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A Review on Parametric Optimization of Tig Welding

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ABSTRACT:

Quality and productivity play important role in today's manufacturing market. Now a day's due to very stiff and cut throat competitive market condition in manufacturing industries . The main objective of industries reveal with producing better quality product at minimum cost and increase productivity.TIG welding is most vital and common operation use for joining of two similar or dissimilar part with heating the material or applying the pressure or using the filler material for increasing productivity with less time and cost constrain. To obtain main objective of company regards quality and productivity. In the present research project an attempt is made to understand the effect of TIG welding parameters such as welding current , gas flow rate ,welding speed ,that are influences on responsive output parameters such as hardness of welding, tensile strength of welding, by using optimization philosophy. The effort to investigate optimal machining parameters and their contribution on producing better weld quality and higher Productivity.

I. INTRODUCTION

Electrical arc was first described by davy in England in the year 1809,but the beginning of arc welding could become possible only with the improvements in electric dynamos or generators between 1877and 1880. Auguste de meritens established arc welding process in 1881 which was applied to join certain components of electrical storage batteries. Arc and molten pool shielding with an inert gas (co2) was advantage by Alexander in USA in year 1928 and the patent for TIG welding was received by Hobart and Devers in 1930 in USA. First gas tungsten arc spot welding torch based upon TIG welding was introduced around 1946.TIG is an abbreviation for tungsten-inert-gas(fig-1). The process is also termed as gas-tungsten-arc welding and designated as GTAW. In this process, an arc is struck between a non-consumable tungsten electrode and the base metal. The arc is shielding by the inert argon or helium or argon-helium mixture. A filler wire may or may not be Used. When it is used, it is fed externally into the arc in the form of rod or strip by the welder. The welder also has to control the arc length and travel speed.

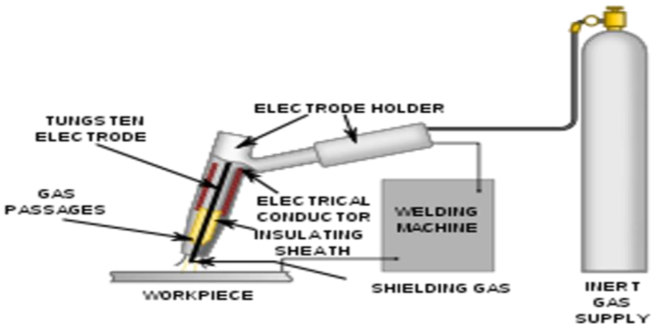

Fig: 1

Equipment:

[1] Welding power source, high frequency unit, dc suppressor unit and cables.
[2] Welding torch, tungsten electrode and filler metals.
[3] Inert gas cylinder, pressure regulator and flow meter.
[4] Cooling water supply.
[5] Water and gas solenoid valves.

Inert Gases Used In TIG welding:

[1] Argon: Argon is most commonly used gas for TIG welding .It can be used on all metals.
[2] Helium: Pure helium can be used for welding aluminum and copper alloys.
[3] Helium-argon mixtures: Helium-argon mixtures give deeper penetration, greater heat input and hence faster welding.
[4] Argon-hydrogen mixture: Addition of hydrogen to argon increases the arc voltage and provides benefits similar to helium.

Working Principle of TIG Welding Operation:

