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

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ABSTRACT: Welding is the metal joining process in which two or more metal having same material or different can be joined by heating to a plastic state. It is mostly used for joining metals in process industry, in fabrication, maintenance, repair of parts and structures. The metal plates and pipes used in process industry and they have welding strength as their important parameter.

In this thesis, the welding speed and geometry to find out tensile and impact strength in case of butt weld joint will be done. For V-groove geometry different models of plate with various included angles from 350, 450, 500will be made from structural steel (A633 Grade E).Currently different welding speeds are used in precision welding applications such as nuclear reactor pressure vessels, boilers etc. where welding accuracy as well as quality with strength is an important parameter. So in this project experimentation will be done on different welding speed such as 0.4 cm/sec, 0.8 cm/sec and 1.20cm/sec to prepare a V-groove butt weld joint. Generally the V-groove geometry with included angle up to 600 is in use.

INTRODUCTION

TIG welding process and provide some history. TIG stands for Tungsten Inert Gas and is technically called Gas Tungsten Arc Welding or GTAW. The process uses a non-consumable tungsten electrode that delivers the current to the welding arc. The tungsten and weld puddle are protected and cooled with an inert gas, typically argon. TIG welding is similar to oxy-acetylene welding in that you use a filler material for build-up or reinforcement. TIG welding is often referred to as Heli-arc welding, originating from an early Hobart "Heli-Arc" machine. The name comes from using helium gas as a shield around the electric arc. TIG welding was developed in the 1930s and was used during World War 2 as the preferred way to weld many aircraft parts. Previously, some alloy steels and aluminum had to be welded with a torch, something that required considerable skill and time.

In race car fabrication, we use the TIG welding process for aluminum and 4130 chrome-moly steel. If you are going to be welding on either of these materials, you need a quality TIG welder. Miller offers products that will accommodate anyone from a home hobbyist to an advanced user.My machine of choice is the Miller Syncrowave 200. This welder has an air-cooled torch rather than a water-cooled setup. Why? Well, it is less expensive, as well as lighter. Unless you are in a production situation where you are running long welds without interruption, the air-cooled torch is quite adequate for this product. Most TIG welders will have an AC/DC switch. Use DC current for welding steels and AC current when welding aluminum. By the way, this welder can also be used for Stick welding.

Advantages of TIG welding

Non-consumable **electrodes** - It helps to provide flawless joints because it is not needed to stop for replacing the electrode as in consumable electrode welding. That also contributes to reducing downtime in production.
No flux is required because inert gas shields molten metal. So no slag and slag inclusion problems.
High quality and strong welding achieved by TIG.
Cleaner and more appealing joints. Sometimes they don't need finishing process.
They are suitable for welding of very thin sections.
The versatility of method. They can work with and without filler metal.
A wide range of metal can be welded. Nonferrous metals like aluminium, copper and dissimilar metal can be welded without any challenge.
Non-corrosive and ductile joints.
The minimum amount of flames and spark. Less distortion due to small heat zone.
It can be done in both automatic and manual.

Disadvantage of TIG welding

TIG is a time-consuming process - They are slower than any other welding process. Lower filler deposition rate.

More complicated - Highly skilled and professional workers are needed to perform TIG welding.
Safety issue - Welders, are exposed to high intensity of light which can cause eye damage.
High initial cost.
It cannot use in thicker sheets of metal.

LITERATURE REVIEW

Effect of welding geometry parameter on hardness for aisi304 tig.Welding is an area in which technological developments out match the developments in its science base which is primarily driven by the phenomenal industrial demand for welded structure. Reliability, Reproducibility and Viability requirements are forcing Technologists to look at weld defects such as distortion, hot cracking, in a systematic and logical approach than on experimental basis. Distortion is an unwanted physical change from specifications in a fabricated structures is caused by non-uniform expansion and contraction of the weld metal during heating and cooling cycle of the welding process many factors viz., material properties, welding process and procedures adopted make accurate prediction of distortion difficult. Groove angle, Root gap and root face was taken to analyze Hardness in butt weld joints. A review paper on effect of welding speed and groove angle on Strength of butt weld joint using tig welding. 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 objective 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.

METHODOLOGY

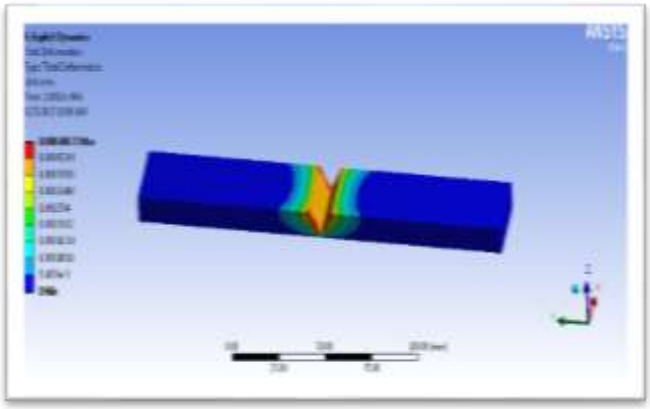
Objective of the work

In this thesis, materials V-groove geometry different models of plate with various included angles from 350, 450, 500will be made from structural steel (A633 Grade E).Currently different welding speeds are such as 0.4 cm/sec, 0.8 cm/sec and 1.20cm/sec to prepare a V-groove butt weld joint. Effect of process current on the tensile strength of weld joint will be analyzed.

