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NON DESTRUCTIVE TEST ANALYSIS AND INVESTIGATION OF EN24 STEEL WELDMENT WITH VARIOUS PROCESS PARAMETER USING GTAW WELDING

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ABSTRACT

In this competitive world, the customers perceive the most reliable high quality with low cost product. In order to satisfy the customers demand, the manufacturing industries are being forced to continuously optimize their process parameters. This project work is part of program for the development of EN24 steels to increase mechanical properties and minimization of metallurgical defects to increasing weldment.

The quality of weld in TIG mainly influenced by independent variables such as welding current, speed of electrode and electrode stick out. The planned experiments are conducted in the TIG welding machine the test piece examination is carried out by Tensile and Hardness Test finally NDT test through MPI (Internal Welding Defects) Test.

KEY WORD EN 24 Steel alloy,Gas Tungsten Arc Welding, Non Destructuive Test Analysis, TAGUCHI L4 ARRAY

1. INTRODUCTION TO NDTE

Non-destructive Test and Evaluation is aimed at extracting information on the physical, chemical, mechanical or metallurgical state of materials or structures. This information is obtained through a process of interaction between the information generating device and the object under test. The information can be generated using X-rays, gamma rays, neutrons, ultrasonic methods, magnetic and electromagnetic methods, or any other established physical phenomenon.

The process of interaction does not damage the test object or impair its intended utility value. The process is influenced by the physical, chemical and mechanical.

NDT Methods range from the simple to the intricate. Visual inspection is the simplest of all. Surface imperfections invisible to they may be revealed by penetrate or magnetic methods. If serious surface defects are found, there is often little point in proceeding further to the more complicated examination of the interior by other methods like ultrasonic or radiography.

The principal NDT methods are Visual or optical inspection, Dye penetrant testing, Magnetic article testing, Radiography testing and Ultrasonic testing.

ASNT - American Society for Non destructive Testing
ISNT - International Society for Non destructive Testing
CWI - Certified Welding Inspector
NDT - Non Destructive testing
NDE - Non Destructive Evaluation
NDI - Non Destructive Inspection

APPLICATION OF NDT

1. Nuclear, space, aircraft, defense, automobile, chemical and fertilizer industries.
2. Heat exchanger, Pressure vessels, electronic products and computer parts.
3. High reliable structures and thickness measurement.

TYPES OF NDT

1. Visual Testing- Ultraviolet. Infrared and visible light
2. Penetrate testing
3. Electromagnetic testing
4. Magnetic particle Testing
5. Acoustic Emissions
6. Ultrasonic testing
7. Radiography (RT) – X rays , Gamma rays & Beta particles
8. Penetrant Test Report

3. INRODUCION TO GTAW

Gas tungsten arc welding (GTAW), also known as tungsten inert gas (TIG) welding, is **an arc welding process that uses a non-**consumable tungsten electrode to produce the weld. The weld area and electrode are protected from oxidation or other atmospheric contamination by an inert shielding gas (argon or helium). A filler metal is normally used, though some welds, known as autogenous welds, or fusion welds do not require it. When helium is used, this is known as heliarc welding. A constant-current welding power supply produces electrical energy, which is conducted across the arc through a column of highly ionized gas and metal vapors known as a plasma. GTAW is most commonly used to weld thin sections of stainless steel and non-ferrous metals such as aluminum, magnesium, and copper 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. However, GTAW is comparatively more complex and difficult to master, and furthermore, it is significantly slower than most other welding techniques. A related process, plasma arc welding, uses a slightly different welding torch to create a more focused welding arc and as a result is often automated.

Manual gas tungsten arc welding is a relatively difficult welding method, due to the coordination required by the welder. Similar to torch welding, GTAW normally requires two hands, since most applications require that the welder manually feed a filler metal into the weld area with one hand while manipulating the welding torch in the other. Maintaining a short arc length, while preventing contact between the electrode and the workpiece, is also important

To strike the welding arc, a high frequency generator (similar to a Tesla coil) provides an electric spark. This spark is a conductive path for the welding current through the shielding gas and allows the arc to be initiated while the electrode and the workpiece are separated, typically about 1.5–3 mm (0.06–0.12)

Once the arc is struck, the welder moves the torch in a small between moving the torch forward (to advance the weld pool) and adding filler metal. The filler rod is withdrawn from the weld pool each time the electrode advances, but it is always kept inside the gas shield to prevent oxidation of its surface and contamination of the weld. Filler rods composed of metals with a low melting temperature, such as aluminum, require that the operator maintain some distance from the arc while staying circle to create a welding pool, the size of which depends on the size of the electrode and the amount of current. While maintaining a constant separation between the electrode and the workpiece, the operator then moves the torch back slightly and tilts it backward about 10–15 degrees from vertical. Filler metal is added manually to the front end of the weld pool as it is needed.

