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Investigation of Weld Characteristics of Stainless Steel Material Fabricated by TIG Welding Process: A Review

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ABSTRACT-- *The welding process for ss410 metal by using TIG welding voltage gas flow rate and strike off distance were selected to ascertain with effect on the metal hardness of the welding bed NDT technique is used to detect of the welding bed.ss410 have gathered wide acceptance in the fabrication of light weight structures requiring a high strength to weight ratio and good corrosion resistance. Modern structures concept demand reduction in the weight as the cost of production and fabrication of the material 410 SS joints are inevitable for certain application due to unique performances such as corrosion resistance and mechanical properties the process welding parameters like current voltage gas flow rate of TIG for getting maximum weldment best mechanical properties the analysis of the test result is conducted welding parameter range that given best result found this combination can be considered as good range for TIG welding of SS410 material and conduct the study of temperature distribution and total heat flux of welding area of using analysis. Scope of arc welding has to be increased in the various engineering field like aerospace nuclear and under water industries where complex geometry and hazardous environment necessitate fully automated system even traditional application of arc welding such as off highway and automotive manufacturing have to be increased due to their demand in quality cost accuracy and volume to stay competitive as a result process parameter are need to improve the existing process weld*

Keywords*-- TIG, SS4l0, SS04L, Arc welding, Manufacturing*

I. INTRODUCTION

Welding is a permanent joining process used to join different material like alloy or plastic together at their contracting surfaces by application of heat or pressure during welding the work piece to be joined are melted a the interfaces and after solidification a permanent joint can be achieved sometimes a filler material is added to form a weld pool of molten material which after solidification gives strong bond between the material weld ability of material depend on different factor like the metallurgical changes occur during welding change in hardness weld zone due to rapid solidification[1] the capacity to limit the current to the set value is equally crucial when the electrode is short circuited to the work piece otherwise excessively high current will flow damaging the electrode

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open circuit voltage of power source ranges from 60 to 80v the electric arc can be produced 20000degree and this heat can be focused to melt than two different part of material[2]

2.The aim of this review paper is to investigate of weld characteristics of stainless steel Grade 410is the basic martens tic stainless steel, like most non-stainless steels. It can be hardened by a "quench-and-temper" heat treatment It contains a minimum of 11.5 per cent chromium, just sufficient to give corrosion resistance properties. It achieves maximum corrosion resistance when it has been hardened and tempered and then polished. Grade 410 is a general purpose grade often supplied in the hardened, but still machine able condition. [3]The applications where high strength, moderate heat and corrosion resistance are required. Martens tic stainless steels are optimized for high hardness and other properties are to some degree compromised. Fabrication must be by methods that allow for poor weldability and usually the need for a final heat treatment.[4] Corrosion resistance of the martens tic grades is lower than that of the common austenitic grades, and their useful operating temperature range is limited by their loss of ductility at sub-zero temperatures and loss of strength by over tempering at elevated temperatures.[5]

II. TYPES OF WELDING

TIG - Gas Tungsten Arc Welding (GTAW)
Stick - Shielded Metal Arc Welding (SMAW)
Flux-Cored Arc Welding (FCAW)
Energy Beam Welding (EBW)
Atomic Hydrogen Welding (AHW)
Gas Tungsten-Arc Welding
Plasma Arc Welding

TIG welding is an arc welding process that uses a non-consumable tungsten electrode to produce the weld. The weld area is protected from atmosphere by an inert shielding gas (argon or helium), and a filler metal is normally used. The power is supplied from the power source rectifier through a hand-piece or welding torch and is delivered to a tungsten electrode which is fitted into the hand piece [6]

D.Kumaravel etal.the welding process for SS410 metal by using TIG welding. Welding voltage, gas flow rate and strike off distance were selected to ascertain with effect on the metal hardness of the welding bed. NDT technique is used to detect the defect of the welding bed. SS410 have gathered wide acceptance in the fabrication of the lightweight structures requiring a high strength to weight ratio and good corrosion resistances [7]

A.Balamurugan etal. the various engineering fields like aerospace, nuclear and underwater industries where complex geometry and hazardous environments necessitate fully automated systems. Even traditional applications of arc welding such as off highway and automotive manufacturing have to be increased due to their demand in quality, cost, accuracy and volume to stay competitive As a result process parameters are needed to improve the existing process of welding[8]

M.R.Ramachanandharan etal. the austenitic stainless steel (316L) is welded by GTAW process and its mechanical property were studied and the process welding parameters like current voltage gas flow rate of TIG for getting maximum weldments, best mechanical properties and min HAZ. The analysis of the test results is conducted and the combination of welding parameter ranges that gives best result is found. This combination can

be considered as good working ranges for TIG welding of SS316L material and conduct the study of temperature distribution and total heat flux of welding area using ANSYS[9]

