STUDY OF HAZ ANALYSIS IN TIG WELDING

[1]Bhupendra Kumar, [2]Prof. (Dr.) Ravish Kumar Srivastava
[1]M.Tech Student, [2]Professor
[1&2]Subharti Institute of Technology and Engineering, Meerut-250005

ABSTRACT

In order to evaluate the wealdability performance of TIG on stainless steel plate of no.

301 & 316 the calculated parameters of the weld pool demonstrate due to the more concentrated heat flux and higher flow velocity of the constricted arc the pressure on the surface of melted steel is increased. Also the convective and conductive components of the power flux from the arc to the work piece are larger. As the result, the weld pool is deeper and, at the same time, the HAZ is much smaller in case of the constricted are. The simulation model is found to be in good agreement with experimental results for the arc temperature and enable to calculate optimal parameters of constricted arc welding result as predicted in simulated results. Therefore, it can be used to form technical demands for the control of the heat flux depending on the welded material and it's thickness. It supports increasing quality and predictability of the welding seams. The modification of the model, described in the simulation method, provides more accurate precise result.

INTRORUCTION

TIG attachment may be a method of arc attachment that uses a non-consumable atomic number 74 conductor to create the weld. The weld space is protected against atmosphere by Associate in Nursing inert shielding gas (argon or helium), and a filler metal is employed usually. the ability is equipped from the ability supply (rectifier), through a hand-piece or attachment torch and is delivered to a atomic number 74 conductor that is fitted into the hand piece. an electrical arc is then created between the atomic number 74 conductor and therefore the work piece employing a constant-current attachment power offer that produces energy and conducted across the arc through a column of extremely ionising gas and metal vapours. The atomic number 74 conductor and therefore the attachment zone square measure protected against the encompassing air by argonon the electrical arc will manufacture temperatures of up to twenty,000oC and this heat may be centered to soften and be a part of 2 totally different a part of material. The weld pool may be wont to be a part of the bottom metal with or while not filler material. Schematic diagram of TIG attachment and mechanism of TIG attachment square measure shown in fig. 1 & fig. two severally. Fig 1: Schematic Diagram of TIG attachment System. [Ref: 1] Fig. 2: Principle of TIG attachment. [Ref: 1]

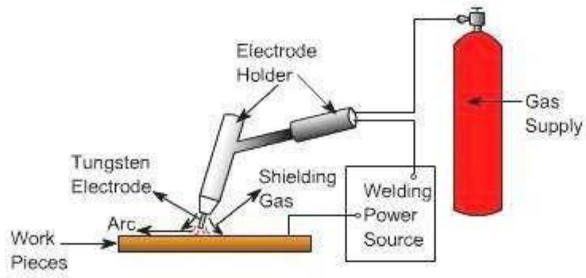

Fig. 1.0

Tungsten electrodes square measure ordinarily offered from zero. 5mm to 6.4 millimetre diameter and one hundred fifty -200 millimetre length. this carrying capability of every size of conductor depends on whether or not it's connected to negative or positive terminal of DC power supply. The power supply needed to take care of the TIG arc incorporates a drooping or constant current characteristic that provides Associate in Nursing primarily constant current output once the arc length is varied over many millimetres. Hence, the natural variations within the arc length that occur in manual attachment have very little result on attachment current. The capability to limit this to the set worth is equally crucial once the conductor is brief circuited to the work piece, otherwise to a fault high current can flow, damaging the conductor. electric circuit voltage of power supply ranges from sixty to eighty V. 1.3 varieties of attachment current employed in TIG attachment can simply overheat and burn away. DCRP produces a shallow, wide profile and is principally used on Very light material at low Amp. c. AC (Alternating Current): it's the popular attachment current for many white metals, e.g. atomic number 13 and atomic number 12. The warmth input to the atomic number 74 is averaged out because the AC wave passes from one facet of the wave to the opposite. On the [*fr1] cycle, wherever the atomic number 74 conductor is positive, electrons can be due base material to the atomic number 74. this may end in the lifting of any chemical compound skin on the bottom material. This facet of the wave kind is named the cleansing [*fr1]. because the wave moves to the purpose wherever the atomic number 74 conductor becomes negative the electrons can be due the attachment atomic number 74 conductor to the bottom material. This facet of the cycle is named the penetration 1/2 the AC wave forms. d. AC with sq. Wave: With the appearance of contemporary electricity AC attachment machines will currently be made with a wave kind referred to as sq. Wave. The sq. wave has higher management and every facet of the wave will provides a additional cleansing 1/2 the attachment cycle and additional penetration. 1.4 blessings of TIG attachment TIG attachment method has specific blessings over different arc attachment method as follows ¬ I. slender focused arc II. able to weld metal and non-ferrous metals III. doesn't use flux or leave any scoria (shielding gas is employed to safeguard the weld-pool and atomic number 74 electrode) IV. No spatter and fumes throughout TIG attachment 1.5 Applications of TIG attachment The TIG attachment method is best suited to metal plate of thickness around 5-6 millimetre. Thicker material plate also can be welded by TIG exploitation multi passes which ends in high heat inputs, and resulting in distortion and reduction in mechanical properties of the bottom metal. In TIG attachment prime quality welds may be achieved thanks to high degree of management in heat input and filler additions on an individual basis. TIG attachment may be performed all told positions and therefore the method is beneficial for tube and pipe joint. The TIG attachment may be a extremely governable and clean method wants little or no finishing or generally no finishing. This attachment method will be used for each manual and automatic operations. The TIG attachment method is extensively used in the alleged advanced trade applications like I. Nuclear trade II. Aircraft III. Food process trade Maintenance and repair work exactitude producing trade VI. industry 1.6 method parameters of TIG attachment The parameters that have an effect on the standard and outcome of the TIG attachment method square measure given below. a) attachment Current Higher current in TIG attachment will result in splatter and work piece become injury. once more lower current setting in TIG attachment result in protruding of the filler wire. generally larger heat affected space may be found for lower attachment current, as high temperatures have to be compelled to applied for extended periods of your time to deposit identical quantity of filling materials. mounted current mode can vary the voltage so as to take care of a continuing arc current.

