of the molten portion rises, and fluctuations in the arc develop over time. When the arc is constant under current conditions, the molten component's fluidity rises, and the arc is prone to inclination due to the formation of protuberances. Witcreated tungsten and lanthanideed tungsten produce a rather stable arc, but at high welding currents, concentration suffers. The arc with striated tungsten, which has a significant electron emission capability, lacks stability for a period after startup under low current settings, but the degree of inclination is minor, and the original shape of the electrode tip is well preserved.

Awais, A. (2019) [11], GTAW lap connecting of Al5052 and Ti6Al4V with AlSi5 filler wire. 28. China Welding (2). The 5052 aluminium alloy (Al5052) was joined to Ti6Al4V titanium alloy using gas tungsten arc welding (GTAW) with AlSi5 filler wire (Ti6Al4V). According to microstructure study, the interfacial area of Al5052/Ti6Al4V generated a non-uniform persistent reaction layer, and the intermetallic compounds (IMCs) layer of Ti (Al, Si)3 phase formed with the partial substitution of aluminium by silicon.

Seong-Jong, K.I.M., Seok-Ki, J.A.N.G., Min-Su, H.A.N., Jae-Cheul, P.A.R.K., Jeong, J.Y., & Chong, S.O. (2013) [12], for the 5052-O Al alloy, which is primarily utilised in ships, the best corrosion protection potentials were investigated. An impressed current cathodic protection (ICCP) system was used to examine the surface morphologies of specimens to determine the optimum corrosion protection potential to overcome pitting, corrosion, stress corrosion cracking (SCC), and hydrogen embrittlement in sea water optimum protection potential range of 1.3 V to 0.7 V. Low current densities in the range of 1.3 V to 0.7 V have been found in electrochemical experiments, and favourable specimen surface morphologies were observed following the potentiostat experiment.

Xu, C., & Peng, C. (2020) [13], the TIG welding-brazing capabilities of 5052 Al alloy and Ti6Al4V alloy in butt configuration with Zn foil addition were examined with varying welding heat input. In terms of experimentation and analysis, the joint morphology, mechanical performance, microstructure, and j, opening mechanism were explored. The TIG welding-brazing procedure was effectively developed to combine 5052 Al and Ti6Al4V alloys, according to the findings. Low heat input resulted in a bulk of leftover Zn and a thin TiAl3 IMCs layer in the fusion and brazing zones, respectively. With the right amount of heat, both homogenous Zn atom diffusion and the production of a clubbed interfacial reaction layer helped to improve joint performance. Under a current of 90A, the optimal Al/Ti joint with a maximum joining strength of 192 MPa was produced. The fracture occurred along the Al/Ti interface in the weld seam zone, and the fracture morphology included typical dimples and ripping ridges.

Ye, Z., Huang, J., Gao, W., Zhang, Y., Cheng, Z., Chen, S., & Yang, J. (2017) [14], traditional techniques produce an Al/steel butt joint with an unstable weld appearance and unpredictable interfacial chemicals, which have a substantial impact on the final properties. The MIG-TIG double-sided arc welding-brazing (DSAWB) procedure was used to butt-join AA5052 aluminium alloy and Q235 low-carbon steel of 3.0 mm thickness in this investigation, there is no groove. The joints' microstructure and mechanical properties were compared to those of a typical metal inert gas (MIG) joint. Because of the DSAWB method's double-sided heating and gas shielding, good weld quality, particularly back appearance, was accomplished at a lower welding heat input than normal MIG. FeAl3 needles and Fe2Al5 lamellar Fe2Al5 were identified at the brazing interface. Due to the lower heat input, the maximum thickness of the Fe2Al5 was effectively limited to 2.03 m. When the optimal parameters were used in typical MIG, Massive FeAl3 and Fe2Al5 strata measuring 4.20 m thick with visible fractures have been observed. The DSAWB joints had an average tensile strength of 148.1 Mpa, which was 2.5 times that of standard MIG joints, thanks to the good weld appearance and effective management of the interfacial intermetallic compound.

