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PRAGYAN

Half Yearly Students' Technical Times

RANE POYTECHNIC TECHNICAL CAMPUS

ARDUINO-A BOOMING ELECTRONIC PLATFORM

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INTRODUCTION

Arduino/Genuino Uno is a microcontroller board based on the ATmega328P (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.. You can tinker with your UNO without worring too much about doing something wrong, worst case scenario you can replace the chip for a few dollars and start over again.

"Uno" means one in Italian and was chosen to mark the release of Arduino Software (IDE) 1.0. The Uno board and version 1.0 of Arduino Software (IDE) were the reference versions of Arduino, now evolved to newer releases. The Uno board is the first in a series of USB Arduino boards, and the reference

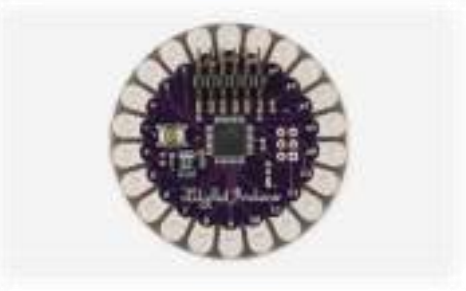
model for the Arduino platform; for an extensive list of current, past or outdated boards see the Arduino index of boards.

HISTORY OF ARDUINO

The Arduino project started at the Interaction Design Institute Ivrea (IDII) in Ivrea, Italy. At that time, the students used a BASIC Stamp microcontroller, at a cost that was a considerable expense for many students. In 2003, Hernando Barragán created the development platform *Wiring* as a Master's
Thesis project at IDII, under the supervision of Massimo Banzi and Casey Reas, who are known for work on the Processing language. The project goal was to create simple, low-cost tools for creating digital projects by non-engineers. The Wiring platform consisted of a printed circuit board (PCB) with an ATmega168 microcontroller, an IDE based on Processing, and library functions to easily program the microcontroller. In 2003, Massimo Banzi, with David Mellis, another IDII student, and David Cuartielles, added support for the cheaper ATmega8 microcontroller to Wiring. But instead of continuing the work on Wiring, they forked the project and renamed it *Arduino*. Early arduino boards used the FTDI USB-to-serial driver chip and an ATmega168. The Uno differed from all preceding boards by featuring the ATmega328P microcontroller and an ATmega16U2 (Atmega8U2 up to version R2) programmed as a USB-to-serial converter.

