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Effect of Various Fluxes on Weld Characteristics in Activated Tungsten Inert Gas (TIG) Welding Process

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Abstract—*In this research the effects of various fluxes on weld characteristics in A-TIG process have been investigated. Activated metal oxides Manganese dioxide (MnO_2), Titanium dioxide (TiO_2), and Silicon dioxide (SiO_2) were used for comparative studies on bead geometry such as depth of penetration, weld width and aspect (D/W) ratio on 10 mm thick AISI 301 austenitic stainless steel with conventional TIG welding. Autogenous TIG welding process was used. Paste form of activated flux which is made up with the mixing of acetone and binder (sodium silicate), applied on the surface of workpiece by using spray gun. The results showed that all activated fluxes have satisfactory increased depth of penetration and aspect (D/W) ratio. Among the all fluxes MnO_2 has less depth of penetration but it has higher aspect (D/W) ratio than TiO_2 activated flux and conventional TIG welding. It has been found that TIG welding with SiO_2 flux has highest increased depth of penetration compared with all activated flux used.*

1. INTRODUCTION

Tungsten inert gas welding is also known as gas tungsten arc welding which uses a non-consumable electrode to generate arc between workpiece and electrode. Argon or helium gases are use to protect the weld bead for atmosphere contaminates, these gases are also called shielding gas and filler materials are normally used. The process grants the operator greater control over the weld than competing processes such as shielded metal arc welding and gas metal arc welding, allowing for stronger, higher quality welds. TIG welding is use to joint ferrous and non-ferrous materials such as steel, copper, aluminium, magnesium, nickel, and their alloys.

TIG welding process has fails to weld thick section of material in single pass and it has low productivity. To improve the performance of TIG welding activated flux are use to increase the depth of penetration in single pass was first proposed by Paton electric welding institute in 1960. Activated flux is mixed with the acetone and blinder and applied thin past on the workpiece by brush or spray. A-TIG welding technique makes it possible to intensify the conventional TIG welding practices for joining the more than 10 mm thick plate by single pass with no edge preparation.

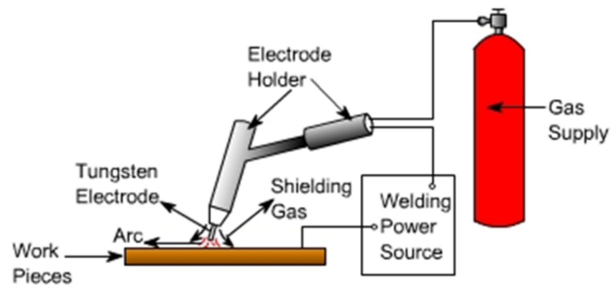


Fig. 1. Schematic diagram of TIG welding

M. Zuber et al. (2014) have investigated on Effect of flux coated gas tungsten arc welding on 304L. In this investigation the researcher used SiO_2 flux and the result shows that the penetration increased upto 200%, ferrite number increased upto 14 % and the hardness value of the material also increased.[1] G. venkatesan et al. (2014) has studied on Effect of ternary fluxes on depth of penetration in A-TIG welding of AISI 409 ferritic stainless steel. In this study the flux increased depth of penetration upto 100%.[2] Xiong Xie et al. (2015) have researched on Effects of nano-particles strengthening activating flux on the microstructures and mechanical properties of TIG welded AZ31 magnesium alloy joints. The researcher used mixed TiO_2 and nano-SiC particles as activated flux and showed that microstructure, microhardness in fusion zone, ultimate tensile strength was improved.[3]

Based on the previous researches, the present investigation deals with the three types of activated fluxes which are applied on the workpiece prior to welding. The bead geometry is then compared with and without using activated fluxes. The effects of the different fluxes has also been investigated.

