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A REVIEW PAPER ON COMPARATIVE INVESTIGATION OF V AND U GROOVE BUTT WELD JOINT FOR STRENGTH ANALYSIS USING TIG WELDING

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ABSTRACT

Now a days in shipping, aerospace and in process industry aluminum and its alloys are commomly used because of their valuable properties such as light weight, brtter corrosion resistance and weldability. The current study aim to compare mechanical properties of AA6063 and AA2024 for different groove angle and bevel heights keeping root opening, voltage and current constant. The specimens are prepared by using V and U groove butt weld joints.

In this work gas tungsten arc welding process has been selected because TIG welding is the process of joining different materials with higth quality in the presence of inert gas. Alternating current power source has been selected because of better cleaning action and due to alternating current the high heat concentration on the material can be avoided. Mechanical tests such as tensile test, impact test, hardness test have been conducted to find out the mechanical properties such as tensile strength, impact strength, toughness of HAZ.

KEYWORDS: Groove Angle, TIG Welding, V- Groove Butt Weld Joint, Root Opening, Bevel Height

INTRODUCTION

Welding is a process of permanent joining of two materials merging with each other by the suitable combination of temperature, pressure and metallurgical conditions. Accordng to the different combination of temperature and pressure a large range of welding processes are avalible. Gas tungsten arc welding is one of the most important arc welding process in industry that uses a non-consumable tungsten electrode and an inert gas for arc shielding. It is commonly used for welding hard to weld metals, like aluminum, stainless steel, magnesium and titanium. Gas tungsten arc weld quality is strongly characterized by the welding speed. This is because the welding speed plays an important role in determining the mechanical properties of the butt weld joint. In current senario, statistical experimental design, linear regression modeling, and neural networks have been used to study the effect of welding process parameters on the butt weld joint strength. It has been shown that the welding process parameters are strongly correlated to the butt weld joint strength. Therefore, it is very important to select the welding process parameters for obtaining optimal butt weld joint strength.

LETERATURE REVIEW

Different researchers have discussed on effect of various parameters on strength of aluminum alloy in different ways. They are as follows.

R.R.Balasubramanian et.al. studied and compared the mechanical properties of non-heat treatable Aluminium alloy AA5083 and heat treatable Aluminium alloy AA7020 using Tungsten Inert Gas welding. 5556A filler were used to weld AA7020 alloy and 5183A filler for AA5083 alloy. Effect of pulsing mode over conventional mode of GTA process were also investigated for AA5083 alloy. In this work, gas tungsten arc welding process has been selected because it is low heat input process. Low heat input process has selected because AA7020 and AA5083 were low melting point material. The alternating current (AC) power source has been selected because of better cleaning action and high heat concentration on the materials can be avoided. Mechanical testing like tensile test, impact test, bend and hardness test have been critically analysed and the properties were summarized and correlating with microstructure and SEM fractographs.

S.C. Juang et.al In this paper, the selection of process parameters for obtaining an optimal weld pool geometry in the tungsten inert gas (TIG) welding of stainless steel is presented. Basically, the geometry of the weld pool has several quality characteristics, for example, the front height, front width, back height and back width of the weld pool. To consider these quality characteristics together in the selection of process parameters, the modified Taguchi method is adopted to analyze the effect of each welding process parameter on the weld pool geometry, and then to determine the process parameters with the optimal weld pool geometry. Experimental results are provided to illustrate the proposed approach.

T.H. Hyde et. al. studied some typical results obtained from finite element (F.E.) creep and continuum damage mechanics analyses for assessing weld repair performance. Results presented cover a range of analyses, taking account of the effects of repair profiles/ dimensions, geometry change during creep end (system) bading reheating effects in the weld metal of partial repair welds and initial damage level etc. Authors obtained the results shown the significant increase of the total life, as the load increases, particularly when the time to repair is close to the failure life of the original weld.

T. H. Hyde et. al. studied finite element creep and damage analysis were performed for a series of new, service-aged, fully repaired and partially repaired circumferential welds in CrMoV main steam pipes under an internal pressure and a uniform axial stress, using simplified ax symmetric models. Thickness of pipe was 63.5mm, angle $15^0$and welding width is 46 mm. Authors conclude that, because of complex nature of the problem exact analytical solutions can not be obtained for the stresses and strain within welds under creep conditions. Weld width on the failure life is relatively small.

Y. J. Oh et. al. studied for bottom nozzle failure mechanism of water reactor pressure vessel (R.P.V.) under severe accident conditions and concluding that crack, like separations were revealed at the nozzle weld metal to R.P.V. interfaces indicating the importance of normal stress component rather than the shear stress in the creep rupture.

N. E. Ipek studied the gas metal arc welding (GMAW) process which is extensively used in manufacturing of variety of ferrous and nonferrous metals because it greatly increases the quality of welding. The objective of this study is to develop an approach that enables the determination of critical GMAW variables and optimization of process variables by using integrated de- sign of experiment (DoE) and goal programming (GP) methods conjunctively. This paper presents a methodology for simultaneously determining the variables of a GMA process with multiple performance objectives utilizing full-factorial design of experiments, regression analysis and goal programming.

Lakshman Singh studied the type of welding (Tungsten Inert Gas) (TIG) welding is a high quality welding process used to weld the thin metals and their alloy. 5083 Aluminium alloys play an important role in engineering and metallurgy field because of excellent corrosion properties, ease of fabrication and high specific strength coupled with best combination of toughness and formability.