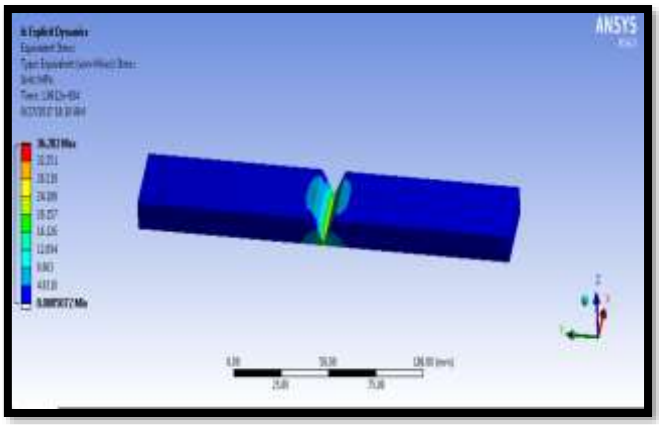
STATIC ANALYSIS OF TIG WELDING

AT GROOVE ANGLE 35^0 AND SPEED-0.4cm/sec

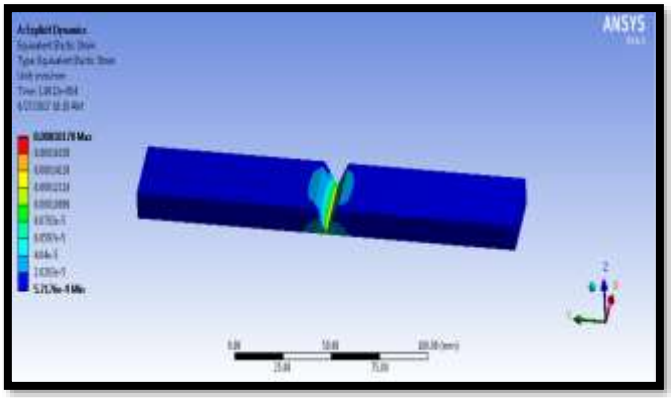
DEFORMATION



STRESS



STRAIN



EXPERIMENTAL PROCEDURE

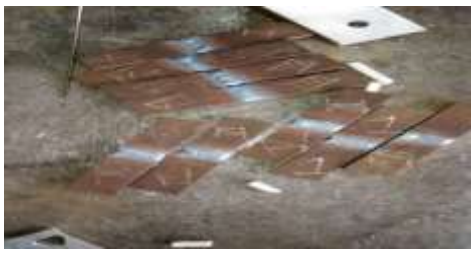
In this thesis, experiments are made to understand the effect of TIG welding parameters welding speed and groove angle on output parameters such as hardness of welding, tensile strength of welding.

TIG welding experimental images

Work pieces

Welding process

Welding pieces



PROCESS PARAMETERS	LE VEL1	LEVEL2	LEVEL3
WELDING SPEED (cm/s)	0.4	0.8	1.20
GROOVE ANGLE(°)	35	45	50

GROOVE ANGLE(°)	WELDING SPEED (cm/s)
35	0.4
35	0.8
35	1.2
45	0.4
45	0.8
45	1.2
50	0.4
50	0.8
50	1.2

GROOVE ANGLE(°)	WELDING SPEED (cm/s)	ULTIMATE TENSILE STRENGTH (MPa)
35	0.4	375
35	0.8	410
35	1.2	451.197
45	0.4	403
45	0.8	440.581
45	1.2	372
50	0.4	375.287
50	0.8	369
50	1.2	378

TEST REPORTS

For the experiment, welding parameters selected are shown in table.

The welding current and electrodes considered are

INTRODUCTION TO TAGUCHI TECHNIQUE

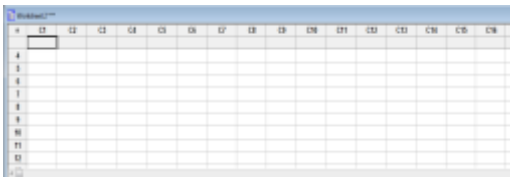
Taguchi defines Quality Level of a product as the Total Loss incurred by society due to failure of a product to perform as desired when it deviates from the delivered target performance levels.

This includes costs associated with poor performance, operating costs (which changes as a product ages) and any added expenses due to harmful side effects of the product in use.