2. MATERIAL AND EXPERIMENTAL PROCEDURE

2.1 Base metal and its composition

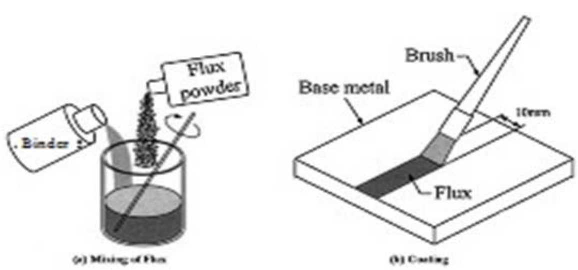
The material used in this study is austenitic stainless steel 301. The composition of the base metal is given in Table 1. The workpieces were cut in the dimension of 100 mm X 50mm X 10mm plates. Before welding the workpieces were cleaned with emery papers and then with acetone.

Table 1. Composition of material

Component	Percentage (%) Weight
C	0.066
Si	0.296
Mn	1.17
P	0.029
S	0.006
Cr	16.28
Mo	0.083
Ni	6.17
Co	0.077
Ti	0.008
V	0.051
Fe	Rest

2.2 Preparation of flux

The paste was made by mixing various powders in acetone with very small amount of sodium silicate as binder. This paste was applied with the help of brush on the surface of work piece before welding. Acetone has tendency to vaporise and leave the flux on the surface of workpiece and sodium silicate has tendency to sticking and bind the flux particle together.



2.3 Experimental procedure

In the first step, the welding parameters were decided on the basis of several trial experiments and are listed in Table 2.

Table 2. Process parameter used

parameters	value	units
Welding current	150	A
Total arc voltage evolution	10-15	V
Travel speed	100	mm/min
Arc gap	2	mm
Diameter of electrode	2.4	mm
Gas flow rate	15	L/min

Prior to welding the metal power is mixed with acetone and sodium silicate (as binder) to make paint like solution and applied a very thin layer approximately 0.2mm on the workpiece surface with the help of brush. Uniformity in applied flux is most important to get good quality of weld and more depth of penetration.

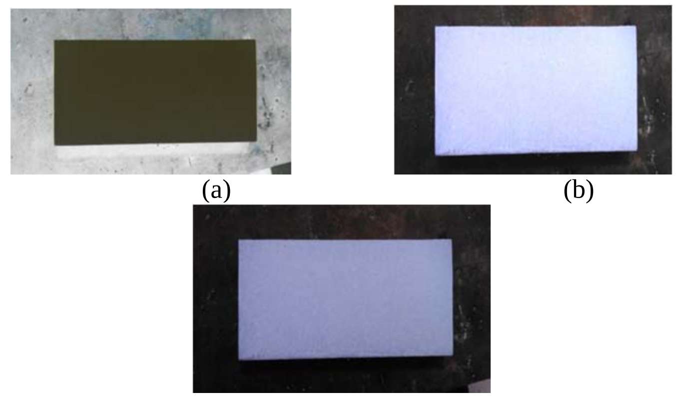


Fig. 2 Photograph of applied fluxes (a) MnO_2 flux, (b) TiO_2 flux and (c) SiO_2 flux.

TIG welding is done on the workpieces which are coated with the fluxes and without flux. The beads deposited on base plates has been shown in Fig 3

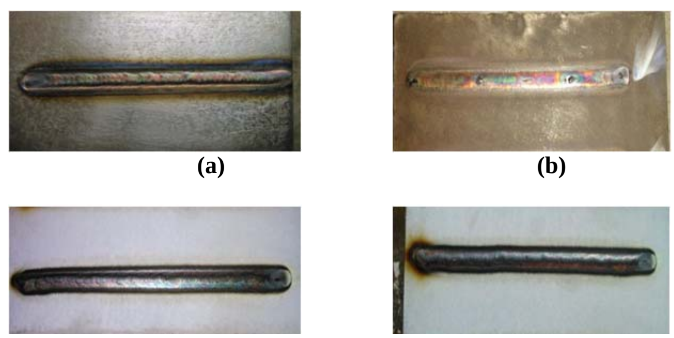


Fig. 3 photograph of weld bead on workpiece (a) without flux (b) MnO_2 flux (c) TiO_2 flux (d) SiO_2 flux

2.4 Measurement of bead dimensions

The weld beads were cross sectioned from the middle of workpiece where stable beads were obtained. The specimens removed from the middle of workpieces were polished using standard metallurgical procedures. Then polished surface was etched to reveal the bead geometry. The measurement of bead dimensions was done as per UNS SS30100 Standard on stainless steel specimen on the stereozoom microscope analyzer available at SLIET Longowal (Punjab. Before analysis, etchant is use to reveal bead geometry. Stereozoom analyzer is used to measure the bead geometry like bead width, depth of penetration and heat affected zone (HAZ) of the specimens.