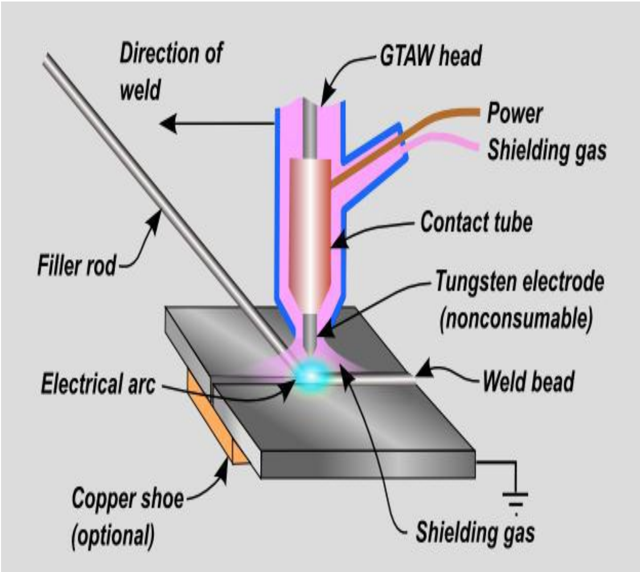

Fig: 2

TIG is an arc welding process, as shown in Fig2. Wherein coalescence is produced by heating the work piece with an electrical arc struck between a tungsten electrode and the job. The electrical discharge generates a plasma arc between the electrode tip and the work piece to be welded. It is an arc welding process wherein coalescence is produced by heating the job with an electrical arc struck between a tungsten electrode and the job. The arc is normally initialized by a power source with a high frequency generator. This produces a small spark that provides the initial conducting path through the air for the low voltage welding current.
The arc generates high-temperature of approximately 6100 C and melts the surface of base metal to form a molten pool. A welding gas (argon, helium, nitrogen etc) is used to avoid atmospheric contamination of the molten weld pool. The shielding gas displaces the air and avoids the contact of oxygen and the nitrogen with the molten metal or hot tungsten electrode. As the molten metal cools, coalescence occurs and the parts are joined. The resulting weld is smooth and requires minimum finish.

ADVANTAGES:

[1] No flux is used, hence there is no danger of flux entrapment when welding refrigerator and air conditioner components.
[2] Because of clear visibility of the arc and the job, the operator can exercise a better control on the welding.
[3] This process can weld in all positions smooth and sound welds with less spatter.
[4] TIG welding is very much suitable for high quality welding of thin material
[5] It is a very good process for welding nonferrous metals(aluminum)and stainless steel

DISADVANTAGES:

[1] Tungsten if it transfers to molten weld pool can contaminate the same. Tungsten inclusion is hard and brittle.
[2] Filler rod end if it by change comes out of the inert gas shield can cause weld metal contamination.
[3] Equipment costs are higher than that for flux shielded metal are welding.

APPLICATIONS:

[1] Welding aluminum, magnesium ,copper ,nickel and their alloys, carbon, alloys or stainless steel, inconel ,high temperature and hard surfacing alloys like zirconium, titanium etc.
[2] Welding sheet metal and thinner sections.
[3] Welding of expansion bellows, transistor cases, instrument diaphragms, and can-sealing joints.
[4] Precision welding in atomic energy, aircraft, chemical and instrument industries.
[5] Rocket motor chamber fabrications in launch vehicles.

II. LITRETURE REVIEW

Many investigators have suggested various methods to explain the effect of process parameter on Tig welding process in material properties.

Ugur Esme et al, [1] were carried out investigated the multi-response optimization of tungsten inert gas welding (TIG) welding process for an optimal parametric combination to yield favorable bead geometry of welded joints using the Grey relational analysis and Taguchi method. Sixteen experimental runs based on an orthogonal array of Taguchi method were performed to derive objective functions to be optimized within experimental domain. The objective functions have been selected in relation to parameters of TIG welding bead geometry; bead width, bead height, penetration, area of penetration as well as width of heat affected zone and tensile load. The Taguchi approach followed by Grey relational analysis to solve the multi-response optimization problem. The significance of the factors on overall quality characteristics of the weldment has also been evaluated quantitatively by the analysis of variance method (ANOVA). Optimal results have been verified through additional experiments. This shows application feasibility of the Grey relation analysis in combination with Taguchi technique for continuous improvement in product quality in manufacturing industry.

S.C. Juang et al, [2] were carried out the selection of the process parameters for TIG welding of stainless steel with the optimal weld pool geometry has been reported. The optimal weld pool geometry has four smaller-the-better quality characteristics, i.e. the front height, front width, back height and back width of the weld pool. The modified Taguchi method is adopted to solve the optimal weld pool geometry with four smaller-the better quality characteristics. Experimental results have shown that the front height, front width, back height and back width of the weld pool in the TIG welding of stainless steel are greatly improved by using this approach.

S. Krishnanunni et al, [3] were carried out found that the effect of welding condition on hardness of pure titanium material. This research paper variation of macro hardness and micro hardness at the weld heat affected zone of grade-2 pure titanium is presented. Butt welding of thin pure Ti sheets is prepared by TIG welding using argon gas as the shielding gas. Amount of shielding gas and number of passes are taken as the variables in welding conditions. It was found that the maximum value of hardness is obtained corresponding to shielding gas flow rate of 7 l/min and 4 numbers of welding passes.

Raghuvir Singh et al, [4] were carried out investigated the effect of TIG welding parameters like welding speed, current and flux on depth of penetration and width in welding of 304L stainless steel has been studied. From the study it was observed that flux used has the most significant effect on depth of penetration followed by welding current. However Sio2 flux has more significant effect on depth. Optimization was done to maximize penetration and having less bead width.

