The Effect of Activating Flux in 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 ,electrode angle ,that are influences on responsive output parameters such as weld penetration, depth to width ratio, strength of weld joint by using optimization philosophy. The effort to investigate optimal machining parameters and their contribution on producing better weld quality and higher Productivity

I. INTRODUCTION

Until the end of the 19th century, the only welding process was forge welding, which blacksmiths had used for centuries to join iron and steel by heating and hammering. Arc welding and oxyfuel welding were among the first processes to develop late in the century, and electric resistance welding followed soon after. Welding technology advanced quickly during the early 20th century as World War I and World War II drove the demand for reliable and inexpensive joining methods. Following the wars, several modern welding techniques were developed, including manual methods like shielded metal arc welding, now one of the most popular welding methods, as well as semi-automatic and automatic processes such as gas metal arc welding, submerged arc welding, flux-cored arc welding and electro slag welding.Welding is a fabrication or sculptural process that joins materials, usually metals or thermoplastics, by causing coalescence. This is often done by melting the work pieces and adding a filler material to form a pool of molten material (the weld pool) that cools to become a strong joint, with pressure sometimes used in conjunction with heat, or by itself, to produce the weld. This is in contrast with soldering and brazing, which involve melting a lower-melting-point Material between the work pieces to form a bond between them, without melting the work pieces.

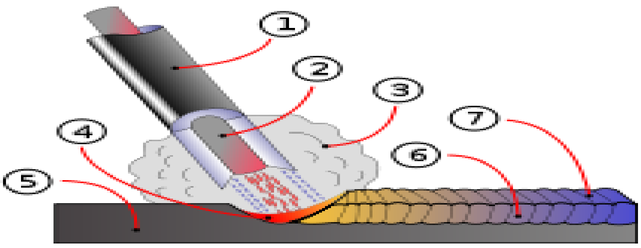

Fig. 1 – Schematic diagram of the Diagram of arc and weld area, in shielded metal arc welding.

1. Coating Flow
2. Rod
3. Shield Gas
4. Fusion
5. Base metal
6. Weld metal
7. Solidified Slag

Welding is used as a fabrication process in every industry large or small. It is a principal means of fabricating and repairing metal products. The process is efficient, economical and dependable as a means of joining metals. This is the only process which has been tried in the space. The process finds its applications in air, underwater and in space.

Why welding is used, because it is suitable for thicknesses ranging from fractions of a millimetre to a third of a meter Versatile, being applicable to a wide range of component shapes and sizes.

Flux:
The term Flux is overcome from Latin word fluxus and it means flow.
It is a chemical cleaning agent, flowing agent, or purifying agent.
Flux are mainly used to remove oxide impurities of weld and also absorb impurities from slag.
The activator in flux used to reduce corrosive effect at room temperature and increase the temperature of job at certain level.
For most welding operation commonly used fluxes are SiO_2 , TiO_2 , Cr_2O_3 , ZrO_2 , Al_2f_3 etc .

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.

INTRODUCTION TO TIG WELD

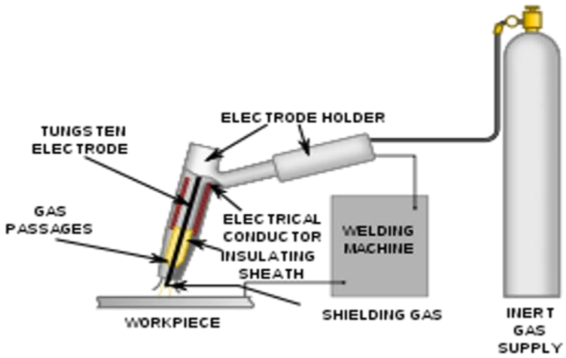

Fig. 1: schematic diagram of TIG welding

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.

It is an arc welding process wherein coalescences produced by heating the job with an electric struck between a tungsten electrode and the job. A shielded gas (argon, helium, nitrogen, etc) is used to avoid atmospheric contamination of the molten weld pool.A filler metal may be added, if required.Welding current, water and inert gas supply are turned on. The arc struck either by touching the electrode with a scrap tungsten piece or using a high frequency unit.In the first method arc is initially struck on a scrap tungsten piece and then broken by increasing the arc length. This procedure repeated twice or thrice warms up the tungsten electrode. The arc is then struck between the electrode and precleaned job to be welded. This method avoids breaking electrode tip, job contamination and tungsten loss.In the second method, a high frequency current is superimposed on the welding current. The welding torch (holding the electrode) is brought nearer to the job. When electrode tip reaches within a distance of 3 to 2 mm from the job, a spark jumps across the air gap between the electrode and the job. The air path gets ionized and arc is established.After striking the arc, it is allowed to impinge on the job and a molten weld pool is created. The welding is started by moving the torch along the joint as in oxy-acetylene welding. At the far end of the job, arc is broken by increasing the arc length. The shielding gas is allowed to impinge on the solidifying weld pool for a few seconds even after the arc is extinguished. This will avoid atmospheric contamination of the weld metal.

