PROJECT

Report

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Acknowledgement

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Introduction

Welding is a process by which two materials, usually metals, are permanently joined together by coalescence, which is induced by a combination of temperature, pressure, and metallurgical conditions.

Welding process of dissimilar metal is more important because of difference in the metallurgical characteristic.

The selection of filler metals compatible to both base metals is crucial during welding process.

Until the end of the 19th century, the only welding process was forge welding, which blacksmiths had used for millennia to join iron and steel by heating and hammering. Arc welding and oxy fuel welding were among the first processes to develop late in the century, and electric resistance welding followed soon after. Welding technology advanced quickly during the early 20th century as world wars drove the demand for reliable and inexpensive joining methods. Following the wars, several modern welding techniques were developed, including manual methods like submerged arc welding, now one of the most popular welding methods, as well as semi-automatic and automatic processes such as GMW, SAW and electroslag welding. Developments continued with the invention of laser welding, magnetic pulse welding and friction stir welding in the latter half of the century. Today, as the science continues to advance, robot welding is commonplace in industrial settings, and researchers continue to develop new welding methods and gain greater understanding of weld quality.

TYPES Of Welding

1. MIG Welding

MIG stands for metal inert gas or MIG welding; this process uses a thin wire as an electrode. The wire heats up when it is fed through the welding machine to the welding point. Shielding gas must be used to protect the weld from airborne contamination.

However, it usually takes the form of carbon dioxide, oxygen, argon, or helium. This method is widely used for machining metals such as stainless steel copper, nickel, carbon steel, aluminum, and more. Of all welding processes, this is the most popular in the construction and automotive industry.

Also, Gas metal arc welding is considered one of the most straightforward welding techniques to learn, making it an excellent focus for beginners. It also requires minimal cleaning, offers fast welding speeds and better control over thinner materials.

2. TIG Welding

TIG is one of the best welding techniques and is also known as tungsten inert gas or TIG welding. TIG is often used to weld together thin and non-ferrous material such as aluminum, copper, lead, or nickel. It is widely used in the manufacture of bicycles or airplanes.

In contrast to other types of welding processes, TIG welding uses a non-consumable tungsten electrode to produce the weld seam. It would be best if you still had an external gas supply, usually argon or a mixture of argon and helium.

It is considered one of the most challenging welding methods to master and a technique that produces the highest quality welds.

3. ARC Welding

Arc is one of the types of welding process that includes metal inert gas welding MIG, electrode welding, tungsten inert gas welding (TIG), also gas tungsten arc welding (GTAW), gas welding, metal active gas welding (MAG), core wire arc welding (FCAW), gas metal arc welding (GMAW) (SAW), protective metal arc welding (SMAW) and plasma welding.

Moreover, these techniques typically use filler material and are mainly used to join metals such as stainless steel, aluminium, nickel and copper alloys, cobalt, and titanium. Arc welding processes are widely used in industries such as oil and gas, energy, aerospace, automotive, and more.

4.Solid State Welding

Mainly metal joining process is classified into two types. The first one is liquid state welding process in which, metal work pieces are heated until its melting temperature and the metal to metal joint form due to solidification of melted work pieces together. Sometimes this process uses filler material which is melted with base material and allow to solidity, which make a permanent strong joint. The other one is solid state welding process in which no molten or liquid state involves and metal joining process takes place due to application of high pressure into solid state. The metal to metal joint form due to inter molecular diffusion process at the interface surfaces. This is basic principle of it.

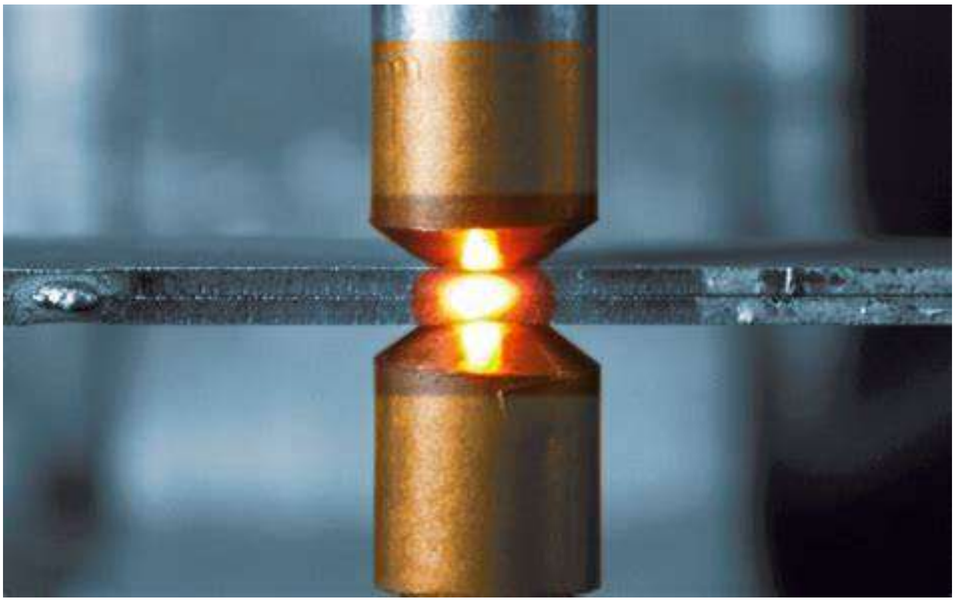
Any welding process where no melting takes place comes under this group. Although fusion welding processes are many, there exist quite a few solid-state welding processes also. Some examples are provided below. Note that many people consider resistance welding group as solid-state welding; here the same is kept under fusion welding as nugget is formed due to melting of faying surfaces by resistance heating.