TIG welding technique is one of the precise and fastest processes used in aerospace, ship and marine industries. TIG welding process is used to analyze the data and evaluate the influence of input parameters on tensile strength of 5083 Al-alloy specimens, Welding current (I), gas flow rate (G) and welding speed (S) are the input parameters which effect tensile strength of 5083 Al-alloy welded joints. As welding speed increased, tensile strength increases first till optimum value and after that both decreases by increasing welding speed further.

H.R.Ghazvinloo studied the arc voltage, welding current & welding speed on fatigue life, impact energy & bead penetration of AA 6061 joint produced by robotic MIG welding, result clearly found that when heat input increases ,fatigue life of weld metal decreases so impact energy increases. linear increase in depth penetration with increasing welding current & arc voltage also observed.

MATERIALS AND METHODS

Materials

The material used to carry out experimental work to investigate and compare V groove and U groove butt weld joint for strength analysis using AA6063 and AA2024. The diamensions of weld materials are 8×300×300mm.

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Table 1. Chemical composition of work material AA6063

Elements	Al	Si	Cu	Mg	Cr
Weight %	97.9	0.6	0.28	1.0	0.2

Table 2. Chemical composition of work material AA2024

Elements	Al	Si	Cu	Mg	Cr
Weight %	93.61	0.19	3.94	1.24	0.09

Welding geometry

The two plates are welded by the single V-groove butt weld joint with different groove angles and bevel heights. The geometry of butt weld joint is as follow.

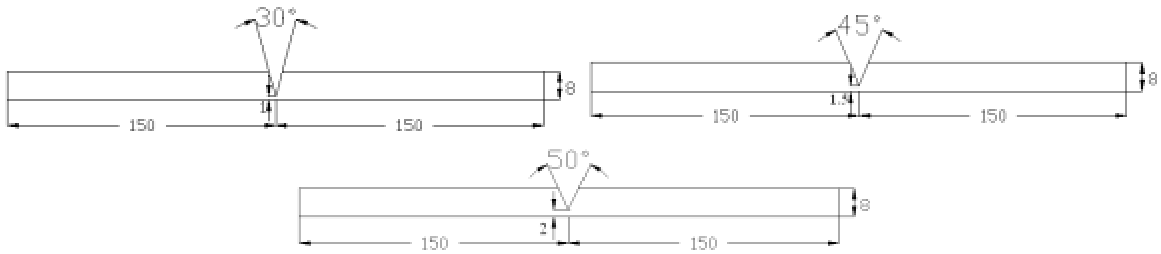

Figure 1: ***Welding geometry of V Groove groove butt weld joint with groove angle 30^0, 40^0, 50^0 respectively.***

The two plates are welded by the single U-groove butt weld joint with different groove angles and bevel heights. The geometry of butt weld joint is as follow.

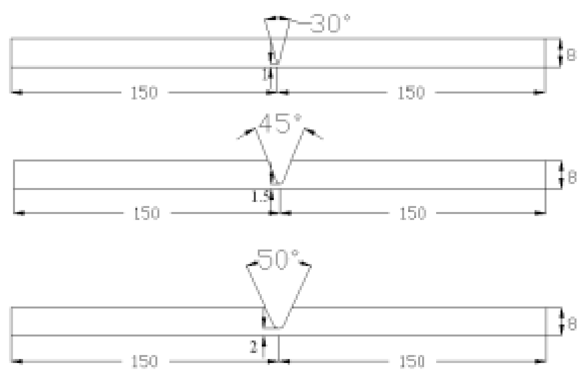

Figure 2: ***Welding geometry of U Groove groove butt weld joint with groove angle 30^0, 40^0, 50^0 respectively.***

Welding process

TIG Welding

TIG welding is an electric arc welding process in which the fusion energy is produced by an electric arc burning between the workpiece and the nonconsumable tungsten electrode. The inert gases are used to provide the shielding over the electrodes and weld pools because inert gases are in active in nature so it avoids the contamination. Variety of tungsten electrodes are used with in the process. The electrode is normally ground to a point or truncated cone configuration to minimize arc wandering.

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EXPERIMENTATION

Table 2. Experimentation values for V and U groove butt weld joint for material AA6063 and AA2024

Specimen No	Root Opening in mm	Groove Angle in Degree	Bevel Height in mm	Type of Groove	Material
1	2	30	1	V	AA6063
2	2	45	1.5	V	AA6063
3	2	50	2	V	AA6063

Specimen No	Root Opening in mm	Groove Angle in Degree	Bevel Height in mm	Type of Groove	Material
1	2	30	1	U	AA6063
2	2	45	1.5	U	AA6063
3	2	50	2	U	AA6063

Specimen No	Root Opening in mm	Groove Angle in Degree	Bevel Height in mm	Type of Groove	Material
1	2	30	1	V	AA2024
2	2	45	1.5	V	AA2024
3	2	50	2	V	AA2024

Specimen No	Root Opening in mm	Groove Angle in Degree	Bevel Height in mm	Type of Groove	Material
1	2	30	1	U	AA2024
2	2	45	1.5	U	AA2024
3	2	50	2	U	AA2024

CONCLUSION

Following are the probable outcomes which are obtained at the end of experimentation and testing

1) Comparative Investigation in between V and U groove butt weld joint for tensile strength. Using aluminium alloy 6063 and 2024 at different groove angles and bevel heights.
2) Comparative Investigation of V and U groove butt weld joint for impact strength. Using aluminium alloy 6063 and 2024 at different groove angles and bevel heights.
3) To find out the effect of the different groove angles and bevel heights on toughness of HAZ for AA6063 and AA2024
4) To suggest the best suitable material for maximum tensile, impact strength and minimum hardness of HAZ.
5) To suggest the best suitable groove angle and bevel height for maximum tensile, impact strength and for minimum hardness of HAZ and distortion for plate welding application.

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