TYPES OF ARDUINO

ARDUINO UNO



ARDUINO LILYPAD

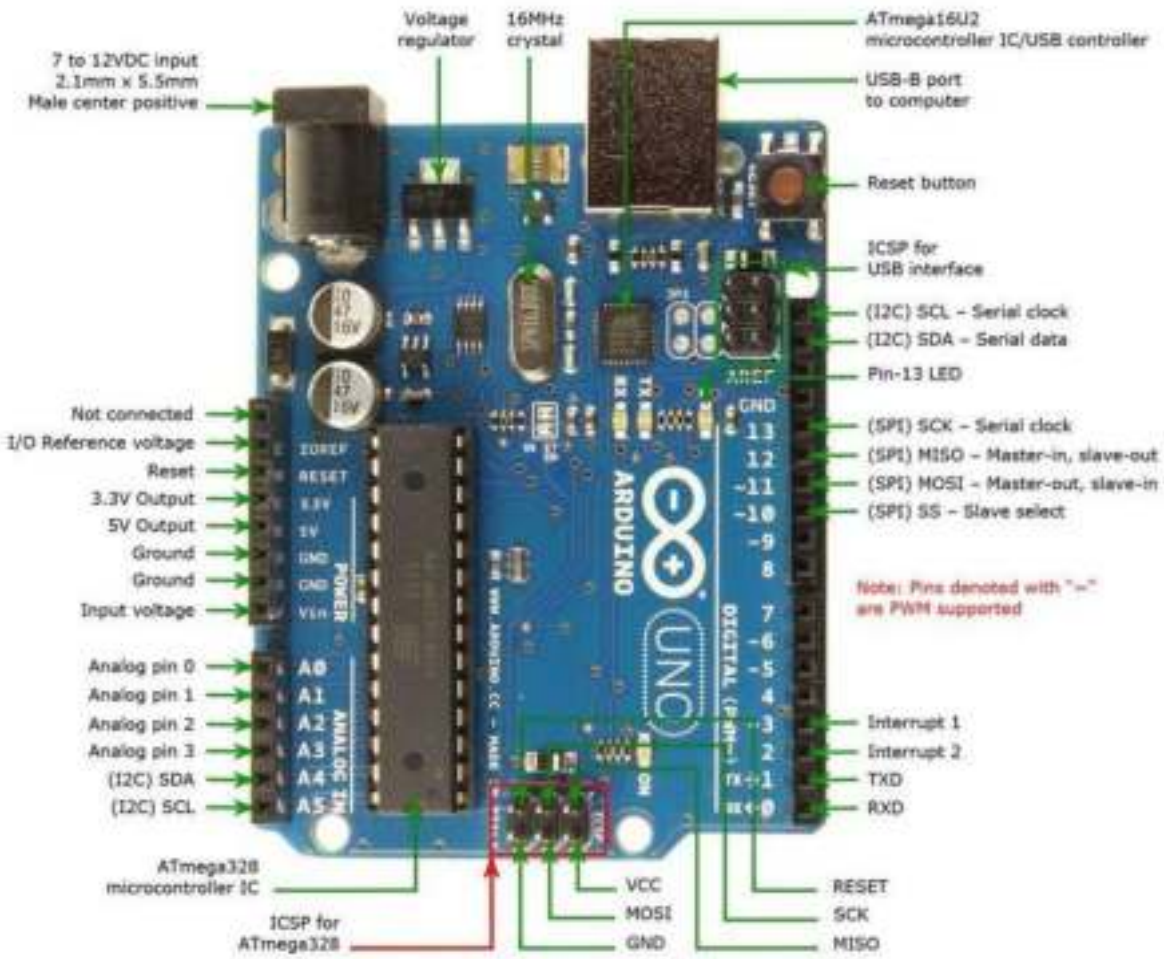
ARDUINO MEGA

ARDUINO LEONARDO

ARDUINO MEGA

ARDUINO LEONARDO

GENERAL PIN FUNCTION



- **LED**: There is a built-in LED driven by digital pin 13. When the pin is high value, the LED is on, when the pin is low, it is off.
- **VIN**: The input voltage to the Arduino/Genuino board when it is using an external power source (as opposed to 5 volts from the USB connection or other regulated power source). You can supply voltage through this pin, or, if supplying voltage via the power jack, access it through this pin.

- **5V**: This pin outputs a regulated 5V from the regulator on the board. The board can be supplied with power either from the DC power jack (7 - 20V), the USB connector (5V), or the VIN pin of the board (7-20V). Supplying voltage via the 5V or 3.3V pins bypasses the regulator, and can damage the board.
- **3V3**: A 3.3 volt supply generated by the on-board regulator. Maximum current draw is 50 mA.
- **GND**: Ground pins.
- **IOREF**: This pin on the Arduino/Genuino board provides the voltage reference with which the microcontroller operates. A properly configured shield can read the IOREF pin voltage and select the appropriate power source, or enable voltage translators on the outputs to work with the 5V or 3.3V.
- **Reset**: Typically used to add a reset button to shields that block the one on the board.

Special pin functions

Each of the 14 digital pins and 6 analog pins on the Uno can be used as an input or output, under software control (using pinMode(), digitalWrite(), and digitalRead() functions). They operate at 5 volts. Each pin can provide or receive 20 mA as the recommended operating condition and has an internal pull-up resistor (disconnected by default) of 20-50K ohm. A maximum of 40mA must not be exceeded on any I/O pin to avoid permanent damage to the microcontroller. The Uno has 6 analog inputs, labeled A0 through A5; each provides 10 bits of resolution (i.e. 1024 different values). By default, they measure from ground to 5 volts, though it is possible to change the upper end of the range
using the AREF pin and the analogReference() function.

In addition, some pins have specialized functions:

- **Serial** / UART: pins 0 (RX) and 1 (TX). Used to receive (RX) and transmit (TX) TTL serial data. These pins are connected to the corresponding pins of the ATmega8U2 USB-to-TTL serial chip.
- **External interrupts**: pins 2 and 3. These pins can be configured to trigger an interrupt on a low value, a rising or falling edge, or a change in value.
- **PWM** (pulse-width modulation): pins 3, 5, 6, 9, 10, and 11. Can provide 8-bit PWM output with the analogWrite() function.
- **SPI** (Serial Peripheral Interface): pins 10 (SS), 11 (MOSI), 12 (MISO), and 13 (SCK). These pins support SPI communication using the SPI library.
- **TWI** (two-wire interface) / I²C: pin SDA (A4) and pin SCL (A5). Support TWI communication using the Wire library.
- **AREF** (analog reference): Reference voltage for the analog inputs.