- Cold Welding (CW)
- Roll Welding (ROW)
- Pressure Welding (PW)

5.Resistance Welding

Resistance welding is a welding technology widely used in manufacturing industry for joining metal sheets and components. The weld is made by conducting a strong current through the metal combination to heat up and finally melt the metals at localized point(s) predetermined by the design of the electrodes and/or the workpieces to be welded. A force is always applied before, during, and after the application of current to confine the contact area at the weld interfaces and, in some applications, to forge the workpieces.

Depending on the shape of the workpieces and the form of the electrodes, resistance welding processes can be classified into several variants among which the most commonly used are spot welding, projection welding, seam welding and butt welding.



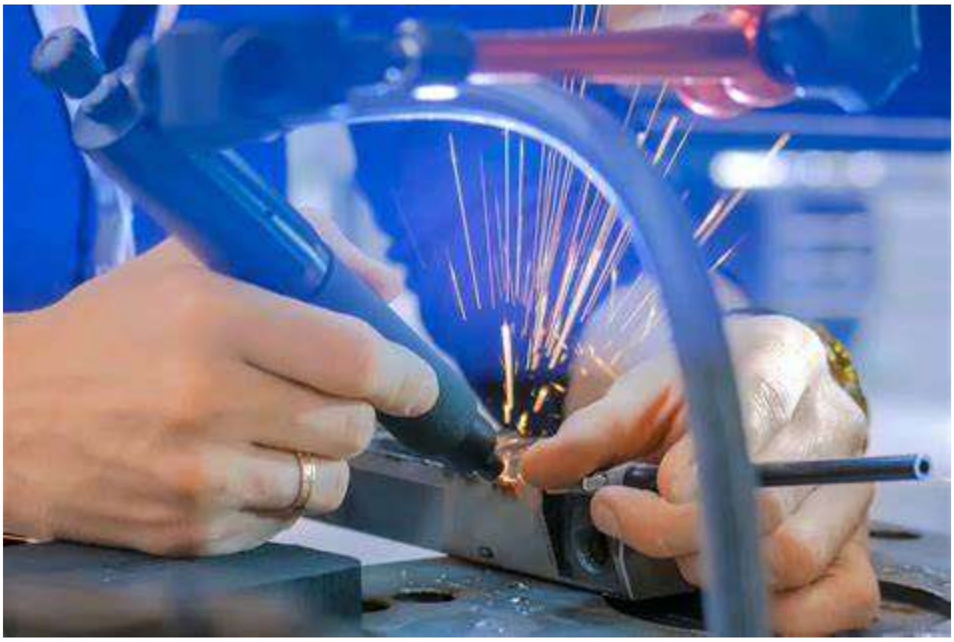
Electric Resistance Welding

What is Tig welding?

It is a type of Arc Welding.Straight polarity is used.It is extremely versatile , but it is also one of the more difficult welding technique to learn.Two hands are needed for TIG welding . One hand feeds the rod whilst the other holds a TIG torch.

Torch creates the heat and arc, which are used to weld most conventional metals, including aluminum ,steel, nickel alloys, copper alloys, cobalt and titanium.TIG welders can be used to weld steel, stainless steel, chromoly , aluminum, nickel alloys , magnesium, copper, brass, bronze, and even gold.

When TIG welding was introduced around the 1940's Helium gas was the primary shielding gas used in process. The term Heli arc welding was the common phrase used back in the day and now is a registered trademark “GENUINE HELLIARC", from what I know, it now owned by ESAB welding equipment! Why would this matter when you are job hunting or working in a shop? Most old timers and veteran welder's refer to TIG welding as Heli arc welding. I learned this very early on when I started to weld. I did not know Heli arc was also TIG welding! I thought when I went to welding school TIG welding was a new process I was going to learn. Wrong! Just like my former boss called the refrigerator the "ice box", they are both the same thing. When someone refers to TIG welding as heli arc, it's pretty safe to assume either they have a lot of experience, or apprenticed under a journeyman welder who has been around.



Literature Review

In literature review we studied different research paper and identify their objective an result.

Literature Review 1

Mechanical Properties of Dissimilar Welds Between Stainless Steel and Mild steel

Shamsul Baharin et al. carried out the experiments to join of stainless steel 304 to mild steel by a gas tungsten arc welding (GTAW) and they observed that yield strength and tensile strength of welded samples using mild steel welding electrode were slightly lower than welded samples using stainless steel welding electrode, however, both types of welded samples exhibited optimum strength of the welded joint.