Wenchao Dong et al, [5] were investigated the oxygen content is high, the weld shape is narrow and deep because of the inward convection induced by both the Marangoni force and the electromagnetic force for different welding parameters. When the welding speed or electrode gap increases, the temperature gradient on the pool surface is decreased and the inward Marangoni convection is weakened, which makes the weld D/W ratio decrease. Under the higher welding current, the inward convection induced by the electromagnetic force is strengthened and the higher weld D/W ratio is obtained. Under low oxygen content, the outward Marangoni convection is the main convection mode in the weld pool and makes the weld shape wide and shallow. The inward convection induced by the electromagnetic force is contributive to the increase of the weld depth. The weld width weakly increases compared with the weld depth. Therefore, the weld D/W ratio slightly decreases with the increasing welding parameters.

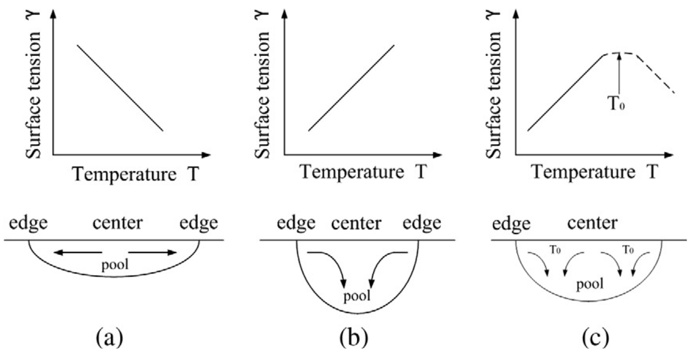

Fig. 1. Marangoni convection mode in the weld pool.

Dongjie Li et al, [6] were investigated the effect of two typical weld pool shapes, wide-shallow and narrow-deep. Marangoni convection was considered to be the main factor controlling fluid flow in the liquid pool. Inward Marangoni convection leads the heat flux to transfer from the edges of the weld pool to the centre and form a deep and narrow weld pool shape. Changes in the welding parameters directly change the heat input and the pattern of the Marangoni convection, thus controlling the shape of the molten pool. For the pure-He-shielded TIG process, the outward Marangoni convection was weakened with increasing oxygen content; thus, the D/W ratio increased slightly. For the double-shielded TIG process, the convection was enhanced with increasing oxygen content over a certain range, up until a large amount of oxide was formed. The heavy oxide layer on the pool surface weakens the inner direction of Marangoni convection so as to affect the heat flow fluid from the outer part to the inner part of weld pool surface, and harm the welding efficiency. The double-shielded TIG process is an appropriate method for adding an active element, such as oxygen, into the weld pool so as to transform the outward flow of Marangoni convection into an inward flow. This method allows for a wider range of welding parameters to obtain a narrow and deep weld pool.

Parikshit Dutta et al, [7] were carried out the conventional regression analysis and neural network-based approaches. The NN-based approaches were seen to be more adaptive compared to the conventional regression analysis, for the test cases. It could be due to the reason that the NN-based approaches were able to carry out interpolation within the ranges of the variables and Genetic-neural (GA-NN) system outperformed the BPNN in most of the test cases (but not all). It is so, because a GA based search was used in the former approach, in place of a gradient-based search utilized in the latter approach. BPNN showed a slightly better performance compared to the genetic-neural system initially, but after about 60,000 iterations, the latter started to perform better than the former.

Shanping Lu et al, [8] were investigated the Arc ignitability and stability of He (gas) shielded GTA welding can be significantly improved when Ar gas is mixed into the He shielding. Adding a small amount of oxygen to the He–30%Ar and He–50%Ar shielding, the GTA weld shape significantly changes from a wide shallow type to a narrow deep one. The electrode tip work distance is an important parameter affecting the GTA weld shape in He–30% Ar–O2 and He–50%–O2 shielding.

Paulo J. Modenesi et al, [9] were investigated the use of fluxes, even of extremely simple formulation, can greatly increase (up to around 300%) the weld penetration in TIG welding. It was possible to obtain full penetration welds in 5 mm thick plates of austenitic stainless steel with no preparation and currents of about 230 A. The operational characteristics of the ATIG process were not very different from those of conventional TIG welding. The arc voltage changed by <3%, and, in most cases, the voltage variation was <1 V. Comparison of the operational parameters, of the arc shape, and of the geometric parameters of the beads, suggests that factors acting on the weld pool are, possibly, responsible for the changes in weld bead shape.

III. CONCLUSION

From various literature survey efforts to identify in TIG welding process most of welding parameters like welding current, welding speed, depth to width ratio are generally used in research work. Also identify TIG welding carried out on different materials like mild steel , titanium alloy, brass, carbon, stainless steel etc.., But we may be choose work piece material differ from above for experimental work and most applicable in industrial practices. We may be try to find out welding hardness, tensile strength, by theoretical equations and experimentally measure with help of different input parameter. For achieving the prosperious result of experiment the austentic type stainless steel with the grade E310 is used.

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