Arduino's Role:

Arduino is going to play a role in the IoT revolution. First of all, many Arduino kits were developed for the sole purpose of participating in the next IoT uprise. They come with Ethernet or wifi built-in modules that let you build your electronic IoT applications. And connect them to the cloud or to any other device using the internet. Arduino offers different sizes for both industrial and personal use. That also span a range of specifications for the various applications. Not only that, but they also provide IoT shields that offer more functionalities and extensions to the existing boards.

If you're not familiar with shields, they are basically board-sized extensions. They add functionalities to an existing board, for

example, the Ethernet shield was used to make a standard Arduino UNO board able to use Ethernet connections.

Arduino UNO board is used in the following applications.

- Weighing Machines.
- Traffic Light Count Down Timer.
- Parking Lot Counter.
- Embedded systems.
- Home Automation.
- Industrial Automation.
- Medical Instrument.
- Emergency Light for Railways

Advantages of arduino

- inexpensive.
- open source in hardware.
- don't need to external programmer (Burner)
- programming ease.
- open source in software.
- IDE Software operate on any operating system.

CONCLUSION

- **The possibilities to use the Arduino are literally infinite**. There are billions of people around the world and a fair amount of them have probably, at some point in their lives, imagined a device not available on the market or a device that was too expensive that could help them in some aspect of their lives.

TIG and MIG Welding Process

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ABSTRACT

Welding is an age old method used for joining the metals permanently. There are various methods available for welding such as Gas welding, Resistance welding, High energy beam welding, Solid state welding, Arc welding etc. Various factors on the basis of which we choose the method of welding are thickness of the metal, speed of welding, current available, surface condition of metal, coefficient of thermal expansion, etc. In this paper we have tried to analyze the impact of two important types of Arc welding i.e. Gas metal arc welding (MIG) and Gas Tungsten arc welding (TIG) on microstructural and mechanical properties of the weldments of various metals. Mechanical properties such as yield strength, ultimate tensile strength, percentage reduction in area, percentage elongation values related to weldments of various materials are compared under different conditions

INTRODUCTION

Welding is the most common fabrication process widely used in industry. A fabrication method used to permanently join different metals, plastics, alloys together, by the application of heat and pressure. Depending upon the type of process used, either heat or pressure both may be applied or only one is sufficient for a desirable coalescence. The heat required for the process of welding can be obtained by using an electric current, gas flame, etc. A filler

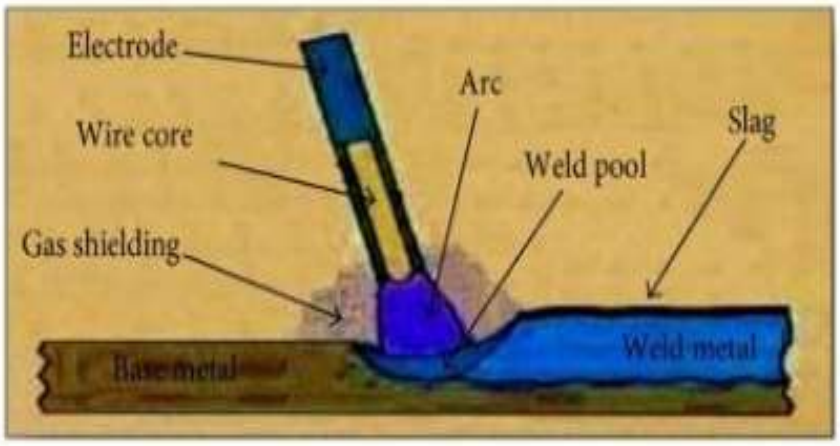


Fig1: Welding process

metal may be used for forming a weld pool which on solidification provides coalescence. We choose the welding process depending upon the weld ability of the material which further depends upon the changes that occur in properties during welding such as changes in hardness of the welded area, the extent of oxidation, crack propagation, etc.

Among the various available welding processes TIG and MIG welding have vast application in the industry. They come under the category of arc welding in which an electric power supply is used to produce an arc between electrode and the work-piece material to be joined. Due to the heat released the work piece melts at the surface and welding action takes place. The power can be either AC or DC type and the power source must convert high voltage, low amperage current

into a safe low voltage, heavy current supply suitable for arc welding.

