Study the parametric optimization of TIG welding

Gurdev singh[1], Aman Bansal, Dr Amit kumar Gupta, Amandeep singh

Dept. of mechanical engineering, Institutes of engineering and technology (I.E.T) Bhaddal, Ropar, Punjab

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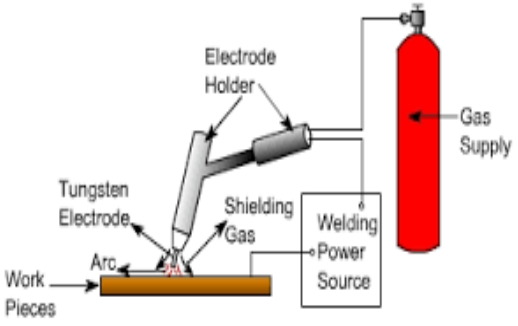
Abstracts:- *Tungsten inert gas welding or in other word known as Gas tungsten arc welding is one of the welding process among the other welding technique. This type of welding is highly used to join the ferrous and non ferrous metal. The main motive of this paper study to knows about the optimal parameters for TIG welding. The material properties like Tensile strength, impact strength, hardness of weld joints largely affected by welding parameters. Therefore in last decade researcher have workout to find the optimal parameters for TIG welding. So this paper review the different scientific research in TIG welding to find the best parameter with help of Taguchi technique.*

Key words:- TIG welding, parameters, optimization, weld joints, Taguchi technique

1. INTRODUCTION

TIG welding process is most widely used process in which used a power source, electrode, shielding gas, electrode and work piece . This process is mainly used to joining thin and medium thickness materials. The TIG welding process consists of non consumable electrode which provides the arc for the welding [1]. The protection of molten puddle is done with the help of shielding gas.



1.1 WORKING

The working of TIG Welding process shown in diagram. When the current supply between the electrode and work piece so due to this potential difference set up and spark is produce. This spark produces very high temperature near about 6000 ^{0}C and due to this the weld pool is produce by melting work piece with help of heat which is generating during the sparking between electrode and work piece. To avoid from the contamination from atmosphere shielding gas (argon and helium) is used. Mostly argon is used because it is heavy and produces better shielding at lower flow rate [2]. In TIG welding, current alternate between two levels. Pulse current is known as first level or high current state and background known as second level and lower level.

1.2EQUIPMENTS

(1) Power source, high frequency units and cables
(2) Electrode, torch and filler rods,
(3) Inert gas with regulators.

1.2.1 Power supplies :- In the TIG welding there are two power source mainly used direct current power supplies for steels, titanium and nickel and alternate current power supplies for aluminum and magnesium.

1.2.2 Electrode:- In the TIG non consumable tungsten electrode used having high melting temperature near about 3500 ^{o}C . There are three types of materials used for TIG welding: pure tungsten, Zirconiated tungsten & thoriated tungsten.

Filler rod:- the selection of filler rods mainly depends on the compositions of base metal.

1.2.3 Inert gas:- The selection of shield gas most effect weld quality . In TIG welding argon. Helium and argon- helium mixture used. Mostly argon is used because of its weight and less expenders.

2. LITERATURES

A.s Sahi invested that the influence of the heat on the mechanical properties and microstructure properties of weld material. In experiment different three heat parameters taken on the tungsten arc welding process. Significant grain coursing was found in the area of heat effective zone for all joints moreover it was observed that grain coarsening in affected area set up with increase in the heat input. In this present work researchers also found that length and spacing in weld zone depend on the heat input which also effects the tensile properties of weld joint.

Mr.Pikid Danugmala proposed the optimal factors on gas metal arc welding with factorial design with 2 level and four factors current, speed, gas, voltage. Researcher with the help of central composite design finds out optimization of important parameters. The optimal conditions were 125.00 amp. of current, 14.20 inch per minute of speed and 27 Voltage. The optimal of tensile test was 599.379N/mm^2.

Qiang Zhu studied the effects on pore distribution and tensile properties of arc ultrasonic in tungsten arc welding on the MGH 956 alloy . Researcher investigated that the excitation current of arc ultra sonic has a very large effect on the tensile strength and on the pores distribution. When current step up from 20A to 30A tensile strength also step up. When ultra sonic frequency decreased from 60 kHz to 30 kHz, bubbles floated outside and increase tensile strength. More over ultrasonic has little influence on weld joints micro hardness change.

R. Arabi jeshvaghani find the effect on microstructure and wear of Ni- based alloy Using tungsten inert gas welding , in which experiment 1-2 mm thick coating was deposit on weld piece .Electron and Optical microscopy, X-diffraction analysis were used for microstructure of weld joint . Results shows that M23c6 carbides have large amount of Ni solid solution and partial heat melted zone had eutectic and martensite microstructure but martensite structure shown in heat effected zone.