The welding torch and filler metal are generally kept inclined at angles of 70-80˚ and 10-20˚ respectively with the flat work piece. A leftward technique may be used. A flux (derived from Latin fluxes meaning “flow”), is a chemical cleaning agent, flowing agent, or purifying agent. Fluxes may have more than one function at a time. They are used in both extractive metallurgy and metal joining.The role of a flux in joining processes is typically dual: dissolving of the oxides on the metal surface, which facilitates wetting by molten metal, and acting as an oxygen barrier by coating the hot surface, preventing its oxidation. In some applications molten flux also serves as a heat transfer medium, facilitating heating of the joint by the soldering tool or molten solder

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 fewer spatters.
[4] TIG welding is very much suitable for high quality welding of thin material

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

From 1995, there are lot of articles are published on effect of flux in Tig welding. Not all the articles are directly related to our work, especially, those articles which were focused on computational work. Many articles addressed experimental findings and remaining discussed various theories. In this subsection, we are going to discuss only those articles (experimental and/or theoretical work) which are directly related to current work.

JAGJIT RANDHAWA[1] was carried out Tig welding process and experimental investigations towards Effect Of A-Tig Welding Process Parameters On Penetration In Mild Steel Plates are conducted. TIG welding is mostly used to weld thin sections for high surface finish. A major drawback in the processes having very small penetration as compare to other arc welding process. The problem can be avoided by using active flux in conventional TIG welding. In the present study investigate the optimization of A-TIG welding process on mild steel for an optimal parameter by using Taguchi technique. The effect of various process parameters (welding current (I), welding speed (V), active flux) .IN the present study efforts were made to increase the weld penetration by Appling the active flux and to optimize the process parameters.

J. NIAGAJ[2] The impact of activating flux and selected fluorides on A-TIG welding of Grade 2 titanium. The paper also presents the dimensions and macrostructure of welds and describes welded joints produced with BC-Ti activating flux as well as the mechanical properties such as strength, impact energy and hardness of specific weld zones. In addition, the article contains information about performed bend tests and results of macrostructure investigation.

A.R. Ibrahim[3] Gas tungsten arc welding is fundamental in those industries where it is important to control the weld bead shape and its metallurgical characteristics. However, compared to the other arc welding process, the shallow penetration of the TIG welding restricts its ability to weld thick structures in a single pass (~ 2 mm for stainless steels), thus its productivity is relativity low. This is why there have been several trials to improve the productivity of the TIG welding. The use of activating flux in TIG welding process is one of such attempts. In this study, first, the effect of each TIG welding parameters on the weld’s penetration depth was shown and then, the optimal parameters were determined using the Taguchi method with L_9 (3^4) orthogonal array. SiO_2 and TiO_2 oxide powders were used to investigate the effect of activating flux on the TIG weld penetration depth and mechanical properties of 316L austenitic stainless steel. A camera was used to observe and record images of the welding arc, and analyze the relationship between increasing the penetration depth and arc profile. The experimental results showed that activating flux aided TIG welding has increased the weld penetration, tending to reduce the width of the weld bead. The SiO_2 flux produced the most noticeable effect. Furthermore, the welded joint presented better tensile strength and hardness**.**

Syarul Asraf Mohamat[4] Flux Core Arc Welding (FCAW) is an arc welding process that using continuous flux-cored filler wire. The flux is used as a welding protection from the atmosphere environment. This project is study about the effect of FCAW process on different parameters by using robotic welding with the variables in welding current, speed and arc voltage. The effects are on welding penetration, micro structure and hardness measurement. Mild steel with 6mm thickness is used in this study as a base metal. For all experiments, the welding currents were chosen are 90A, 150A and 210A and the arc voltage is 22V, 26V and 30V respectively. 20, 40 and 60 cm/min were chosen for the welding speed. The effect will studied and measured on the penetration, microstructure and hardness for all specimens after FCAW process. From the study, the result shown increasing welding current will influenced the value depth of penetration increased. Other than that, the factors that can influence the value of depth of penetration are arc voltage and welding speed.