Also the electrode used can be consumable or non- consumable, bare or coated. The welding region is usually protected by some type of gas or shielding vapor usually Argon or Helium and sometimes a mixture of both to protect the area from atmospheric contamination.

The physical difference between TIG and MIG is based on the type of electrode being used. In TIG we use a non-consumable tungsten electrode while on the other hand in MIG we use consumable electrode in form of a wire. An effort has been made to analyze the findings of different researchers on mechanical and microstructural properties of TIG and MIG welded components.

LITERATURE REVIEW

The paper reviews the impact of various process parameters in TIG and MIG welding, which affect the mechanical and microstructural properties of the base metal. Different works of researchers in this field have been covered in this paper.

Naitik S Patel, Prof. Rahul B Patel, in their paper"A Review on Parametric Optimization of TIG Welding" (2014)[3] , have reviewed the effect of welding parameters such as welding current , gas flow rate ,welding speed on output parameters viz. hardness of welding and tensile strength of welding.

Effect of arc voltage, weldingcurrent and welding speed on fatigue life, impact energy andbead penetration of AA6061 joints produced by robotic MIG welding" byH.R. Ghazvinloo,

R.Sudarshan, Dr. M.Devaiah in their paper "Effect of Process Parameters in MIG Welding on Mild Steel IS 2062" (2018) [8], carried out an experiment on the

weld of MS IS 2062 for the yield strength and the ultimate tensile strength with respect to variation of current, voltage and angles of v- butt joint.

From the above experiment they concluded that the ultimate tensile strength and yield strength will vary depending upon the various angles used. It was also concluded that with increase in the value of current and voltage there is an increase in yield strength and ultimate tensile strength.

In the paper "Determination of welding parameters for shielded metal arc welding" by Ugur Soy, Osman Iyibilgin, FehimFindik, Cemil Oz and YasarKiyan(2011)[9], they have determined the welding parameters for shield metal arc welding.

GAS TUNGSTEN ARC WELDING OR TUNGSTEN INERT GAS WELDING -TIG

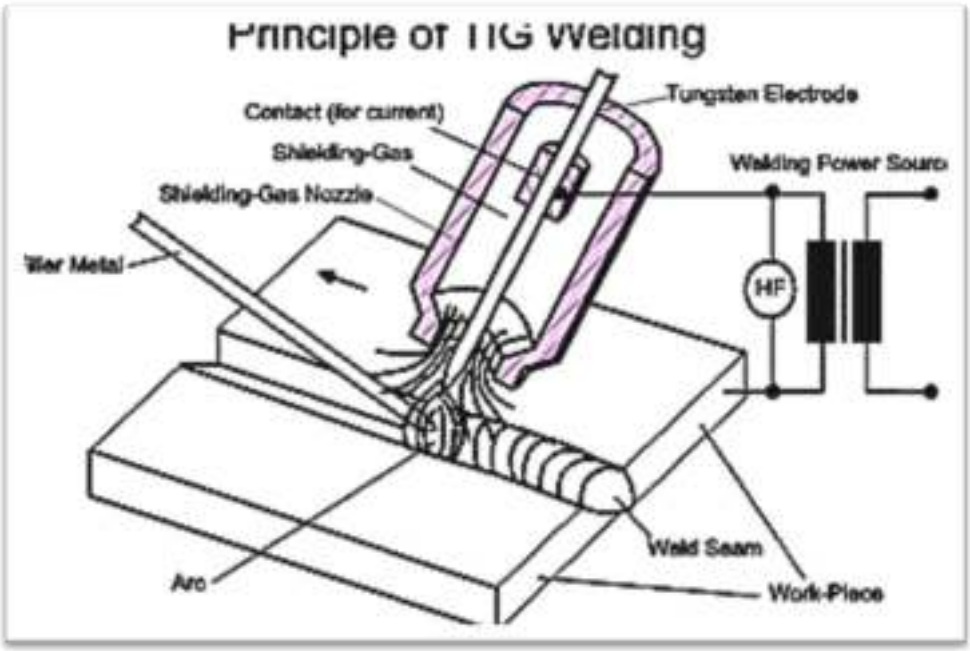
It was developed during Second World War. With the development of TIG welding process, welding of difficult to weld materials e.g. Aluminum and Magnesium became possible. The use of TIG today has spread to a variety of metals like stainless steel, mild steel, high tensile steels, Al alloy, Titanium alloy etc.