3. RESULTS AND DISCUSSIONS

3.1 Effect on weld bead with and without flux

In conventional TIG welding, the direction of convection in weld is towards the edge from the centre of the weld. This convection shows low depth of penetration and wide weld width. But in activated TIG welding the convection is reverse from edge to centre to the weld. The images show the differences between conventional TIG welding and activated TIG welding [4].

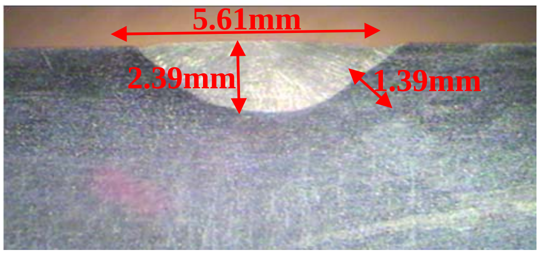


Fig. 3 Weld bead obtained without flux

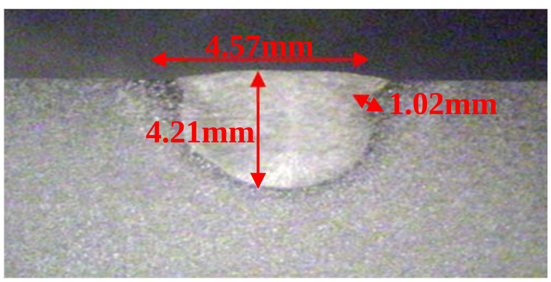


Fig. 4 Weld bead with MnO_2 flux

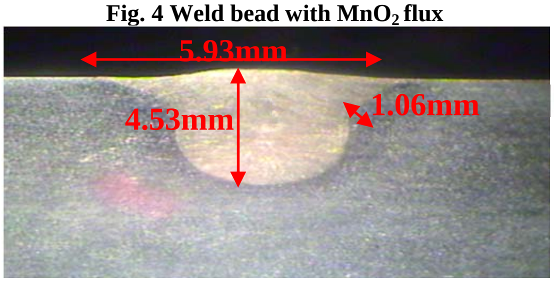


Fig. 5 Weld bead with TiO_2 flux

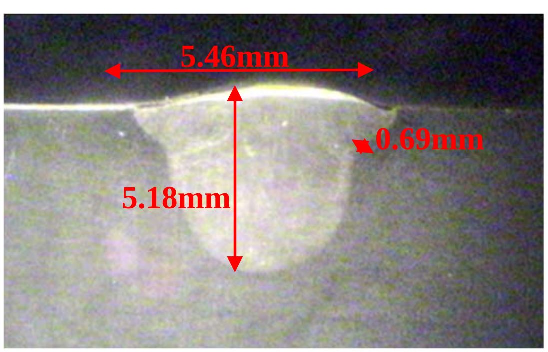


Fig. 6 Weld bead with SiO_2 flux

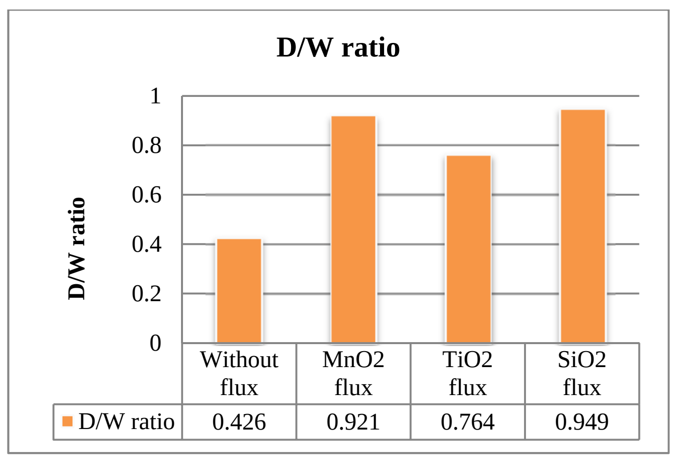
The results show that application of fluxes increase the depth of penetration. MnO_2 activated flux has lowest penetration among the other fluxes upto 4.21mm and SiO_2 activated flux has highest depth of penetration upto 5.18mm.