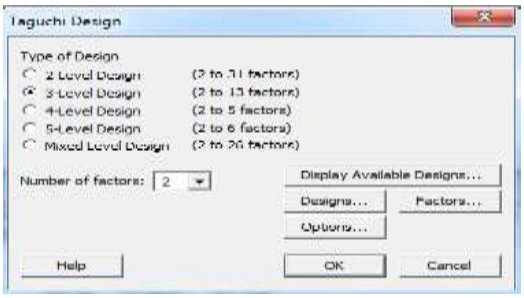
OPTIMIZATION OF ULTIMATE TENSILE STRENGTH USING MINITAB SOFTWARE

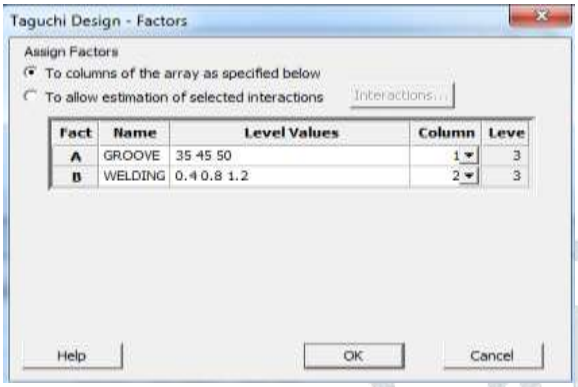
Design of Orthogonal Array:

First Taguchi Orthogonal Array is designed in Minitab17 to calculate S/N ratio and Means which steps is given as:



FACTORS





OPTIMIZATION OF PARAMETERS

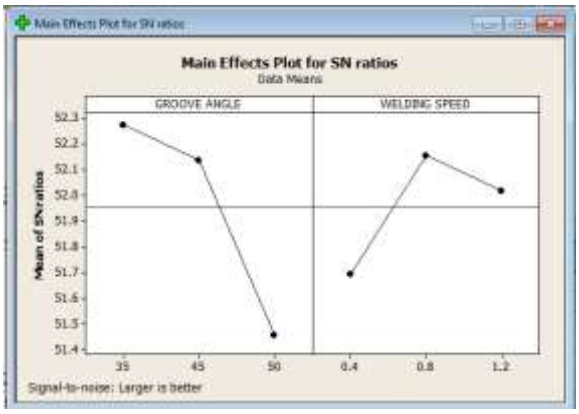
Worksheet 1 ***

	C1	C2
	GROOVE ANGLE	WELDING SPEED
1	35	0.4
2	35	0.8
3	35	1.2
4	45	0.4
5	45	0.8
6	45	1.2
7	50	0.4
8	50	0.8
9	50	1.2

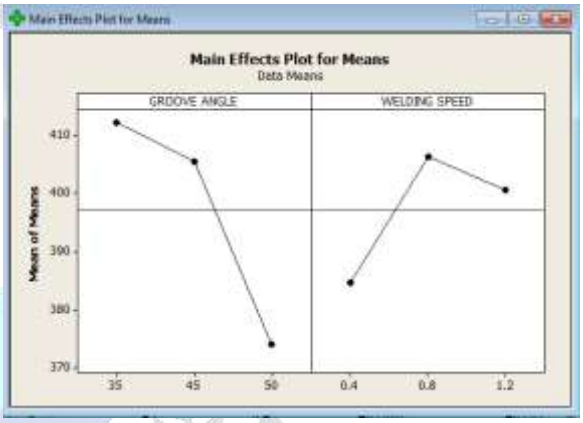
Worksheet 1 ***

	C1	C2	C3
	GROOVE ANGLE	WELDING SPEED	TENSILE STRENGTH
1	35	0.4	375.000
2	35	0.8	410.000
3	35	1.2	451.197
4	45	0.4	403.000
5	45	0.8	440.581
6	45	1.2	372.000
7	50	0.4	375.287
8	50	0.8	369.000
9	50	1.2	378.000

S/N ratio plot



Means plot



CONCLUSION

The experiment designed by Taguchi method fulfills the desired objective. Fuzzy interference system has been used to find out the ultimate tensile strength .The all possible values of have been calculated by using MINITAB 17.0 software. Analysis of variance (ANOVA) helps to find out the significance level of the each parameter. The optimum value was predicted using MINITAB-17 software.

The welding parameters are Welding speed, and groove angle for TIG welding of work piece steel. In this work, the optimal parameters of welding speed are 0.4cm/s, 0.8 cm/s & 1.2 cm/s, groove angle 35,45 and 50 degrees. Experimental work is conducted by considering the above parameters. Ultimate tensile strength validated experimentally.

The experimental results confirmed the validity of the used Taguchi method for enhancing the welding performance and optimizing the welding parameters in TIG welding at welding speed 1.2 cm/s , and groove angle 35.

AuthorsBiography

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