Yashwant Thakur etal. TIG welding parameter tensile impact Behaviour Aluminium alloy joint the literature survey, it is found that welding of Aluminium is very difficult with conventional arc welding processes. There of welding parameters which affect the welding quality for again repeatability. Different parameter ranges & their effects are studied. In this particular study, TIG welding set up will be used to weld 10mm thick AA7005 plate by changing the welding parameters. The effect of these parameters on tensile and impact strength of welding joints will be analysis[10]

I.J Rohith etal. TIG welding 304 stainless steel the quality of the weld largely depends on the mechanical properties of the welded specimens. For this work the input process parameters considered are voltage Welding Current, Gas Flow Rate and Speed. The prediction of output parameters Vickers Hardness and Tensile Strength were carried out through Artificial Intelligence technique based Adaptive Neuro Fuzzy Inference System tool is used[11]

Radha Raman etal. tensile strength MIG and TIG dissimilar joint in the present study, stainless steel of grades 202, 304, 310 and 316 were welded with mild steel by Tungsten Inert Gas (TIG) and Metal Inert Gas (MIG) welding processes. The percentage dilutions of joints were calculated and tensile strength of dissimilar metal joints was investigated. The results were compared for different joints made by TIG and MIG welding processes and it was observed that TIG welded dissimilar metal joints have better physical properties than MIG welded joints[12]

Bhavin Shaik etal. the TIG welding restricts its ability to weld thick structures in a single pass thus its productivity is relativity low and skill welders are required. The use of activated flux in conventional GTAW process is one of the most significant advancements for overcoming the shortcomings of TIG welding, which helps in increasing the depth of penetration in single pass and to also increase depth to width ratio of the weld pool, thereby increasing the productivity of the process and also it helps in achieving better mechanical properties[13]

R.Kumar etal. Austenitic stainless steels are widely used in the application of aircraft engine parts, heat exchangers furnace parts etc. It contains both chromium and nickel. Nickel and chromium aids stability of austenite overwide range of temperatures and high corrosion resistance respectively. 316L austenitic stainless steel is low carbon (0.03%) steel, developed from 316 austenitic stainless steel and contains carbon (0.08%). The causes of decreased contents of carbon, minimizes the problem of harmful carbide precipitation during welding[14]

Saurabh Kumar etal. TIG (Tungsten Inert Gas) welding and MIG (Metal Inert Gas) welding are most important welding techniques in industry point of view. Stainless steel is a common material used in all industries In this paper the study is done on welding technique (TIG or MIG) to find which welding technique is the best for stainless steel-202. The comparison is done on the basis of mechanical properties of the welded joint of TIG and MIG welding on stainless steel-202. It was observed that TIG welding has better in Tensile strength and hardness[15]

A.Raveendra etal. the weld of SS304using GTAW with pulsed current and non pulsed current at different frequencies of 5Hz,&10Hz on 3mm thick sheets. Hardness test, tensile test and microstructure results of weldments were studied aim of this experimental work is to see the effect of pulsed current on the characteristics of weldments. The experimental results pertaining to different welding parameters for the above material using pulsed and non-pulsed current GTAW are discussed and compared.[16]

Palani pk saju etal. The effect of TIG welding process parameter on welding of aluminium 65032 response surface methodology was to conduct experiment the parameter selected controlling the process are welding speed 150 200mm/min current 100-120 a gas flow rate 10-12 lit/min strength of welded joint were tested by a elongation were also calculated to evaluate the ductility of the weld joint from the result of the mathametical model have been developed to study the effect of process parameter on tensile strength and perecent elongation[17]

Indira Rani etal. performed an investigation on the mechanical properties of TIG welding Aluminium Alloy a plate dimension 300*150*6mm and the experimentation welding parameter was current as 70-74 a travel speed (700-760)MM/MIN and pulse frequency 3and7 HZ it was concluded from the experiment that tensile strength and yield strength of the weld joint was closer to the base metal failure took place at heat affected zone which result that weldment have better weld joint strength[18]

N.Karunagaran etal. investigation to compare the mechanical properties and welding profile of TIG welding Aluminium alloy joint the effect of pulse current on tensile strength hardness microstructure stress distribution was report and this investigation Aluminium plate and dimension were used the parameter of welding current 55-75 a voltage 11-13.5v and a constant welding speed were used for this experiment improve tensile of the weld compared current welding due to grain refinement occurring in the fusion range[19]

grade 410 is the basic martens tic stainless steel like most non stainless steel it can be hardened by quench temper heat treatment it consist a minimum of 11.5 per cent chromium just sufficient to give corrosion resistance properties it achieve maximum corrosion resistance when it has been hardened and tempered and then polished grade 410 is a general purpose grade often supplied in the hardened but still machine able condition the application where high strength moderate heat and corrosion resistance are required marten tic stainless steel are optimized for high hardness and other properties are to some degree compromised fabrication must be by method that allow for poor weld ability and usually the need for final heat treatment corrosion resistance of the marten tic grade is lower than that of the common austenitic grade and their useful operating temperature range is limited by their loss of ductility at subzero temperature and loss of strength by over tempering at elevated temperature[20]