S.P. Lu proposed that pure He gas using in TIG welding as inner shield gas on cr13Ni5Mo martensitic stainless steels and a mixer of He and CO_2 act as outer shielding gas for welding purpose . This is welding lead to solve the problem of oxidation of electrode. The oxygen content present in the weld pool have large impact of surface tension if the oxygen content present in the range of 80-120 ppm the change from outward to inward, as result show large weld depth/width ratio. This experiment shows high welding accuracy as comparing to the traditional Tig welding and also shows good impact than metal arc welding.

Uger Esme were investigated that the optimization parameter of tungsten inert gas (TIG) welding process to the optimal parameter of welded joint with the help of Taguchi and the grey relational technique. Sixteen experiments were performed with an orthogonal array of Taguchi technique to found the objective function with in experimental domain. This objective function selected with relation to parametric geometry of bead of TIG welding , bead penetration, bead height, bead width and heat effected Zone as well as tensile load. This Taguchi technique performed by grey relational analysis to short out the optimums problems. The important factors on all qualitative characteristics of weld joint evaluated with help of ANOVA. These optimal results verified with the help of additional experiment. This represents feasibility of grey relational analysis in combination with addition of Taguchi method for continuously implementation in productive quality for industry.

Mukesh, Sanjeev Sharma these paper discuss the influence of different input parameters such as welding current, gas flow rate and welding speed on the mechanical properties in TIG. The output response such as microstructure, hardness, and tensile strength of weld specimens are investigated in this study. In this L9 orthogonal array is used, which consist of 3 input parameters. Analysis was done by the application of Taguchi design using Minitab 16. Austenitic stainless steel 202 grade size 100 x 50 x 6 mm with square edge butt joints were prepared in this experiments. ANOVA analysis was performed for the analysis purpose which show that the current is the most significant parameters that influenced the tensile strength and micro-hardness of the weld. The delta ferrite in matrix of austenite SS 202 Microstructure of weld metal structure shows. The highest tensile strength is 0.595 KN/mm2 is obtained at speed of welding 180mm/s, current 210 A and gas flow rate 141m/s.

Raghuvir singh were carried out experiment and investigated the influence of TIG welding Parameters like speed, flux and current on penetrated depth and width in welding joints of 304 Stainless steels have observed. From the observation it was found that the fluxes used have very most efficient effect on the depth of penetration followed by welding current. Moreover SIO_2 is large effect on depth. Optimization was worked out to minimize bead width and maximize penetration.

Dheeraj singh, Joyti vimal, These investigators proposed significant parameters of welding in Tungsten arc welding (TIG) with using the Taguchi research methodology with L16 table .

in this experiment researcher use 4 parameters and 4 levels . The name of parameters are operated in this experiment are gas flow, current, welding speed and angle of gun. The response are penetration , width of bead , tensile load and bead geometry. The experiment were performed on 304 SS plate having (30x 250) dimension. From this experiment An optimal parameters came out for best response that are current 40 Ampere , speed 12m/min, angle of gun 80 degree and gas flow rate 5l/min.

Deepak Malik, Sachin kumar : studied the angular distortion in butt weld plates . These angular distortion come in existence due to un - uniform shrinkage along the weld length. In this paper use L9 orthogonal array to design the experiment. TIG welding was worked on 302 SS having length 50mm and thickness and using 4 parameters and three levels. Length of work piece , diameter of electrode , current and gap between plates . Angular distortion shows the significant effect due to increase plate length as well as diameter of electrode and it have negative effect due to increase current and increase the gap between passes.

N.Ren ,M.Zan studied the effect on the heat affected zone of welding parameters . this experiment are carried by using FE simulation. After experiment shows that as the weld portion lie opposite, the constraining effect like thickness decrease and circumferential and heat effective zone (HAZ) increases.

Indra Rani : studied that mechanical properties of AA6351 work piece by using TIG welding with pulsed current and non pulsed current . size of work piece are 300mm , 150mm and 6mm. This experiment was carried out with current 70-74 A, frequency 3 and 7 Hz and 700-760 mm/min. in this paper concluded very less defect. it show that weld is done at correct tip angle of Torch.

3. CONCLUSIONS

The present paper give a study of optimization on the parameters on TIG welding. From the literature, it observed that there are lot of work have done for parameters like current, voltage, gas flow and speed to find out the tensile strength , hardness and heat effected zone. From above papers study some conclusions came outside which is given below.

1. Different parameters (different gas, electrode diameters, different compositions of filler rods) of process can be taken for welding 309 stainless steel with Taguchi and ANOVA method.
2. To study the effects of parameters on impact strength of butt weld joint on different grove angles.
3. To find out the residual stress on different parameters during the welding process.
4. To find out the best suitable parameters for maximum tensile strength, fatigue strength, hardness and heat effected zone.

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Authors :-

1. Gurdev Singh, Asst. Prof. IET Bhaddal Technical Campus, Ropar, Punjab, India.
2. Dr. Amit Kumar Gupta, Dean Academics & HOD-ME, IET Bhaddal Technical Campus, Ropar.
3. Aman Kumar Bansal, Professor. IET Bhaddal Technical Campus, Ropar.
4. Amandeep Singh , Asst. Prof. IET Bhaddal Technical Campus, Ropar, Punjab