b) attachment Voltage Welding Voltage may be mounted or adjustable betting on the TIG attachment instrumentation. A high initial voltage permits for straightforward arc initiation and a larger vary of operating tip distance. Too high voltage, will result in massive variable in attachment quality. c) Inert Gases: The choice of protecting gas is depends on the operating metals and effects on the attachment value, weld temperature, arc stability, weld speed, splatter, conductor life etc. it additionally affects the finished weld penetration depth and surface profile, porosity, corrosion resistance, strength, hardness and crispiness of the weld material. argonon or inert gas could also be used with success for TIG attachment applications. For attachment of very skinny material pure argonon is employed. argonon typically provides Associate in Nursing arc that operates additional swimmingly and quietly. Penetration of arc is a smaller amount once argonon is employed than the arc obtained by the utilization of inert gas. For these reasons argonon is most popular for many of the applications, except wherever higher heat and penetration is needed for attachment metals of high heat physical phenomenon in larger thicknesses. atomic number 13 and copper square measure metals of high heat physical phenomenon and square measure samples of the kind of fabric that inert gas is advantageous in attachment comparatively thick sections. Pure argonon may be used for attachment of structural steels, low alloyed steels, untarnished steels, aluminium, copper, metallic element and atomic number 12. argonon gas mixture is employed for attachment of some grades of untarnished steels and nickel alloys. Pure inert gas could also be used for atomic number 13 and copper. inert gas argonon mixtures could also be used for low alloy steels, atomic number 13 and copper. d) attachment speed: Welding speed is a crucial parameter for TIG attachment. If the attachment speed is increased , power or heat input per unit length of weld is decreases, so less weld reinforcement results and penetration of attachment decreases. attachment speed or travel speed is primarily management the bead size and penetration of weld. it's mutually beneficial with current. Excessive high attachment speed decreases wetting action, will increase tendency of undercut, consistence and uneven bead shapes whereas slower attachment speed reduces the tendency to consistence. 1.7 Properties and blessings of Al: Aluminium may be a Very light weight metal (specific weight of two.7 g/cm3). Use of atomic number 13 in automobile and part reduces dead-weight and energy consumption. Strength of atomic number 13 may be improved as per the desired properties for numerous applications by modifying the composition of its alloys. atomic number 13 may be a extremely corrosion resistant material. differing kind s of surface treatment will any improve its corrosion resistance property. atomic number 13 is a wonderful heat and electricity conductor and in regard to its weight is nearly doubly nearly as good a conductor as copper. This has created atomic number 13 the foremost ordinarily used material in state transmission lines. Aluminium is ductile and incorporates a low temperature. in a very liquified condition it may be processed in a very range of the way. Its malleability permits product of atomic number 13 to be primarily shaped on the point of the top of the product's style.

EXPERIMENTAL PROCESS

Welding power source for AC/DC TIG Welding current: 4 - 400 Amps or better. (less than 4 and greater than 400 Amps)

- Mains Input Voltage : Three Phase 415V AC +/- 10%, 50Hz
- Power Factor at 100% TIG mode : 0.85 or better
- Insulation category : H class or better
- Gas Post Flow : 0– 25 sec or better
- It shall be equipped with microprocessor and digital signal processor or superior technology.
- It shall Confirms to latest international standards BS EN 60974 or equivalent.
- It shall have capability of working in low amperage range with stable arc.
- It shall have a provision for front Panel Digital Amp meter which shall be capable of online digital readout.
- The machine shall have built in computerized control option which can be used any time to be interfaced with computer, as and when required.
- Machine shall have over temperature protection with Thermo stabilized cooling of machine.
- The welding set shall have provision for automatic tripping with error display facility (If the Power source is overheated).

2. Water Cooled TIG Welding Torch current rating 400 Amps or more with at least 3.8 meter long cable having cable cover and bayonet type connecter (Dinse /OKC or equivalent) type connector.

3. Suitable Heat Oil Fire Retardant [HOFR] copper earthing cable at least 3.0 meter long with clamp at one end and bayonet type male connecter (Dinse /OKC or equivalent) at other end.

