# PERFOMANCE OF ACTIVATED FLUX ASSISTED TIG PROCESS BY ANN ON SS316 MATERIAL

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## ABSTRACT

*Gas tungsten arc welding has wide variety of application in industries due to advantages like high reliability, low cost, higher production rate. Activating flux is a concept, which is used in different welding process like GTAW, EBW and PAW. The flux ingredient which is inorganic compound (which can be used to produce deep penetration and are constriction).*

*In the present work, at attempt has been made to use of activated Flux for improving depth to width ratio as well strength of the weld joint in thicker job requirement need for improving deep penetration in minimum pass and using ANN optimization technique getting best set of process parameter.*

**Keyword:** *GTAW, Active flux, Penetration, ANN*

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## 1. INTRODUCTION

Gas Tungsten Arc Welding (GTAW) is an arc welding process that joins metals together by heating them with an electric arc that is established between a Non-Consumable electrode (tungsten) and the work piece. A filler wire is applied as and shielding gas (Ar, Hi, N) or gas mixture acts to shield the arc and molten weld pool. At first, it was considered to be fundamentally a high current density, small-diameter, non-consumable electrode process using an inert gas for arc shielding. As a result, it became known as Tungsten-inert gas (TIG) welding, which is still common nomenclature. Subsequent process developments included operation at low current densities and pulsed direct current, application to a broader range of materials, and the use of reactive gases (particularly Ar) and gas mixtures. The latter development, in which both inert and reactive gases are used, led to the formal acceptance of the term Gas tungsten arc welding. GTAW process can be operated in semi-automatic and manually modes. All commercially important metals, such as carbon steel, high-strength low-alloy steel, stainless steel, and aluminium, copper, and nickel alloys can be welded in all positions by this process if appropriate shielding gases, electrodes, and welding parameters are chosen.

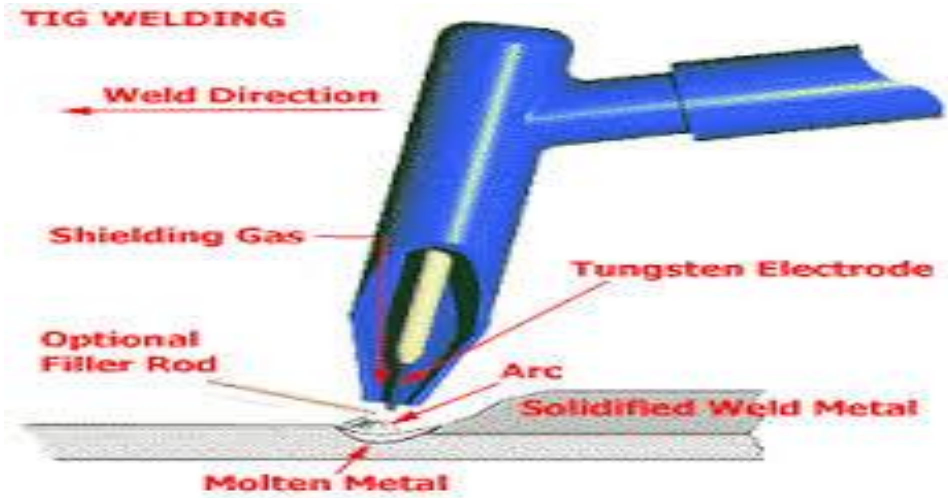



**Fig 1: Gas Tungsten Arc Welding**

**Activated Flux Welding**

The study was concerned with the activating flux gas tungsten arc welding. The flux ingredient, which is inorganic compound (which can be used to produce deep penetration and arc constriction) are available in variety of range and compositions. Some of fluxes have been reported effective for particular materials. Activating fluxes contain oxides and halides (chlorides and fluorides). Oxide coating consists of iron, chromium, silicon, titanium, manganese, nickel, cobalt, molybdenum and calcium are reported to improve weld ability and increase the welding speed.

The halogens, calcium fluoride and $AlF_2$, have claim to constrict the arc and increase weld depth of penetration Activated flux is a mixture of inorganic material suspended in volatile medium (acetone, ethanol etc.).

Inactivated flux GTAW process, a thin layer of the fine flux is applied on the surface of the base metal with brush before welding. Flux mixed with acetone to make it in a paste form as shown in the Fig.2. During activated flux, welding a part or all the fluxes is molten and vaporized. There is different types of fluxes (oxides) used in welding like $Fe_2O_3$, $SiO_2$, $MgCO_3$, $Al_2O_3$ etc. As a result, the penetration of the weld bead is significantly increased.

