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Optimization of TIG Welding

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***Abstract*: Tungsten Inert Gas (TIG) welding process is mostly used in industries to join either similar or dissimilar materials. Particularly it is used to achieve a high strength joint among metals and alloys. In this project we are going to test and analyse the hardness and toughness of weld bead for different materials under constant welding parameters. The TIG welding process mainly focuses on increasing the depth of penetration and the reduction in the width of weld bead as these parameters have 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.**

***Keywords*: TIG welding, similar and dissimilar materials, high strength joints, effects of welding, Hardness and Toughness, depth of penetration.**

1. Introduction

Welding is a permanent joining process used to join various ferrous and nonferrous materials by the application of heat and pressure. In few cases filler material is required to form a weld pool of molten metal which gives a strong bond after solidification. Weldability of a material is influenced by many parameters: melting point, thermal conductivity, thermal expansion, electrical resistance, surface conditions etc. In TIG welding process straight polarity i.e. tungsten (non consumable) electrode connects with negative terminal and work pieces connect with positive terminal except for reactive materials. Mostly argon or helium is used as shielding gas to prevent the interaction of atmospheric gases with welding area and to transfer the heat during welding. Shielding gas also facilitates to maintain stability. Today, the applications of TIG welding have been extended to variety of ferrous materials like MS, SS, HSS as well as non ferrous materials like Cu alloys, Al alloys etc. to give high quality weld. Fig. 1 exhibits the view of Automatic TIG welding machine used in the present experimental work with following objectives:

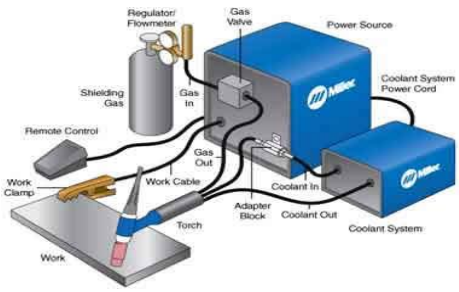

Fig 1. TIG Welding Machine Setup

2. Concept

Welding joints is an edge or point where two or more metal pieces or plastic pieces are joined together. The two or more workpieces (either metal or plastic) are joined with the help of a suitable welding process to form a strong joint. According to the American Welding Society, there are basically five types of welding joints and these are Butt, Corner, Lap, Tee and edge joint.

The 5 basic welding joints are
1. Butt joint
2. Corner joint
3. Lap joint
4. Tee joint and
5. Edge joint

A. Butt Joint

The joint which is formed by placing the ends of two parts together is called butt joint. In butt joint the two parts are lie on the same plane or side by side. It is the most simplest type of joint used to join metal or plastic parts together.

The different weld types in butt welding are
(i) Square Butt weld
(ii) Bevel groove weld
(iii) V-groove weld
(iv) J-groove weld
(v) U-groove weld
(vi) Flare-V-groove weld
(vii) Flare-bevel-groove butt weld

B. Corner Joint

The joint formed by placing the corner of two parts at right angle is called corner joint. Two parts which is going to be weld with corner joint forms the shape of L.

The different weld types in corner joint are as follows
(i) Fillet weld
(ii) Spot weld
(iii) Square-groove weld or butt weld
(iv) V-groove weld
(v) Bevel-groove weld
(vi) U-groove weld
(vii) J-groove weld
(viii) Flare-V-groove weld
(ix) Edge weld
(x) Corner-flange weld

C. T-Joint

The joint which is made by intersecting two parts at right angle (i.e. at 90 degree) and one part lies at the centre of the other. It is called as T joint as the two part welded look like English letter 'T'.

The types of welds in T joint are as follows
(i) Fillet weld
(ii) Plug weld
(iii) Slot weld
(iv) Bevel-groove weld
(v) J-groove weld
(vi) Flare-bevel groove
(vii) Melt-through weld

D. Lap Joint

The lap joint is formed when the two parts are placed one over another and then welded. It may one sided or double sided. This types of welding joints are mostly used to join two pieces with different thickness.

The Various weld types in lap joint are
(i) Fillet weld
(ii) Bevel-groove weld
(iii) J-groove weld
(iv) Plug weld
(v) Slot weld
(vi) Spot weld
(vii) Flare-bevel-groove weld

E. Edge Joint

The joint formed by welding the edges of two parts together are called edge joint. This joint is used where the edges of two sheets are adjacent and are approximately parallel planes at the point of welding. In this joint the weld does not penetrates completely the thickness of joint, so it cannot be used in stress and pressure application.

The various weld types in this welding joint are:
(i) Square-groove weld or butt weld
(ii) Bevel-groove weld
(iii) V-groove weld
(iv)J-groove weld
(v) U-groove weld
(vi) Edge-flange weld
(vii) Corner-flange weld

3. Methodology

1. Selection of materials such as M.S., Al and Cu based on their requirements.
2. Welding the selected materials keeping the parameters such as welding current, welding speed, Gas flow rate and ambient temperature constant.
3. Analyze the hardness and toughness of weld bead for individual materials.
4. Determine the welding effectiveness under TIG welding process.

Effects of welding process:

Welding Current: The higher current damages the work pieces during the welding and limiting current facilitates to prevent spatter.

Welding speed: Too higher welding speed may results in to lack of penetration while too slow may results in to excessive deposition rate. Therefore, a balanced welding speed should be maintained.

Gas flow rate: The purpose of gas flow rate is to protect the weld zone from atmospheric contamination otherwise oxidation will results in to defect. Therefore, a certain amount of gas flow rate is required to be maintained.

After welding, weldments are tested for hardness and toughness in Rockwell hardness tester and impact test respectively.

4. Conclusion

This paper presented an overview on optimization of TIG welding.

5. Future Scope

TIG is most commonly used to weld thin sections of M.S. and non-ferrous metals such as Al and Cu alloys. The process grants the operator greater control over the weld than competing processes such as shielded metal arc welding and gas metal arc welding, allowing for stronger, higher quality welds.

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