3.2 Effect on aspect ratio with and without fluxes

In conventional welding, the surface tension at centre of weld is less than edge of the weld that shows molten metal take place form centre to edge, this phenomena is called marangoni effect. Due to phenomena of surface tension in conventional TIG welding depth of penetration is less than width of weld bead.[4] Therefore the aspect ratio in conventional welding is 0.426. Application of flux constrict the arc to the centre of the weld bead this leads the surface tension towards the centre of the weld bead and the penetration achieved more than the conventional TIG welding process. It is observed that use of SiO_2 activated flux provide better aspect ratio as compare to other used flux in study.

Table 3. Bead dimensions with various fluxes

TIG Welding process	Depth of penetration (mm)	Weld width (mm)	Aspect ratio
Without flux	2.39	5.61	0.426
Using MnO_2 flux	4.21	4.57	0.921
Using TiO_2 flux	4.53	5.93	0.764
Using SiO_2 flux	5.18	5.46	0.949



Graph of aspect ratio

4. CONCLUSION

From the Study following conclusion are drawn.

1. The penetration can increased considerably using activated flux in TIG welding.
2. The maximum penetration 5.18 mm is achieved using SiO_2 flux.
3. Maximum aspect ratio observed is 0.949 for SiO_2 flux. So it is more beneficial to use SiO_2 flux.

4. It is further observed that using SiO_2 flux results in minimum heat affected zone which is desirable.

REFERENCES

[1] M. Zuber et al. (2014), "Effect of flux coated gas tungsten arc welding on 304L", **IACSIT** International Journal of Engineering and Technology, Vol. 6, No. 3 pp. 177-181

[2] G. venkatesan et al. (2014),"Effect of ternary fluxes on depth of penetration in A-TIG welding of AISI 409 ferritic stainless steel", ***Elsevier Ltd.*** Pocedia Materials Science 5 pp. 2402 – 2410

[3] Xiong Xie et al. (2015), "Effects of nano-particles strengthening activating flux on the microstructures and mechanical properties of TIG welded AZ31 magnesium alloy joints", ***Elsevier Ltd.*** Materials and Design 81 pp. 31–38

[4] Prof. A.B. Sambherao (2013)," Use of Activated Flux For Increasing Penetration in Austenitic Stainless Steel While Performing GTAW", ***Elsevier ltd.*** International Journal of Emerging Technology and Advanced Engineering pp. 220-224.

[5] Sanjay G. Nayee et al (2014), "Effect of oxide-based fluxes on mechanical and metallurgical properties of dissimilar activating flux assisted tungsten inert gas welds" ***Elsevier Ltd.*** Journal of Manufacturing Processes 16 pp. 137–143.

[6] Akash B. Patel et al. (2014), "The effect of activating fluxes in TIG welding by using ANOVA for SS 321", **ISSN,** Int. Journal of Engineering Research and Applications pp. 41-48

[7] Jay J. Vora et al. (2015) has studied on Experimental investigation on mechanism and weld morphology of activated TIG welded bead-on-plate weldments of reduced activation ferritic/martensitic steel using oxide fluxes", ***Elsevier ltd.*** Journal of Manufacturing Processes 20 pp. 224-233.

[8] Ankur Bajpai et al. (2015),"Investigations on structure–property relationships of activated flux TIG weldments of super-duplex/austenitic stainless steels", ***Elsevier B.V.*** Materials Science & Engineering A 638 pp. 60–68