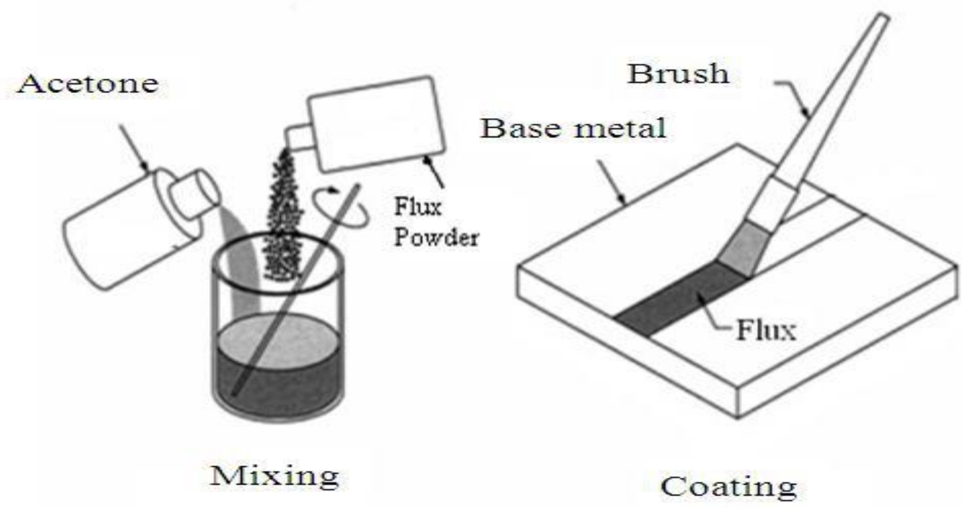
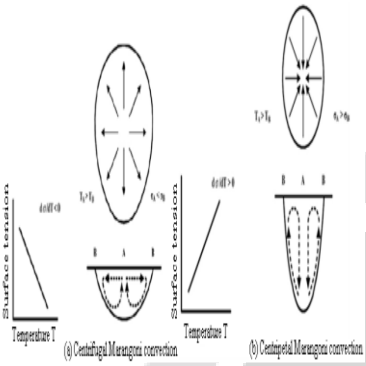



**Fig.2 Method of applying flux**

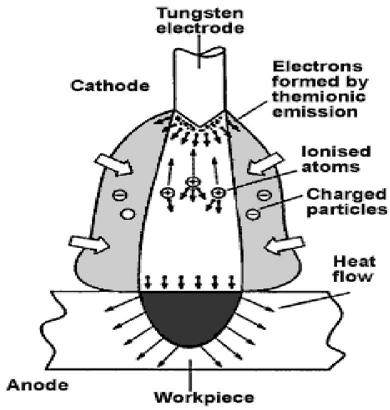
**Mechanisms For Deep Penetration**

At the present, no theory of the mechanisms by which the activating flux leads to an increased penetration of the weld bead is generally agreed. Available literatures show that some of the mechanisms, which play major role in increase depth of penetration, are given below.

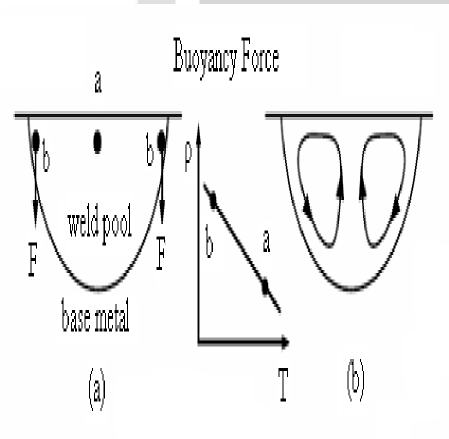
- Marangoni Effect.
- Electromagnetic force.
- Arc constriction due to negative ions.
- Buoyancy force.
- Arc constriction due to active flux



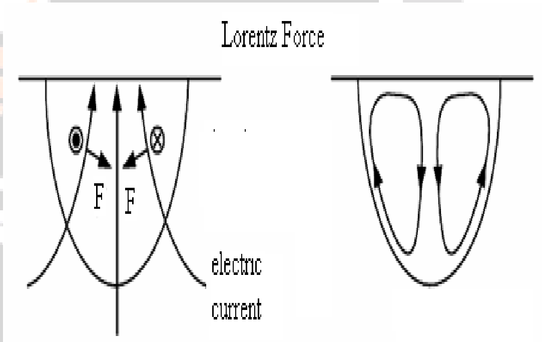

Marangoni Effect.




Arc constriction due to negative ions




Buoyancy force.




Electromagnetic force.