All welded samples fractured at mild steel base metal indicated the regions of stainless steel base metal, fusion zone and heat affected zone are stronger than mild steel base metal.

Literature Review 2

Mechanical and Microstructural Characterization of TIG Welded Dissimilar Joint between 304L Austenitic Stainless Steel and Incoloy 800HT Nickel Alloy

***Grzegorz Rogalski et al*.** carried out the experiment of mechanical properties and microstructure of 304L austenitic stainless steel/Incoloy 800HT dissimilar welded joints are investigated. The joints were made of 21.3 mm × 7.47 mm tubes using the TIG process with the use of S Ni 6082 nickel filler metal. No welding imperfections were found and high strength properties of joints were obtained.

They observed that as part of nondestructive testing, tests were performed to detect surface imperfections (VT, PT) and weld imperfections (RT). All tested specimens obtained positive results of NDT tests.
Static Tensile Test-The obtained results meet the acceptance criterion: the obtain values are approximately 30% higher than the requirements. In addition, it was observed that a fracture occurred in the Incoloy 800HT base material.

Bending Test-The obtained test results were considered positive. All specimens reached a bending angle of 180°. There were no cracks or other material defects on the tensile surfaces

<u>Literature Review 3</u>

Friction stir welding of dissimilar Al 6013-T4 To X5CrNi18-10 stainless steel

Huseyin Uzun et al carried out the experiment on Bonds of aluminium and mild steel were achieved in the friction welding process. The welded materials have lower hardness compared to their parent materials due to thermal effects of the friction welding.

The thermal effects of the friction welding were observed to have lowered the welded materials hardness compared to the parent materials. The tensile strength of the welded rods is lower than the parent rods due to incomplete welding. The finite difference method proposed in this work will provide guidance in weld parameter development and will allow better understanding of the friction welding process.

Literature Review 4

Microstructural characterization of friction stir welding joint of mild steel to Ni based –alloy 625

J. Rodriguez et al carried out the experiment on 6-mm-thick mild steel and Ni-based alloy 625 plates were friction stir welded using a tool rotational speed of 300 rpm and a travel speed of 100 mm· min. A microstructural characterisation of the dissimilar butt joint was performed using optical microscopy, scanning and transmission electron microscopy, and energy dispersive X-ray spectroscopy (XEDS).

After this research they conclude that The FSW of mild steel and Ni-based alloy 625 produces sound welds, without volumetric defects. Different microstructures were recognised in the welds. In the steel, the HAZ showed three region. The thermo-mechanically affected zone (TMAZ) was not observed in the steel because the allotropic transformation hide the deformation history. The phase transformations in the HAZ are similar to those observed in conventional welding processes and were caused by the effect of high temperature during the thermal cycle.

Literature Review 5

Laser welding of stainless steel to titanium using explosively welded composite inserts

A.N CHEREPANOV et al they did research on weld joints between VT1-0 titanium and AISI 321 austenitic stainless steel using laser welding were obtained. To improve the quality and strength properties of joints, two types (SS–Cu–Nb/Ta–Ti) of explosively welded four-layered composite inserts were used. Barrier layers were different from each other by refractory metal

They did Microstructural studies using optical and electron microscopies have revealed that produced joints characterized by absence of defects as well as narrow heat affected zone. At copper –stainless steel interface, severely deformed zone with average depth of 60 µm was observed**.**

It was shown that the strength of produced compositions was higher than that of VT1-0 titanium and defined by materials of composite insert. The highest values of ultimate tensile strength (UTS = 476 MPa) and yield strength (YS = 302 MPa) were corresponded to composition containing niobium foils. In all cases, failure was occurred via the weakest component of composition—copper plate**.**

Literature Review 6

Friction welding of ductile iron with stainless steel

Radosław Winiczenko et all they did study on mechanical properties and microstructure of friction welded coupe of ductile iron with stainless steel are presented. Scanning electron microscopy (SEM) was used for investigation of the fracture morphology and phase transformations taking place during friction welding process.

They observed that Friction welding is accompanied by a transport of atoms in both directions across the ductile iron-stainless steel interface. This results in the enrichment of stainless steel with carbon, and ductile iron with chromium and nickel atoms.

Literature Review 7

Comprehensive analysis of joint strength for dissimilar friction stir welds of mild steel to aluminum alloys

Tsutomu Tanaka et **al** carried out experiment on Post-weld properties of dissimilar friction stir welds of mild steel/A7075-T6 aluminum alloy.

They observed that The joint strength increased with reduction in thickness of the intermetallic compound at the weld interface. During tensile tests of the composite weld, no weld failed in the aluminum base metal. Comprehensive analysis using the heat input parameter showed that the apparent interface strength between the steel and aluminum was lower than the joint strength of the friction-stir-welded

Objective

From above literature review we conclude our objective of research is

Microstructural characterization of tig welded joint of Mild steel and Stainless Steel (SS302) and filler material is SS316L.