WORKING PRINCIPLE OF TIG WELDING

It has the same principle as that of Arc welding. A high intense arc is produced between tungsten and work piece. Due to the arc, heat is produced which is used to join the work piece by fusion. A shielding gas is also used to prevent the weld surface from oxidation. Figure 2 depicts the principle of TIG welding.

EQUIPMENT'S USED:

Power source, TIG torch, shielding gas supply system, filler material, base metal, personal safety equipment's etc. are used to perform high quality welding.



MECHANISM:

A non-consumable electrode of Tungsten is used to produce the weld. The electrodes are commonly available from 0.5 mm to 6.4 mm diameter and150 - 200 mm length. Electrodes have different current carrying capacity depending whether upon their connection to positive or negative terminal. To prevent melting of electrode Thorium or Zirconium is added to the tungsten electrode.

A constant current power source is used so that a constant current is provided even when there are variations in the arc length. Power is supplied through the power source to the welding torch and is delivered to the electrode which is fitted inside the torch holder.

In general AC power supply is preferred for Aluminum and Magnesium because the cleansing action of AC removes oxides and improves weld quality. An electric arc is created between the tungsten electrode and the

work piece using a constant current welding power supply.

The tungsten electrode and the welding zone are protected from the surrounding air by inert gas which is usually Argon or Helium or a mixture of both. Temperature up to 20,000°C is produced which is used to join the two different parts of material. Filler metal is fed manually or automatically to the electric arc. Choice of the filler rod is important depending upon the type of material or alloy we are welding. Figure 3 shows general welding process.

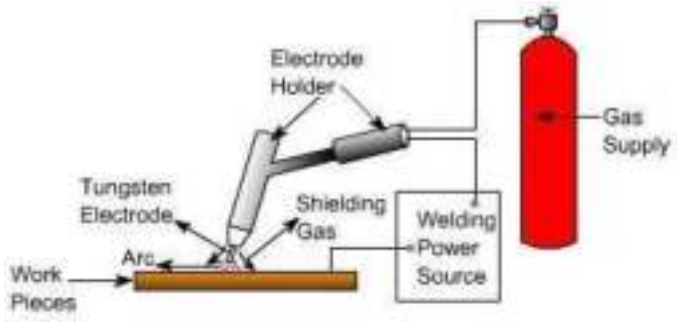


Fig 3: Working Procedure of TIG Welding

PROCESS PARAMETERS:

There are various parameters thataffect the quality and outcome of the TIG welding process such as welding current, welding voltage, inert gas used, welding speed, etc.

APPLICATIONS:

It is best suited for metal plates of thickness around 5-6 mm. By using multiple passes we can even weld metals of higher thickness. It is useful for pipe and tube joints. It is usually used in nuclear industry, air craft industry, food processing industry, automobile industry etc.

ADVANTAGES:

- It produces very high quality weld as compared to other welding processes.
- Welds can be made with or without filler material.
- Easy to weld thin materials.
- Leaves no slag or splatter.

GAS METAL ARC WELDING OR METAL INERT GAS WELDING (MIG)

It was developed in late 1940's and since then it has become very useful in welding industry today. It is suitable for welding a variety of ferrous and nonferrous metals.

PRINCIPLE:

It works on the same principle as that of the arc welding. An electric arc is produced to generate heat and a consumable wire electrode is melt due to this heat and the base metal plates join with the help of the electrode and the weldment is ready.

EQUIPMENT'S USED:

Power source consists of a power supply, transformer, a rectifier which converts the AC supply in DC supply and a control system to control the amount of current.

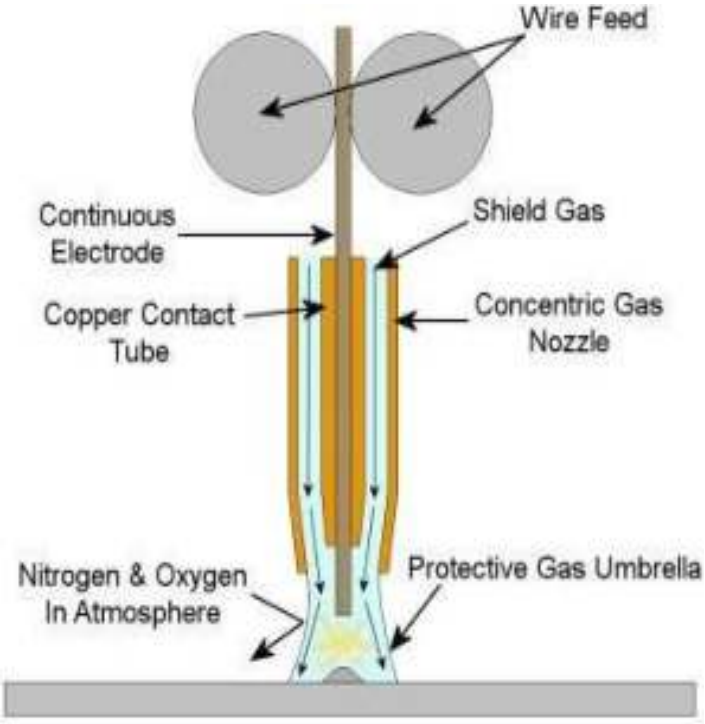
Wire feeding system is used to feed the consumable electrode wire. It consists of a wire pool holder, a driving motor, a set of driving rollers and wire feed controls. The speed of the wire feed depends upon the amount of current being used.