**FIG 3 Mechanisms For Deep Penetration**

## 2. LITERATURE REVIEW

**P. Vasantharaja et al. [1] 2014** were investigation the effect of welding processes on the microstructure, residual stresses and distortion in 16 mm thick316LN stainless steel weld joints made by TIG and A-TIG (activated flux tungsten inert gas) welding processes involving different joint configurations have been studied. The joint configurations employed were double V-groove edge preparation for double side TIG welding. The weld joint fabricated by double side A-TIG welding exhibited the lowest peak tensile residual stress value and minimum distortion. 16 mm thick, 316 LN stainless steel weld joints made by different welding processes with different joint design exhibited different microstructures, peak tensile residual stress and angular distortion values.

**Sanjay G. Nayee [2] 2014** Present investigation is to study the "Effect of Activating Fluxes on Mechanical and Metallurgical Properties of Dissimilar Activated Flux Tungsten Inert Gas Welds". Effect of current, welding speed, joint gap and electrode diameter on weld bead dimensions on 6 mm thick dissimilar weld between carbon steel to stainless steel, was studied under Activated Flux-Tungsten Inert Gas Welding process. During this investigation three different types of oxide powders were used-TiO2, ZnO and MnO2. After welding samples were subject to mechanical testing, in addition to characterization via micro hardness and microstructures of Normal Tungsten Inert Gas Welds and Activated Flux-Tungsten Inert Gas Welds. Activating fluxes TiO2 and ZnO are effective fluxes for Activated Flux-Tungsten Inert Gas Welding of dissimilar weld between CS to SS.

**G. Magudeeswaran [3] 2014**The use of activated flux in tungsten inert gas (TIG) welding typically results in a 200e300% increase in penetration capability and the activated flux can also be used for welding duplex stainless steel (DSS) of higher thickness. The activated TIG (ATIG) welding process mainly focuses on increasing the depth of penetration and the reduction in the width of weld bead has not been paid much attention. The shape of a weld in terms of its width-to-depth ratio known as aspect ratio has a marked influence on its solidification cracking tendency. The major influencing ATIG welding parameters, such as electrode gap, travel speed, current and voltage, that aid in controlling the aspect ratio of DSS joints, must be optimized to obtain desirable ASR for DSS joints. Hence in this study, the above parameters of ATIG welding for aspect ratio of ASTM/UNS S32205 DSS welds are optimized by using Taguchi orthogonal array (OA) experimental design and other statistical tools such as Analysis of Variance (ANOVA) and Pooled ANOVA techniques.

**J Pasupathy [4] 2013** had investigated Mathematical model was developed to predict the tensile behavior of TIG welded dissimilar joints made of 2mm low carbon steel and 1mm AA1050 alloys. The design of experiments concepts was used to optimize the desired number of experiments. TIG welding parameters like Current, Speed and Distance was chosen as the major parameters. Tensile behavior of the dissimilar joints was evaluated. Factorial experimentation technique is convenient to predict the main effects and the interaction effects of different influential combinations of Tungsten Inert Gas welding parameters, within the ranges of investigation on the tensile strength. The developed model can be used to predict the tensile strength in terms of TIG welding parameters obtained from any combinations of welding parameters within the ranges of variables studied. Alternatively, it also helps to choose the influential TIG welding parameters so that a desired value of tensile strength can be obtained. By optimizing the process parameters, we can increase the depth of penetration as well as the strength of the joint.

**G. Srinivasan (5) 2011** Indigenous development of reduced activation ferritic martensitic steel (RAFMS) has become mandatory to India to participate in the International Thermo-nuclear Experimental Reactor (ITER) programme. Optimisation of RAFMS is in an advanced stage for the fabrication of test blanket module (TBM) components. Simultaneously, development of RAFMS filler wires has been undertaken since there is no commercial filler wires are available for fabrication of components using RAFMS. Purpose of this study is to developfiller wires that can be directly used for both tungsten inert gas welding (TIG) and narrow gap tungsten inert gas welding (NG-TIG), which reduces the deposited weld metal volume and heat affected zone (HAZ) width. Further, the filler wires would also be used for hybrid laser welding for thick section joints. In view of meeting all the requirements, a detailed specification was prepared for the development of filler wires for welding of RAFM steel. Meanwhile, autogenous welding trials have been carried out on 2.5mm thick plates of the RAFM steel using TIG process at various heat inputs with a preheat temperature of 250 ◦C followed by various post weld heat treatments (PWHT).

**P. Sathiya (6) 2011** The laser welding input parameters play a very significant role in determining the quality of a weld joint. The quality of the joint can be defined in terms of properties such as weld bead geometry, mechanical properties and distortion. In particular mechanical properties should be controlled to obtain good welded joints. In this study, the weld bead geometry such as depth of penetration (DP), bead width (BW) and tensile strength (TS) of the laser welded butt joints made of AISI 904L super austenitic stainless steel are investigated. Full factorial design is used to carry out the experimental design. Artificial neural networks (ANNs) program was developed in MatLab software to establish the relationship between the laser welding input parameters like beam power, travel speed and focal position and the three responses DP, BW and TS in three different shielding gases (argon, helium and nitrogen). The established models are used for optimizing the process parameters using genetic algorithm (GA).