4. Suitable Heat Oil Fire Retardant [HOFR] copper earthing cable extension at least 3.0 meters long with bayonet type male connecter (Dinse /OKC or equivalent) at both ends.

5. Water cooled TIG torch power cable extension of current rating 400 Amps with bayonet type male connecter (Dinse /OKC or equivalent) at both ends.

6. Water cooling unit suitable for water-cooled TIG Torch specified.

7. 4 Core input supply cable at least 2.4 meter long for 3-Phase rated machine capacity.

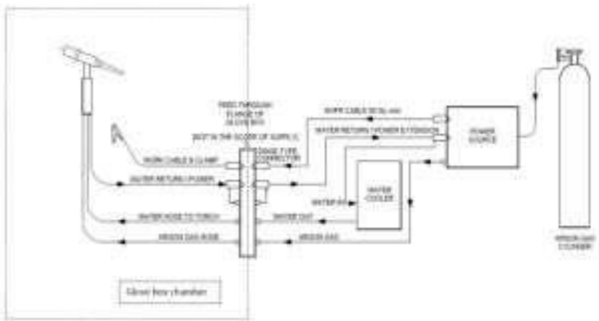

Fig. 2

RESULT AND ANALYSIS

Welding width for all the samples were measured and calculated average welding width as shown in table 4. Average value of welding width then plotted against the applied welding current for different welding speed as shown in Fig. 2. From the plot it is clearly seen that welding width increases almost linearly with increase of welding current.

Fig.4 shows the welded butt joint specimen, where welding performed with different welding speed and current setting as described in table 3.

Sample no	Reading 1 (mm)	Reading 2 (mm)	Reading 3 (mm)	Avg. width (mm)
1	5.43	4.85	4.51	4.93
2	7.35	6.83	7.22	5.14
3	8.95	7.58	7.29	7.94
4	7.24	7.82	7.82	7.626
5	10.92	10.45	10.04	10.47
6	5.03	5.18	4.92	5.042
7	5.53	5.85	5.99	5.79
8	8.57	8.05	7.86	8.16
9	9.27	8.06	8.27	8.54
10	9.13	10.07	8.57	9.256

Table 3

Surface roughness of the weld zone for all the samples were measured and average surface roughness value was calculated from three reading which is tabulated in Table 5. Roughness value found in the range of 1.1 to 3.5 micron, is quite low for a welded specimen. Therefore it can be say that using an automated system good quality of welding is possible which may not require any further finishing operation. These roughness values are again plotted against applied current in fig.

6. But no specific effect of applied current on the surface roughness value has been observed.

Fig. 7 shows the optical image of the welded zone at the cross section for the specimen prepared with different welding speed and current setting. From the images no specific change could b e observed for the weld specimen. However, cross section of the weld zone shows a clear effect of the welding parameters like applied current and welding speed. Fig. 7 shows the optical photograph at the cross section of the welding performed with different current setting and welding speed. From the figure it can be seen that welding is not performed full depth of the work piece. Depending on the welding speed and current setting this welding penetration is changed. It can be say from the observation of the figure that as welding current increases welding depth also increases for fixed value of welding speed. Again for a particular value of welding current welding depth found decreases as the welding speed increases.

4.2 Micro-hardness test: Micro-hardness value of the welded zone was measured for all the welded specimens at the cross section to understand the change in mechanical property of the welded zone. Fig. 8 and 9 shows the micro-hardness value at the welded zone taken from the centre of the welding zone towards the base material for different samples performed with different welding speed and welding current. From the graph it is found that for almost all the sample micro hardness value increases in the welding zone than the base material and these values are in the range of 40 to 80 HV in the welded zone. After a certain distance these value reduces to the hardness of the base material for the sample processed with welding speed 3.5 mm/s and different current setting as shown in Fig. 8. However for the welding done with welding speed 4 mm/s and different current setting micro-hardness value reaches to the micro-hardness value of base material after 5 to 6 mm.

CONCLUSION

The calculated temperature profiles show a good agreement with the measured ones, The temperature of the constricted arc is significantly higher in the arc axis and decreases faster with the arc radius in comparison to the TIG configuration. At the arc edge deviation from thermodynamic equilibrium is expected . At large distance from the arc axis the calculations provide gas temperature whereas spectroscopic measurements reflect electron temperature. Notice, that the improved model leads to a better agreement between simulated and measured temperature profile in comparison with previous work : The experimental result (full line) of TIG welding arc and constricted arc temperature with calculated result (dash line) for the middle of arc (top picture) and for 1 mm above the anode (bottom picture) the simulation results are presented more comprehensively. On the right side of the figures photographs of the high-speed camera are shown. The calculated shape of the arc corresponds well to the photograph. It can also be seen that in the second configuration the arc is narrower and the layer near the anode is not so fuzzy like in TIG welding case

Future scope

In present work welding is performed without any filler material. A filler rod/wire feeding system can be included in the system so that by using filler rod/wire thicker plate can be welded. Welding setup can also be use for welding of some other materials.

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