Welding torch used in MIG is slightly different from the one used in TIG welding. The torch has a mechanism to supply the wire continuously at a

given feed rate. Also it has a nozzle to provide with shielding gases, to protect the weld from oxidation. Depending upon the amount of current supplied the welding torch is air or water cooled.

Shielding gases are mostly used in the form of plasma to prevent the weld from reactive gases in the atmosphere such as oxygen. Choice of the shielding gas depends upon the welding material but mostly Helium and Argon or a mixture of both is used as shielding gases. A general setup of equipment used is shown in figure 4.

MECHANISM:



The mechanism used in MIG is quite similar to the one used in TIG. The AC current from the power source is converted into DC current. This current is then supplied to the welding electrodes. The electrodes are connected to the negative terminal whereas the work piece is connected to the positive terminal. An arc will be generated which produces heat which in turn is used to melt the electrode and the base metal. To make the weld uniform, the electrodes are made of the same metal as that of the base metal.

The electrode travels continuously on the base metal to form a uniform joint. The Arc is covered by a supply of shielding gases to prevent the weld from oxidation by reactive gases. Due to the fact that the electrodes are

made up of wire the deposition rate are good and high amount of current can be used. Mechanism of MIG welding has been shown in figure 5.

APPLICATIONS:

- *It is used for both ferrous and non-ferrous metals.*
- *Used for fabrication of sheet metal products.*
- *It can be used for deep groove welding.*

ADVANTAGES:

- *It is faster than arc welding because filler metal is supplied continuously.*

It is comparatively cheaper than TIG.

REVIEW OF EXPERIMENTAL RESULTS: TENSILE TEST ON TIG& MIG WELDED MILD STEEL COMPONENT

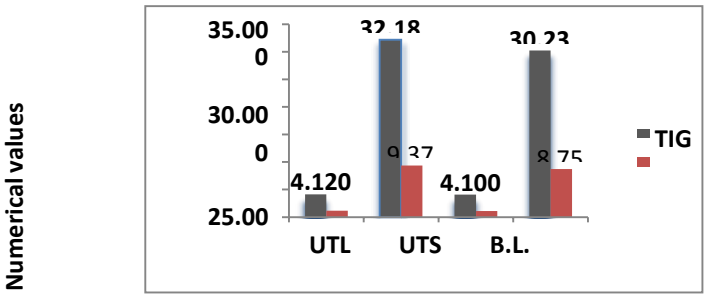


Fig.7Comparison of mechanical properties of TIG & MIG welded mild steel

Tensile test was conducted on the specimen of TIG and MIG welded mild steel components to find the Ultimate tensile load(KN), Ultimate Tensile stress(N/mm^2), Breaking load(KN), Breaking Stress(N/mm^2) and the data obtained is represented in figure 7.

After conducting the experiment they came to the conclusion that TIG welding has better Tensile strength, hardness, impact strength and microstructure compared to MIG for aluminum alloy. They also found out

that the impact strength of TIG joints is higher than that of the MIG joints and the hardness of TIG joints is more whereas that of MIG joints is less. On the microstructure part they concluded that TIG welded components have a fine and uniformly distributed grains. However the microstructure found in MIG welded components is having a dendritic grain structure. Due to this difference in grain structure TIG welded joints have a better tensile strength and mechanical properties than that of the MIG welded joints.

A research was conducted on AA-6062 by Yatender Gupta, Dr. AmitTanwar, Raunak Gupta and the results were published in the paper "Investigation of Microstructure and Mechanical Properties of TIG and MIG Welding Using Aluminum Alloy"[6].The results which were concluded are shown in the figure 9.