Samiuddin, M., Li, J.L., Taimoor, M., Siddiqui, M.N., Siddiqui, S.U., & Xiong, J.T. (2021) [15], multi-pass TIG welding was performed on plates (15300180 mm^3) of the aluminium alloy Al-5083, which is extensively used as a component material in structural applications such as cryogenics and chemical processing. When TIG welding Al-5083 alloy, which is susceptible to welding heat input, the most typical faults are porosity creation and solidification cracking. In the experiment, the heat input was increased from 0.89 to 5 kJ/mm, which was determined by a combination of welding torch travel speed and welding current. To observe the impetus response of heat input on the mechanical characteristics of the joints, tensile, micro-Vicker hardness, and Charpy impact tests were performed. Radiogra The radiography was taken to evaluate the quality of the joint and any welding flaws. All of the examples had lower mechanical qualities than the basic alloy, according to the data. It was discovered that as the heat input was increased, porosity was gradually reduced. The findings also proved that using a medium heat input (1 to 2 kJ/mm) provided the optimum mechanical qualities by eliminating welding flaws, with only about 18.26% of your strength has been lost. All of the welded specimens that gained strength had the same yield strength, demonstrating that heat had no effect. Heat input also has an effect on the diameter of the partially melted zone (PMZ), which enlarged as the heat input increased. PMZ grains are coarser than those in the fusion zone. Charpy impact tests indicated that low heat input specimens (welded at high speed) absorbed more energy than high heat input specimens (due to reduced porosity and the production of equiaxed grains, which improve impact toughness) (welded at low speed). Impact testing in a cryogenic environment (-196°C) was also carried out, with the results confirming that impact properties under the cryogenic environment showed no perceptible change after welding at the specified heat input. Finally, stereo and scanning electron microscopy (SEM) were used to examine macro and micro broken surfaces of tensile and impact specimens, which confirmed the experimental findings.

Chen, W.B. (2016) [16], for attaching 5052 Al alloy to Ti–6Al–4V alloy in a butt configuration, a tungsten inert gas welding–brazing procedure with Al-based filler metal has been devised. The findings revealed that heat altered the form and thickness of the interfacial reaction layer of Al/Ti joints, which had a significant impact on the weldment's mechanical properties. With an optimised tungsten electrode offset D of 1.0 mm from the Al/Ti initial interface to the Al side and a welding current of 70 A, thin cellular-shaped and club-shaped TiAl3 reaction layers formed in the brazing zone, which helped to suppress crack initiation and propagation during the tensile test. The improved Al/Ti joint eventually ruptured at the Al alloy base plate, achieving a maximum tensile strength of 183 MPa. Furthermore, the power density characterization and Al/Ti joint joining process were studied.

Yelamasetti, B., & Vardhan, V. (2021) [17], using the Gaia tungsten arc welding method with ER4043 filler, the weld joints of AA5052 and AA6061 were created in this research. We looked at process characteristics including welding current and root gap, as well as output aspects like ultimate tensile strength, hardness, and impact toughness. The experiments were designed using the FullfacFull factorial method. The ar fit approach was used to create regression models for each output response line. Analyzing the effect of specific parameters on output responses was also done using analysis of variance. When the welding current is 210 A and the root gap is 1 mm, the tensile strength is 393 MPa and the impact strength is 59 J. For these dissimilar welded junctions, the welding current and root gap are the most important characteristics to consider.

Parthasarathy, M.C., & Sathyaseelan, M.D. (2015) [18], study More typically utilised in homebuilt aircraft than commercial or military aircraft, aluminium 6061 alloy is commonly used for aeroplane structures such as wings and fuselages. Because of its advantageous qualities such as light weight, corrosion resistance, high strength to weight ratio, low cost, and so on, AA 6061-T6 aluminium alloy is widely used. For quality welding of aluminium alloys in large structures, pulsed current gas tungsten arc welding (PCGTAW) is commonly utilised. The effect of altering the base current on microstructural and microhardness production is explored in order to determine the heat input. Because of the greater hardness and fine microstructure of the PCGTAW joint, it was discovered that it had superior tensile characteristics and impact strength.

Sarmast, A., & Serajzadeh, S. (2019) [19], In GTA welding of AA5052, the influence of welding current and polarity, i.e. AC and DCEN, on imposed thermal cycles, mechanical characteristics, microstructural events, and residue was studied. Thermal reactions and residual stress distribution in the weldments were evaluated using a three-dimensional thermo-mechanical model. To investigate the impact of welding polarity on component mechanical qualities, tensile testing and hardness measurements were carried out. Optical microscopy was employed to make microstructural observations in order to analyse the microstructural evolutions. The results reveal that the CEN samples produce a wide range of microstructures, from cells at the fusion boundary to equiaxed dendrites at the centre line. The generated microstructure in the AC-welded sample, on the other hand, shifts from columnar dendritic at the fusion line to equiaxed dendritic at the centerline. These microstructural alterations, however, have no effect on the weld metal's mechanical properties. Furthermore, in the AC sample, greater temperature contours resulted in a wider heat-affected zone, 9.5 vs. 6.4 mm, and larger longitudinal tensile residual stresses in the sample welded under DCEN polarity.