T.Kumar etal. studied medium strength Aluminium alloy to check its tensile Characterstics AA606 different combination of welding parameter have been tested on 3m thick plate ALUMINIUM alloy peak current base current pulse frequency on pulse time variable parameter result an increases in base current has inverse effect on tensile strength of the joint hence in this work influences of pulsating current have inverse effect on tensile strength of the joint [21]

V.Anand rao etal. welding aspects of stainless steel 310 for the process of TIG welding this analysis of optimization of joining of similar grade of stainless steel by TIG welding parameter like current filter material welding speed the variable in the study the mechanical properties and microstructure of 310 austenitic stainless steel weld are investigated by using stain less steel filler material different grade high tensile strength was achieved with a current 120a and 309l filler rod and also the weld fewer defects[22]

Bhavin shah etal. this paper represent TIG welding process gas tungsten arc welding is fundamental in those industries where it important to control the weld bed shape and its metallurgical characteristics however compared to other arc welding process the shallow penetration of the TIG welding restricts its ability to weld thick structures in a single pass thus its productivity is relatively low and skill welder are required[23]

Keyur Panchal etal. the effect of TIG welding on stainless steel and mild steel plate TIG welded plates majorly used in industries purpose the welding dissimilar metal is most useful in structural application but the difficulty arises due to welding such plate because of the loss carbon from mils steel and precipitation of chromium in stainless steel during welding this paper main discuss about effect of welding on MS and SS plate and study the result like hardness tensile bend test etc TIG welding perform best on SS and MS welding [24]

VP.patel etal. gas tungsten arc welding process in this paper different types of organization are striving hard to costs maintain high level of productivity meet changing expectation of the customers and attain quality of weld [25]

Palani etal.TIG welding which help in increasing the depth of penetration and depth to width ratio of the weld pool there by increasing the productivity of the process and also its helps in achieving better mechanical properties[26]

PK, Saju investigated the effect of TIG welding process parameters on welding of Aluminium-65032. Response Surface Methodology was used to conduct the experiments. The parameters selected for controlling the process are welding speed (150-200) mm/min current (100-120) A and gas flow rate(10-12) Lit/min. Strength of welded joints were tested by a UTM. Percent elongation was also calculated to evaluate the ductility of the welded joint. From the results of the experiments, mathematical models have been developed to study the effect of process parameters on tensile strength and percent elongation.[27]

K.Gundewar etal. the main factor by improving which the industry can survive in the market productivity quality customer deliver date the parameter also delivered for ss304l by auto TIG welding pipe of ss304l with 8mm thickness after developing these parameter are applied on the standard job items and the penetration controlled within 1mm finally concluded with the implementation of those parameter auto TIG productivity get increased [28]

Jagjit Randhawa etal. 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 [29]

J. Niagaj etal.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 BCTI 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.[30]

A.R. Ibrahim etal. 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 [31]

Syarul Asraf Mohamat etal. 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[32]

Cheng-Hsien Kuo etal. 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, Fe2O3, Cr2O3, andSiO2 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 SiO2 powder can increase joint penetration and weld depth-to-width ratio, and therefore the angular distortion of the dissimilar weldment can be reduced Further more, the defects susceptibility of the as-welded can also be reduced.[33]

Samrad etal. 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 activating flux on the weld joint appearance is investigated[34]

Michael lui etal.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 such as fluorides of the alkali and alkali earth metals. The effects of cryolite (Na3 AlF6), a complex fluoride, on weld bead morphology was studied and compared to the effects from the simple fluoride, MgF2.Cryolite was shown to increase single-pass penetration through a slight arc construction and increase current density mechanism.[35]

III. CONCLUSION

TIG welding can be used successfully to join SS410. The processed joints exhibited better mechanical and metallurgical characteristic joint exhibited 90-95% of parent material hardness value the specimen failures were associated depending upon the improper charges heat value in our experiment we found out the input parameter value 140 peak current base current 80 amps and torch angle 40 degree best value and it does not create any major changes and failures in the testing process the toughness value of the TIG welding ss410 steel comparatively higher value 140 peak current base current 80 amps and torch angle 40 degree than other value induced high tensile strength finally we concluded that in this project investigation the value 140 peak current base current 80amps was the best parameter for ss410 steel for 10mm thickness plate for obtain the good weldment state according to the TAGUCHI design optimized parameter were value impact strength for 10mm thickness plate value was 140 peak current base current 80 amps and torch angle 30degree.

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