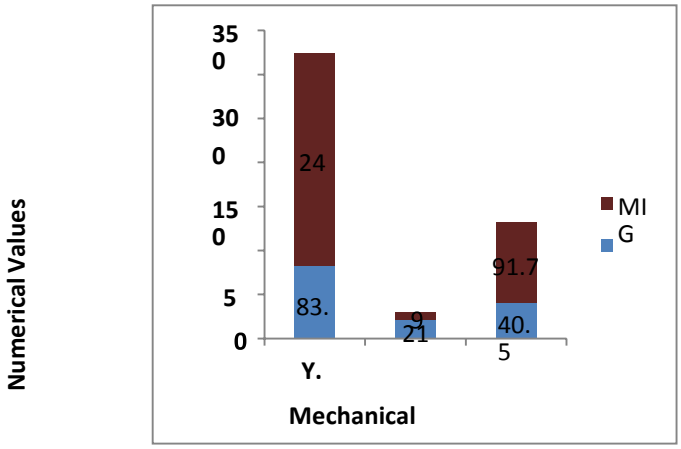


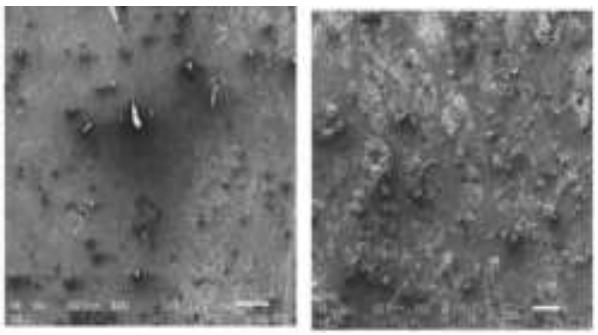
Fig. 9 Comparison of mechanical properties of TIG & MIG welded AA-6062[6].

From the above figure it can be concluded that MIG welding has better yield strength, joint efficiency and microstructure compared to TIG welding for the Aluminum alloy used in the experiment. In case of MIG the microstructure is very fine and equiaxed, having uniformly distributed grains with strengthening precipitates as compared to TIG welding process in which dendritic grain structures is found. Because of fine grain structure, the MIG joint possesses good tensile and mechanical properties than that of the TIG welding processes

and henceMIG welding should be preferred over TIG welding for AA-6062 alloy.

VARIATION OF MICROSTRUCTURE FOR VARIOUS WELDING PROCESS

For Aluminum 6061 Microstructure of only fusion joint is studied because the joint mainly fails at the fusion area. This microstructure is shown in figure10. Ram Gopaland R.S. Jadoun in theirpaper "A Review on Effects of GMAW and GTAW onMechanical Properties on Weld Zone of Aluminum Alloy by Taguchi Design of Experiment Technique" [9] studied the microstructure of weld fusion zone.



TIG *MIG*

Fig. 10 Microstructure of TIG and MIG weldedAluminum 6061[9]

It can be concluded that the TIG welded component has a very fine and uniform grain structure whereas MIG welded component has a dendritic grain structure.

CONCLUSIONS

Following conclusions can be put forward from the above study of the paper:

i. Welding parameters such as welding speed, welding current, welding voltage, etc. have a considerable effect on the properties of the weldment and hence care should be taken while deciding the same.

ii. For A-6061 TIG welding is preferable because the weldment produced has better tensile strength and impact strength as compared to the weldment produced by MIG welding, whereas for A-6062, MIG should be preferred due to favourable grain structure.

iii. For MS IS 2062 ultimate strength and yield strength varies with different bevel angles. Also increase in voltage and current results in increasing yield strength and ultimate tensile strength.

iv. It has been observed that properties are largely dependent upon base material and the process used. If base material are different as mild steel and aluminium , the result require careful consideration.

THERMAL ENERGY SAVING IN MULTIPLE EFFECT OF EVAPORATOR

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ABSTRACT

The effluent water which comes out from the factory due to the usage of water under several processes goes to the Effluent Treatment Plant (ETP). After this process the treated water will undergo RO process which will further treat the water. Then the reject of RO water will be fed as feed water of Multiple Effect of Evaporators (MEE). In MEE the water will be evaporated by the help of steam. Then the evaporated water will be condensed by the condenser due to the vacuum present in the calendric and vapor separator. Then the water is sent to the Agitated Thin Film Dryer (ATFD). In the ATFD, the water is further treated and the salt is being removed at this stage from the water. Then the pure water is separated and sent to the collection tank which is used for gardening purpose. The thermal energy which is steam in this process is costing more tertiary operation cost. So we propose a new method which will be an alternate method for using this TVR process. The method we propose are as follows. As we all know, Water evaporates at 100 ḍegC at atmospheric pressure but it can also be evaporated at lower temperatures if the pressure is reduced. Hence, by maintaining a less atmospheric pressure in the evaporation chambers, the temperature required and the energy required for evaporation of the RO reject can be reduced considerably. This principle can be applied by designing a suitable vacuum arrangement through a vacuum pump.