Zhou, Z.J., & Huang, Z.C. (2014) [20], on 5052 aluminium alloy, AC A-TIG welding was examined. To investigate the influence on weld penetration and formation, single angle-component oxides O_2, SiO_2, Cr_2O_3, V_2O_5 and halide CaF_2 were used as activating fluxes. The results of the trials show that weld penetration and welding productivity can both be enhanced when using A-TIG welding. Activating fluxes, particularly TiO_2 and SiO_2, have a greater impact on weld penetration than conventional TIG welding; also, the better the weld shape produced after coating activating flux is obtained, the narrower the weld width becomes, reducing the HAZ of A-TIG welding.

Rao, M.V., Rao, P.S., & Babu, B.S. (2016) [21], this study looks at the influence of vibratory Tungsten inert gas welding on the hardness of aluminium 5052-H32 alloy weldments. Statistical

Methods/Analysis: Other parameters such as welding current, welding speed, and gas flow rate remain constant while the hardness of Al5052-H32 is examined for various voltage inputs. Findings: The hardness values of specimens made with and without vibrations are compared.The hardness of Al5052-H32 specimens prepared at 160 V input voltage is higher than specimens prepared at 70 V, 230 V, and without vibration.

Shrivas, S.P., Vaidya, S.K., Khandelwal, A.K., & Vishvakarma, A.K. (2020) [22], among the many welding processes, tungsten inert gas (TIG) welding is used to weld mild steel or thin parts of non-ferrous metals such as copper alloys, aluminium alloys, magnesium, and stainless steel. TIG welding has a number of advantages when it comes to combining different metals, such as avoiding slag, reducing the affected zone, and so on. Because input characteristics play a big role in determining the quality of a welded specimen. To design the experiment, obtain the data, and optimise the strength of variation in welding parameters, a plan of experiments based on the L9 orthogon nal array was adopted. Finally, tests were conducted to determine the best process parameters for the en aluminium alloy, with experimental results proving the efficiency of SEM in strength analysis.

Shim, J.Y., Kang, B.Y., & Kim, I.S. (2017) [23], among the several welding procedures, tungsten inert gas (TIG) welding is used to weld mild steel or thin sections of non-ferrous metals such as copper alloys, aluminium alloys, magnesium, and others, excluding steel. Because input parameters play a key part in defining the quality of a welded specimen, TIG welding has a number of advantages when it comes to combining dissimilar metals, such as slag avoidance, minimising the affected zone, and so on. To design the experiment, obtain the data, and maximise the file strength of variation in welding parameters, a plan of experiments based on the L9 orthogonal array was adopted. Finally, tests were conducted to determine the best process parameters for a certain aluminium alloy, with experimental results proving the efficiency of SEM in strength analysis.

Ravendra, A. (2014) [24], the goal of this study is to see how the process parameters of Gas Tungsten Arc Welding affect the depth of penetration of a specific specimen. TIG welding parameters' effects on the weldability of 5052 aluminium alloy specimens with dda dimensions of 100mm long x 50 mm wide x 2.5mm thick are studied in this study. The depth of penetration measured after welding is influenced by welding parameters such as arc voltage, welding current, welding speed, gas flow rate, and heat input.

Raveendra, A., & Kumar, B.R. [25], aluminum alloy (5052) weldments were created utilizing Gas Tungsten Arc Welding with pulsed current pulsed- pulsed current at varied frequencies 2 Hz, 4 Hz, and 6 Hz in this experimental work. Non-destructive testing such as radiography and liquid penetrate tests were performed, assessed, and compared to pulsed and non-pulsed current welding at various frequencies on two distinct thick materials (1.5 mm and 2.5 mm aluminum alloy). The goal of this experiment is to see how pulsed current affects the quality of weldments. The experimental findings for different welding parameters utilizing pulsed and non-pulsed current GTAW for the aforesaid material are described and compared.

Hasanniah, A., & Movahedi, M. (2019) [26], cold roll bonding was used to create Al-1050 clad St-12 sheets with clad layer thicknesses of 350 and 1000 m. Using gas tungsten arc welding, the Al-5052 aluminium alloy and Al-1050/St-12 sheets were lapped and bonded with AleSAlesiler metal. The impact of clad layer thickness and welding current on joint characteristics were investigated. For macro/microstructural research, optical and scanning electron microscopes (SEM) equipped with energy dispersive spectroscopy were used (EDS). Shear-tensile and microhardness tests were used to assess the joint's mechanical behaviour. According to the findings, adding an aluminum-clad layer reduced the AleFe intermetallic thickness at the steel/weld seam or steel/Al1050 clad layer interface to less than 4 m. Fractures in all joints began at the weld's root and extended throughout the weld metal during the shear-tensile test, mostly due to AAlesieutectics. At both 350 and 1000 m clad layer thicknesses, increasing the welding current reduced the joint's shear-tensile strength almost linearly. The thickness of the aluminum-clad layer had a considerable impact on the shear-tensile strength of the joints, however.Due to the broader melted zone in the Al-1050 clad layer, the joint strength was higher for the thinner Al-1050 clad layer at a constant welding current. The joint's maximum shear tensile strength was 197 MPa (80 percent of the Al-5052-H34 base metal's tensile strength).