**Tsann-Shyi Chern et al. [7] 2010** investigated The purpose of this study is to investigate the effects of the specific fluxes used in the tungsten inert gas (TIG) process on surface appearance, weld morphology, angular distortion, mechanical properties, and microstructures when welding 6 mm thick duplex stainless steel. This study applies a novel variant of the autogenously TIG welding, using oxide powders (TiO2, MnO2, SiO2, MoO3, and Cr2O3), to grade 2205 stainless steel through a thin layer of the flux to produce a bead on-plate joint. Experimental results indicate that using SiO2, MoO3, and Cr2O3 fluxes leads to a significant increase in the penetration capability of TIG welds. This study systematically investigates the effects of TiO2, MnO2, SiO2, MoO3, and Cr2O3 fluxes on surface appearance, weld morphology, angular distortion, ferrite/austenite content, and mechanical properties obtained with the TIG process applied to 6 mm thick grade 2205 stainless steels. The surface of TIG welds produced with flux formed residual slag and spatters. Using TIG welding with flux produced a small amount of fume. 2. Using SiO2, MoO3, and Cr2O3 fluxes not only significantly increased penetration capability, but also improved mechanical strength of the grade 2205 stainless steel welds compared with conventional TIG welds.

**J.J. del Coz Díaz et al. [8] 2010** had studied thermal stress analyses were performed in the tungsten inert gas (TIG) welding process of two different stainless steel specimens in order to compare their distortion mode and magnitude. The growing presence of non conventional stainless steel species like duplex family generates uncertainty about how their material properties could be affected under the welding process. To develop suitable welding numerical models, authors must consider the welding process parameters, geometrical constraints, material non-linearity and all physical phenomena involved in welding, both thermal and structural. The movement of the TIG torch was moved in a discontinuous way assuming a constant welding speed. Thirdly, the arc heat input was applied to the weld zone using volumetric heat flux distribution functions. Fourthly, the evolution of the structural response has been tackled through a stepwise non-linear coupled analysis. The numerical simulations are validated by means of full-scale experimental welding tests on stainless steel plates.

- **Objectives**

- Improve Penetration for Welding Process.
- Increase Productivity and reduced the passes of weld.
- Improve depth-to-width of the weld joint.
- To increase anode density and arc force by arc constriction acting on weld pool.
- The better activated flux used in process because best performance in process.

## 3. EXPERIMENT & RESULT

**Parameter considering for the Experiment**

There is a various parameter considering in the TIG welding. When some changes occurred in the different parameter its effect on the welding process. Effect of changing parameter on the welding is different on various materials. There is a table of considering parameter in this dissertation.

**Table: 1 Input Parameter**

| No | Factor | Level-1 | Level-2 | Level-3 | Unit |
|---|---|---|---|---|---|
| 1 | Arc Voltage | 16 | 18 | 20 | Voltage |
| 2 | Welding current | 150 | 165 | 180 | Ampere |
| 3 | Welding speed | 150 | 140 | 130 | mm/min |

**USE FLUX - $Sio_2$ and $Cr_2O_3$**

- **INPUT PARAMETER**

1. Arc voltage (V)
2. Welding current (A)
3. Welding speed (mm/min)
4. Activated flux ($Sio_2$,and $Cr_2O_3$)

➢ **OUTPUT PARAMETER**

1. Depth of penetration (mm)
2. Hardness (HV)

**Table: 2- L9 Orthogonal Array for Experimental Runs**

| NO | Welding Speed (mm/min) | Welding Current (A) | Arc Voltage (V) |
|---|---|---|---|
| 1 | 150 | 150 | 16 |
| 2 | 150 | 165 | 18 |
| 3 | 150 | 180 | 20 |
| 4 | 140 | 150 | 18 |
| 5 | 140 | 165 | 20 |
| 6 | 140 | 180 | 16 |
| 7 | 130 | 150 | 20 |
| 8 | 130 | 165 | 16 |
| 9 | 130 | 180 | 18 |

## 4. CONCLUSION

From the literature review, it has been found that the several researchers has been worked on various TIG welding through using various process parameter like welding speed, voltage, current and active flux. Several researcher has been worked on same material is SS with various process parameter. Also it has been found that the several researchers have been worked on penetration, hardness, tensile strength. Also it has been found that the very less literature have been done on the **SS316 steel material**. **SS316 steel material** are widely using in industry. Thus it has been decided to work on SS316 steel by using welding process.
TIG welding process use on SS316 material use different parameter and flux. Work on SS316 using parameter is mension in my experiment. And my work is optimization base on ANN method is continue.

## 5. REFERENCE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