MULTIPLE EFFECT OF EVAPORATOR (MEE):

Calandria is a Shell & Tube Type Heat Exchanger in which bunch of tubes assembled together for heating of process fluid. The Calandria shall be provided with top and bottom covers for visual inspection/periodic cleaning. A sight glass shall be provided at the bottom of Calandria for condensate observation. First Effect Calandria receives vapor from Discharge of TVR. Second and Third Effect Calandria receives Vapor from First and Second Vapor Separator respectively. First two Calandria are of Falling Film type and third Calandria is of Forced Circulation Type to reduce the scaling of Calandria Tubes. Liquid will recirculate through Recirculation Pumps with high velocity in the tubes of all Calandrias.

PREHEATERS

Preheaters are Shell & Tube Type Heat Exchanger in which bunch of tubes assembled together for heating of process fluid. All Preheater's Shell side is interconnected with Shell Side of all Calandrias. Vapor for heating shall be consumed by Preheater from shell of Calandria. In Preheater Feed is heated up close to boiling point so that Evaporation can immediately take place in first effect Calandria.

VAPOR SEPARATOR

Vapor Separator shall separate the liquid from vapor and shall be placed

Near the bottom of Calandria for falling film type evaporators and at top for forced circulation type evaporator with suitable vapor ducting having tangential inlet. Separator shall have manhole cover, product outlet, vapor outlet, temperatures dial gauge, vacuum gauge, light and sight glasses etc.

CONDENSER

This will be also Shell and Tube type Heat Exchanger, connected with last Vapor Separator The condenser shall be completed with water inlet/ outlet connection with matching flanges, Vacuum connection, sight glass etc. All the Vapors from the third vapor Separator will transfer to the shell side of Condenser for the condensation.

CONDENSATE POT

Condensate Pot is a small cylindrical Close vessel to collect Condensate of Evaporation which is generated from Steam and Evaporated Water. This vessel having very small holdup time. Condensate shall require to continuously taken out from the Pot using Centrifugal Pump.

THERMAL VAPOR RECOMPRESSION (TVR)

TVR is also known as Thermo-compressor and used to reduce the energy

Consumption of the Evaporator plant. It is similar to the Steam Jet Ejector and also maintains the vacuum of the system.

AGITATED THIN FILM DRYER (ATFD)

FEED PUMP-

This is a centrifugal pump. The pump will have Double Mechanical Sealing arrangement. It will be coupled to an electric motor of suitable horse power rating and is used to transfer the feed in the evaporation plant.

RECIRCULATION PUMP

This is axial flow type pump with Double Mechanical Sealing arrangement. It will be coupled to an electric motor of suitable horse power rating and used to recirculate the liquid in the tubes of Calandria.

CONCENTRATE PUMP

This is a centrifugal pump. The pump will have Double Mechanical Sealing arrangement. It will be coupled to an electric motor of suitable horse power rating and used to transfer the concentrated mass to ATFD System for further process.

PRODUCT PIPING

Complete with necessary pipes, bends, flanges, gaskets, nut & bolts tees, valves, pipe supports etc. For inter connecting feed pump, preheater, Calandria, vapor Separators, circulation pump, condensate and non-condensable gas lines etc.

ELECTRICAL PANEL

Electrical panel shall be used for operate the electrical motors. In panel, there is different feeder to operate the motors as per power and control requirement. Panel shall have push button starters for ON - OFF operation of electric items with corresponding indicative lamps. The panel shall be of damp proof connectors.

INSTRUMENT PANEL-

Instrument panel shall be used for operate the Instruments. In panel, there is a CPU and connecting IO device to operate the plant in design philosophy. SCADA shall be provided to monitoring and operate the entire plant. Also PLC panel shall be connected to electrical panel to monitor and control the motors. Also parameter will be saved in system.

Scientist study the world as it is,

Engineers create the world that never has been.

- Theodore Van Karmant

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