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A REVIEW PAPER ON EFFECT OF WELDING SPEED AND GROOVE ANGLE ON STRENGTH OF BUTT WELD JOINT USING TIG WELDING

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ABSTRACT

Welding is most important operation in any industry. It is essential to optimize the various parameters of welding process so that we can achive the reliability, productivity and quality of the products. So industries are forcing the engineers to look at the welding process parameters such as electrodes, inert gas, current, voltage etc. The ojective of any industry is production of high quality products at low cost and increase the production rate. TIG welding process is versatile and commonly used operation for joining of two materials with the application of heat and /or pressure or fillet material to increase the production with less time and cost.The upgoing study is carried out to investigate the influence of welding speed, groove angle and bevel height on strength of mechanical properties such as tensile test, impact test. Also the current study aim to investigate the effect of welding speed on hardness of HAZ(Heat Affected Zone) and longitudinal and transvesr distortion of butt weld joint. Mechanical testings are carried out to find out the mechanical properties of butt weld joint.

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

INTRODUCTION

TIG or GTAW welding is a type of arc welding process that is being widely used in industry for sheet joining purposes.There are many applications of welding made of carbon steel such as bridge structure, fuel tanks, pipelines, shipbuilding, pressure vessels etc are subjected to various stresses such as tensile, compressive and thermal stresses etc. The toughness and resistance of the welded piece to failure depends upon many factors such as welding parameters (current, voltage, speed etc), geometric shape, design of the welding piece, the method implemented for welding and the nature of the applied stresses and others. We know that the welding process relies on an intensely localized heat input, which tends to generate undesired residual stresses and deformations in welded structures, especially in the case of thin plates which is known as distorsion.

LETERATURE REVIEW

Different researchers have discussed on effect of various welding parameters on mechanical strength of butt weld joint in various ways. They are summarized below.

Dr. T. Srihari. al. carried out the effect on groove angle on angular distortion and impact strength butt welds and concluded that the importance of groove angle, also conclude that distortion has been increased with increase in the groove angle till 60^0.

N. Ren et. al. studied the constraining effects of the weld and heat-affected zone (HAZ) material in welded tube numerical control (NC) bending process are key problem to be solved in the research, development and application of thin-walled welded tubes. The constraining effects of the weld and HAZ material in welded tube NC bending process are obtained by using FE simulation. Theresults are shown as follows:

1. As the weld line locates on the outside, the constraining effects of the weld and HAZ material make the tangent strain and thickness strain decrease, the hoop strain increase in weld and HAZ
2. As the weld line locates on the outside, the larger constraining effect of the weld makes the wall thinning at the outside crest line decrease greatly as compared with the model-PA, while the HAZ material has little

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constraining effect on the wall thinning. The constraining effects of the weld and HAZ material become larger as the weld line locates on the outside and inside.

Rossi et.al. mentioned that some objective of the designer for adequate strength and also some golden rules. They mentioned the edge preparation and different weld joint with dimensions.

Sattari-Far et. al. study the effect of the weld groove shape and pass number on residual stresses in butt-welded pipes. They study for 6mm and 10mm thickness pipe with V-groove dimensions are, angle 600, thickness 10 mm and width 2mm. They concluded that,

1. The weld groove shape has no significant effect on residual stresses distribution on the surfaces of butt welded joints in thin pipes (6 mm thick).
2. In thick welded pipes, increase in pass number significantly increases the axial tensile stresses on the inner surface of the pipe.
3. At the weld centre line in thick pipes (10 mm thick) the magnitude of residual stresses in the middle of pipe thickness increased when the pass number decreased.

Sattari-Faret studied the effect of the welding heat input on residual stresses in butt welds of dissimilar pipe joints .this study used finite element techniques to analyze thermo mechanical behavior & residual stresses in dissimilar butt weld pipes.

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 axis 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.

Lakshman Singh studied the (Tungsten Inert Gas) (TIG) type of welding which 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.

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MATERIALS AND METHODS

Materials

The material used to carry out experimental work to investigate the effect of weld weiding speed on butt weld joint strength (Tensile,impact) as well as hardness of HAZ and distortion of ASME 106 Grade B work material. The diamensions of weld materials are 8×300×300mm.

Table 1. Chemical composition of work material

Element of Grade B	C	Mn	P	S	Si	Cr	Cu	Mo	Ni	V
Weight Max.%	0.3	0.29-1.06	0.03-5	0.03-5	0.10	0.40	0.40	0.15	0.40	0.08

Figure 1: ***ASME 106 Ggade B material***

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.

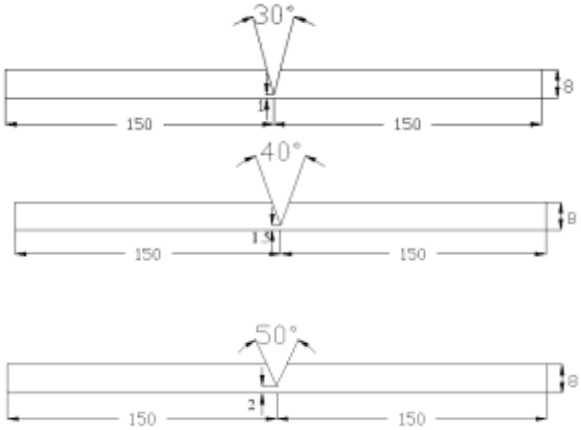

Figure 2: ***Welding geometry with groove angle 30^0, 40^0, 50^0 respectively.***

Welding process

TIG Welding

Tungsten Inert Gas welding is commonly used welding techniques for joining different materials. TIG welding process has important advantages like joining of metals, low heat effected zone, absence of slag etc compared to other welding processes. The accuracy and quality of welded joints totally depends upon type of power supply, welding speed, type of inert gas used for shielding etc. TIG welding, is a welding process that uses the heat to join to materials which is created by the electric arc in between the electrode and workpiece. The inert gas provides shielding over the electrode, molten weld pool and solidify the weld metal from contamination by the atmosphere. The process may be used with or without the addition of filler metal using metal rods.

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EXPERIMENTATION

After preparing the different groove and bevel heights on the plates the samples are welded at different speeds are as follows

Table 2. Welding speed 0.4 **cm/sec**

Specimen No	Welding Speed in cm/sec	Groove Angle in Degree	Bevel Height in mm
1	0.4	30	1
2	0.4	40	1.5
3	0.4	50	2

*Table 3. Welding speed 0.8***cm/sec**

Specimen No	Welding Speed in cm/sec	Groove Angle in Degree	Bevel Height in mm
1	0.8	30	1
2	0.8	40	1.5
3	0.8	50	2

Table 4. Welding speed 1.2 **cm/sec**

Specimen No	Welding Speed in cm/sec	Groove Angle in Degree	Bevel Height in mm
1	1.2	30	1
2	1.2	40	1.5
3	1.2	50	2

CONCLUSION

Following are the probable outcomes at the end of the experimentation

1) To study the effect of different welding speed on tensile strength of butt weld joint at different groove angles and bevel heights.
2) To find out the effect of different welding speed on impact strength of butt weld at different groove angles and bevel heights.
3) To find out the effect of different welding speed on distortion of butt weld joint at different groove angles and bevel heights.
4) To find out the effect of the different welding speed on toughness of HAZ of butt at different groove angles and bevel heights.
5) To suggest the best suitable welding speed for maximum tensile, impact strength and for minimum hardness of HAZ and distortion for plate welding application.
6) To suggest the best suitable groove angle for maximum tensile, impact strength and for minimum hardness of HAZ and distortion for plate welding application.

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