Cheng-Hsien Kuo[5] The effect of oxide fluxes on surface appearance, weld morphology, angular distortion, and weld defect obtained with activated tungsten inert gas (TIG) process applied to the welding of 6 mm thick dissimilar metal plates between JIS G3131mild steel and SUS 316L stainless steel. The CaO, Fe_2O_3, Cr_2O_3, and SiO_2 fluxes used were packed in powdered form. The results indicated that the surface appearance of TIG welds produced with oxide flux formed residual slag. TIG welding with SiO_2 powder can increase joint penetration and weld depth-to-width ratio, and therefore the angular distortion of the dissimilar weldment can be reduced. Furthermore, the defects susceptibility of the as-welded can also be reduced.

I. SAMARD[6] The influence of the activating flux on the weld joint properties at the drawn arc stud welding process with ceramic ferrule is analyzed. In the experimental part of the paper, the arc stud welding process is applied with the application of the activating flux for ATIG process. In order to evaluate the influence of the activating flux on the welding process parameters variations, the main welding parameters were monitored by an on-line monitoring system. Besides monitoring of welding current and voltage, the influence of the active-ting flux on the weld joint appearance is investigated. The macro sections of the weld joints welded with the same parameters, but with and without the presence of activating flux.

Michael lui[7] Conventional gas-shielded arc welding processes remain the most applied technique for joining titanium and titanium alloys. To improve upon single pass weld bead penetration and enhance joining productivity, augmented tungsten inert gas (A-TIG) welding has been used with fluxes that contain activating ingredients, such as fluorides of the alkali and alkali earth metals. The effects of cryolite (Na_3 AlF_6), a complex fluoride, on weld bead morphology was studied and compared to the effects from the simple fluoride, MgF_2. Cryolite was shown to increase single-pass penetration through a slight arc construction and increase current density mechanism.

LI Qing-Ming[8] The effects of activating fluxes on welding arc were investigated. A special set of water-cooling system and stainless steel were used as parent material. During welding process, high-speed camera system and oscillograph were used for capturing instantaneous arc shape and arc voltage respectively. The experimental results indicate that the SiO_2 flux can increase the arc voltage, while TiO_2 has no this effect on arc voltage. Compared with conventional tungsten inert gas welding (C-TIG), it is found that the arc shape of A-TIG welding used with the SiO_2 flux has changed obviously.

P.K. Palani[9]: Austenitic stainless steel cladding is generally used to attain better corrosion resistance properties to meet the re-quirements of petrochemical, marine, and nuclear applications. The quality of cladded components depends on the weld bead geometry and dilution, which in turn are controlled by the process parameters. In this investigation, the effect of cladding parameters such as welding current, welding speed, and nozzle-to-plate distance on the weld bead geometry was evaluated. The objectives of controlling the weld bead geometry can easily be achieved by developing equations to pre-dict these weld bead dimensions in terms of the process parameters. Mathematical equations were developed by us-ing the data obtained by conducting three-factor five-level factorial experiments. The experiments were conducted for 317L flux cored stainless steel wire of size 1.2 mm diameter with IS:2062 structural steel as a base plate. Sensitivity anal-ysis was performed to identify the process parameters exert-ing the most influence on the bead geometry and to know the parameters that must be most carefully controlled. Studies reveal that a change in process parameters affects the bead width, dilution, area of penetration, and coefficient of internal shape more strongly than it affects the penetration, reinforce-ment, and coefficient of external shape.

Dr. M. Vasudevan[10]: Specific activated flux has been developed for enhancing the penetration performance of the TIG welding process for welding of type 304 LN and type 316LN stainless steels. A significant increase in penetration of over 300% has been observed in single pass TIG welding. The significant improvement in penetration was attributed to constriction of the arc and the reversal of Marangoni flow. The use of flux has been found to overcome the variable weld penetration observed during auto genous TIG welding of austenitic stainless steel with less than 50 ppm silver. There was no degradation in the microstructure and mechanical properties of welds produced by A-TIG welding compared to that of conventional TIG welding process.Liming Liu[11]: The Cadmium Chloride flux increases the weld penetration evidently in the Alternating Current Tungsten inert gas (AC TIG) welding of magnesium alloy. In the present study, in order to investigate the effect of the CdCl2 active flux on the weld shape and arc voltage, bead-on-plate specimens are made on AZ31B magnesium alloy pre-placed with CdCl2 active flux by the AC TIG process. Weld pool cross-sections and the arc voltage are analyzed under different welding parameters, welding speed, weld current and arc length. The results showed that compared to the conventional AC-TIG, welding penetration and the weld depth/width with CdCl2 flux are both two times greater than that of without flux under optimal parameters. The voltage decreases with decreasing of travel speeds and arc length decreasing. Besides, the phenomenon of arc trailing in the EN period and arc contraction in the EP period were observed in AC TIG welding of magnesium alloy with CdCl2 flux. It found that the arc voltage increases with the increases of welding current, more energies are supplied for welding, resulting in the increases of arc voltage and weld penetration.T. Kannan[12]: The main problem faced in duplex stainless steel cladding is the selection of the optimum combination of process parameters for achieving the required quality of clad. This paper highlights an experimental study carried out to analyse the effects of various flux cored arc welding (FCAW) process parameters on important clad quality parameters in duplex stainless steel cladding of low carbon structural steel plates. The experiments were conducted based on four-factor five level central composite rotatable design with full replications technique and having mathematical models developed using multiple regression method. The effects of the input process parameters on clad quality parameters have been presented in graphical form, which helps in selecting welding process parameters to achieve the desired clad quality quickly.