Welders often develop a technique of rapidly alternating inside the gas shield. If held too close to the arc, the filler rod can melt before it makes contact with the weld puddle. As the weld nears completion, the arc current is often gradually reduced to allow the weld crater to solidify and prevent the formation of crater cracks at the end of the weld.

INRODUCTION TO EN24

EN24T steel is a high tensile alloy steel renown for its wear resistance properties and also where high strength properties are required. EN24T is used in components subject to high stress and with a large cross section. This can include aircraft, automotive and general engineering applications for example propeller or gear shafts, connecting rods, aircraft landing gear components.

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LITERATURE SURVEY

Activated GTAW process that increases the penetration was first proposed by Paton Electric Welding Institute in the 1960s. [6] The commonly used fluxes are TiO_2, SiO_2, Cr_2O_3, ZrO_2 halide fluxes. These fluxes can be prepared by using different kind of component oxides packed in the powdered form with about 30-60 μm particle size. To produce a paint-like consistency, these powders are mixed with acetone, methanol, ethanol etc. The coating density of the flux should be about 5-6 mg/cm². A thin layer of the flux is brushed on to the surface of the joint to be welded prior to welding followed by application of welding arc for melting the base metal. [6-7] Application of these fluxes results in a) increasing the arc voltage compared with conventional GTAW process under identical conditions of arc length, welding current which in turn burns the arc hotter and increases the joint penetration and weld depth-towidth ratio, which helps in reducing the angular distortion of the weldment b) increasing the constriction of the arc which increases the current density at the anode and the arc force action on the weld pool. [8-10]The arc constriction also facilitates the development of weld of high depth to width ratio. Increase in depth of the penetration in turn increases the rate of lateral heat flow from the weld pool to the base metal. Increased rate of heat flow from the weld pool causes grain refinement owing to the high cooling rate and low solidification time. High depth to width ratio, effect imparted to the weld pool by activated fluxes is found similar to the high energy density process. Activated flux assisted GTA welding processes have been developed for joining of titanium and steel for nuclear and aerospace applications. The commercial fluxes tend to produce a surface slag residue which is required to be removed.

CHEMICAL COMPOSISTION OF EN24

C	SI	MN	S	P	Cr	Mo	Ni
0.36/0.44	0.10/0.35	0.45/0.70	0.040max	0.035max	1.00/1.40	0.20/0.35	1.30/1.70

4.COMPOSISION OF EN-24

SL.NO	ELEMENT	COMPOSITION IN WEIGHT %	
		MIN	MAX
1	Carbon, C	0.37	0.45
2	Manganese, Mn	-	0.70
3	Silicon, Si	-	0.25
4	Molybdenum, Mo	0.2	0.3
5	Chromium,Cr	0.7	0.9
6	Sulphur	-	0.04

5. PROCESS PARAMETERS AND THEIR LEVELS

LEVELS	PROCESS PARAMETERS		
	PEAK CURRENT Amps	BASE CURRENT Amps	BEVEL ANGLE °
1	130	40	65°
2	150	50	70°

6. EXPERIMENTAL PROEDURE

The EN24 alloy steel work pieces were chemically cleaned in hot Sodium Hydroxide for 10 minutes followed by dipping in Nitric Acid solution for about 15 minutes and then washed in water. Lincoln Electrical square wave TIG 355 GTAW machine with DC was used for welding of EN 24 alloy test specimens .The choice of tungsten electrode depends upon the type of welding current selected for the application. Zirconated tungsten (EWZT) electrodes are best suited for DC wherein they keep hemispherical shape and thoriated tungsten electrodes (EWTH-2) should be ground to taper are suitable for DCEP welding are used for this purpose . This welding process was conducted with 3.0 mm diameter 2% Zirconated tungsten electrode for EN24 alloy steel. The welding parameters used for this welding process both in pulsed current and non-pulsed current for two different thicknesses . The edge preparation of the tested EN24alloy steel specimens are shown in figure 2.After welding process is over the investigation of EN24 steel is conducted by TAGUCHI technique.

LINCOLN SQUARE WAVE TIG – 355 GTAW WELDING MACHINE

TAGUCHI METHOD

1. Sometimes called robust design methods. Fields such as Engineering, Biotechnology ,Marketing and Advertising. Taguchi method is a statistical method developed by Taguchi and Konishi .Initially it was developed for improving the quality of goods manufactured, later it was expanded to many other fields.

2. This is one of the major quantitative tools in industrial decision- making. The most common goals are minimizing cost, maximizing throughout, and/or efficiency Process Optimization

CONCLUSION

1. Based on the review, the following conclusions are drawn:

2. Welding parameters have influence on the mechanical properties (tensile, hardness, impact) of GTA welded joints;

3. Corrosion behaviours of GTA welded joints are influenced by welding parameters in varied degrees;

4. High quality GTA welded joint depends primarily on optimized welding parameters arrangement.

5. Better economy, improved efficiency and high profitability are some notable derivable advantages obtainable through proper welding input parameters selection.

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