Ohkubo, M., Tokisue, H., & Kinoshima, K. (1995) [27], the weldability of dissimilar junctions between Al-Mg group wrought alloy A5052 and Al-Si-Mg group alloy casting AC4C was examined using the electron beam welding procedure. The properties of dissimilar junctions welded by high-energy-density welding methods like laser welding and plasma arc welding were also investigated. The following is a summary of the findings:1). When compared to joints between aluminium wrought alloy A5052 and aluminium casting AC4C-F, dissimilar electron beam welded joints between A5052 and AC4C-T6 had enhanced tensile and impact properties. 2). Deep penetration cannot be achieved using laser welding, and porosities are a common occurrence. On the other hand, more research into the use of plasma arc welding is required. 3). Using circular notched tensile test specimens and impact test specimens with varying notch positions, local mechanical properties of dissimilar welds between aluminium wrought alloy and aluminium casting alloy were assessed.

Ye, Z., Huang, J., Cheng, Z., Xie, L., Zhang, Y., Chen, S., & Yang, J. (2018) [28], MIG-TIG double-sided arc welding-brazing (DSAWB) was introduced to join 5052 aluminium alloy and Q235 mild steel of 3 mm thickness without groove. When TIG current was raised, differences in weld appearance, interfacial intermetallic compounds (IMCs), and mechanical properties were investigated under the same MIG heat input. The identical heat input was used to compare the DSAWB and single-side MIG welding-brazing processes. The results showed that DSAWB may significantly improve the weld appearance, particularly the back weld appearance, because to the heat and gas shielding provided by TIG the source at the back. The weld appearance improved steadily before deteriorating as the TIG current was increased. The optimal DSAWB joint was achieved at a heat input of 858 J/cm, with a perfect t weld look and a crack-free IMC layer with an average thickness of 3.1 m. Under the same welding heat input, the single-side MIG welding-brazing technique was unable to obtain back weld appearance, and the IMC layer was thicker near the top of the weld, indicating that the DSAWB procedure lowered the welding heat input necessary for the sound junction. The ideal joints obtained by the DSAWB technique had an average sale strength of 148.1 MPa, whereas the single-side MIG joint shattered after welding.

Yelamasetti, B., Kumar, D., & Saxena, K.K. (2021) [29], the dissimilar metals of AA5052 and AA7075 were connected utilising a gas tungsten arc welding technique with ER4043 as a filler metal in this study. Using infrared thermography, the temperature distribution over the weld surface was measured during welding. Residual stresses were assessed in each welding pass on distinct weld zones using the X-ray diffraction technique. Pass-1, pass-2 a, and pass-3 each had a peak temperature of 712, 789, and 816°C, according to thermography studies. The HAZ of AA5052 recorded higher temperature values than the HAZ of AA7075. Pass-1, 2, and 3 had peak residual stress of 66, 28, and 45 MPa, respectively. The HAZ of AA5052 has the lowest residual stresses compared to the HAZ of AA7075.

Pratik T. Kikani., & Dr. Hemantkumar R. Thakkar, (2020) [30], the goal of this study is to see how pulsed current TIG welding process parameters affect the tensile qualities of Alloy AA6061 T6 material. In order to accomplish complete penetration joints, the peak current, base current, and frequency were carefully chosen. The Taguchi method was used to develop the experimentation design, and statistical tools such as ANNOVA and regression technique were used to get optimised weld parameters. At 180 A Ip, 60 A Ib, and 6 Hz frequency, the tensile and yield characteristics improve to 185.55 Mpa and 156.62 Mpa, respectively. This is owing to the fact that equiaxed dendritic structures can be formed at higher Ip and f.

PROBLEM IDENTIFICATION

- Aluminum alloy AA 5052 is difficult to weld material.
- The weldability of aluminum alloys is poor.
- The strength of joints for cooling equipment is less.

OBJECTIVES

- To identify essential parameters and their theme for the PC TIG welding process.
- To determine how process parameters affect mechanical properties.
- To optimize the process parameters using statistical methods.
- To validate the optimized parameters.

CONCLUSIONS

The Objectives of the present work are to identify essential parameters and their range for the PC TIG welding process, to evaluate the effect of process parameters on mechanical properties, to optimize the process parameters using a statistical method, to validate the optimized parameters. For that, we have investigated different materials and different manufacturing processes and we have got aluminum 5052 alloys as our base metal and pulsed current TIG welding as our basic joining process to join the metals. From lots of research papers, we have found that the TIG welding process is the process that is used to optimize different mechanical properties on the weld strength of different aluminum alloys.

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