H. Y. Huang[13]: The aim of the present study was to investigate the effect of specific oxide fluxes on the surface appearance, weld morphology, retained d ferrite content, hot cracking susceptibility, angular distortion and mechanical properties obtained with the tungsten inert gas (TIG) process applied to the welding of 5 mm thick austenitic stainless steel plates. An autogenous gas tungsten arc welding process was applied to stainless steels through a thin layer of activating flux to produce a bead on plate welded joint. The MnO2 and ZnO fluxes used were packed in powdered form. The experimental results indicated that the 80% MnO2–20% ZnO mixture can give full penetration and also a satisfactory surface appearance for type 304 stainless steel TIG flux welds. TIG welding with MnO2 and/or ZnO can increase the measured ferrite number in welds, and tends to reduce hot cracking susceptibility in as welded structures. It was also found that TIG flux welding can significantly reduce the angular distortion of stainless steel weldments**.**

P. Kanjilal[14]: Rotatable designs based on statistical experiments for mixtures have been developed to predict the combined effect of flux mixture and welding parameters on submerged arc weld metal chemical composition and mechanical properties. Bead-on-plate weld deposits on low carbon steel plates were made at different flux composition and welding parameter combinations. The results show that flux mixture related variables based on individual flux ingredients and welding parameters have individual as well as interaction effects on responses, viz. weld metal chemical composition and mechanical properties. In general, two factor interaction effect are higher than the individual effect of mixture related variables. Amongst welding parameters, polarity is found to be important for all responses under study.

Chunlin Dong[15]: This paper deals with a basic Understanding about arc welding with the activating flux. The effect of various fluxes on the penetration depth and welding arc profiles is investigated in conventional TIG welding of stainless steel. Arc contraction can be verified with the result of video observation. The fluid flow be- heavier is visualized in real-time scale by the use of mi-cro-focused X-ray transmission high-speed video observation system. Stronger inward fluid flow patterns leading to weld beads with narrower width and deeper penetration can be apparently identified in the case of A TIG welding.

It is understood that the activating flux, which draws a lot of attention in increasing welding penetration and improving welding productivity for TIG welding of stainless steel, will be positively applied in other fields when more merits of the active flux are identified and qualified, such as eliminating undercutting in keyhole mode plasma arc welding of stainless steel.Chunli YANG[16]: The mechanism of penetration depth increased by activating flux in activating tungsten inert gas (A-TIG) welding was studied by measuring the distribution of trace element Bi in the weld and monitoring the change of arc voltage during A-TIG welding of stainless steel 0Crl8Ni9 with fluxes $Si0_2$ and Ti02- The results show that the mechanism of penetration depth in A-TIG welding depends on the sort of flux used. The weld pool convection after coating the flux S1O2 and flux T1O2 is changed inversely compared with convectional TIG welding without flux. The arc voltage is increased by flux Si02 whilst flux Ti02 does not have effect on the arc voltage. The reason of penetration depth increase for Si02 is due to the constriction of arc plasma and the change of surface tension gradient. The increase of weld penetration depth with Ti02 only ascribes to the change of surface tension gradient.

III. CONCLUSION

From various literature survey efforts to identify in TIG welding process most of welding parameters like welding flux, 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 penetration, depth to width ratio, strength of welding joint by theoretical equations and experimentally measure with help of different input parameter. For achieving the proseperious result of experimental work and from the letureture study of various research paper the austentic type stainless steel with grade E321 is selected and fluxes are SIO2&TIO2.

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