

ME251- MANUFACTURING SCIENCE

TERM PAPER REPORT

HOW ARC IS GENERATED IN ARC WELDING

NAME- VIPEEN KUMAR.

ROLL NO - 11941360

INTRODUCTION

- **What is arc welding**

It is a welding process in which electricity is used to create enough heat so that metal will melt. When this melted metal cool down results for the joining of metals. In this arc welding, electric power supply is used to create an arc which will finally melt the metals for the joining of metals. This arc is used for melting of basic material and the metal stick which is used as the electrode at the point of contact. In Arc welding , direct current and alternating current can be used by welders. Welders can use consumable electrodes as well as non consumable electrodes.

Shielding gas, slag or vapor are used for protection in welding areas. Manual, fully automated or semi automatic are processes maybe use Arc welding processes. Arc welding used from the late part of the 19th century as it was first developed in this century. During the world war , shipbuilding was commercially produced by welding. Steel structure and vehicle fabrication are now important processes of the Arc welding.

Following types of the Arc welding are:

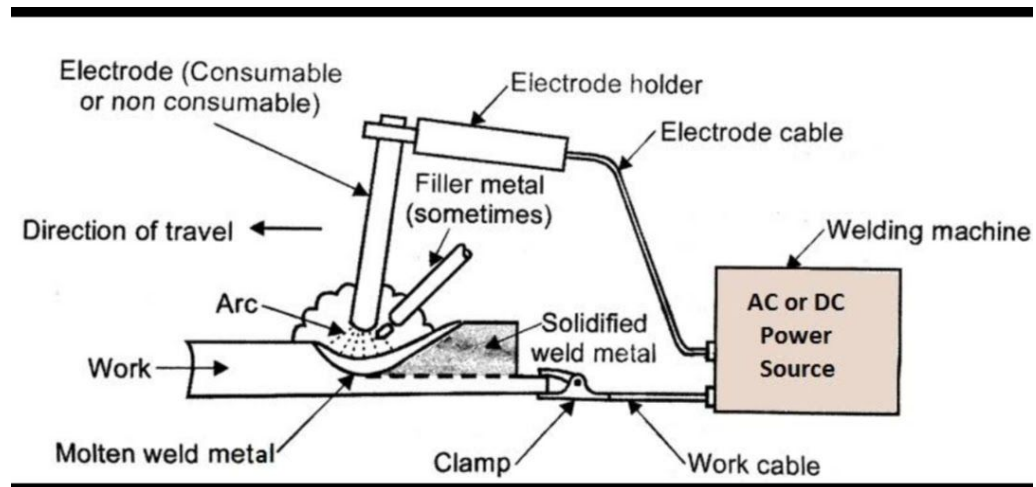
electrode: consumable

- Shielded metal (Arc welding).
- Flux cored (Arc welding).
- Gas metal (Arc welding).
- Carbon (Arc welding).
- Submerged (Arc welding).
- Atomic hydrogen welding.
- Electroslog welding.
- Stud (Arc welding).
- Electro gas welding.

electrode : non consumable

- Tungsten gas (Arc welding).

- Plasma (Arc welding).



- **Power supply**

Different kinds of power supplies are used in Arc welding processes for supplying necessary electrical energy. Sustained voltage(V) power supply and sustained current(I) power supply are the most common processes of power supply for electrical energy. Voltage is mainly considered for the length of the arc and current is mainly considered for the input heat amount. Shielded metal and tungsten gas are the most common processes of manual welding processes that use the constant current power supply because of these different types of processes to maintain the constant current either the voltage varies. It is not easy to hold the electrode perfectly steady in manual welding processes that's why the arc length and then voltage leads to alter. Submerged metal , flux cored and Gas metal are followed by the automated welding processes are used for constant voltage power supplies, which makes constant voltage and leads to change the current. The Arc length is maintained constant in these processes. Any changes in the base material and distance between the wire is easy rectified by the vast change in current . Current will suddenly increase by closer to the base material and the wire with each other, which results as the tip of the wire to melt and the heat to increase while the separation distance returns to its original state.

- **HOW ARC IS GENERATED IN THE ARC WELDING**

Electric Arc is used for producing intense heat which is needed to melt metal in the Arc welding process. The Formation of arc takes place between the electrode and the metal piece that is guided mechanically or manually along the joint. The electrodes may be used as a rod with the motive of carrying the current in between the work and the tip.

Or we can make a rod or wire which is not only used as conduction of current but also adding the filler metal and melts the metal piece to form the joining. A direct current or alternating current power supply sources for desired power requirements is connected to the workpiece with the work cable and an electrode cable is connected to electrode Holder which creates an electric contact to the welding electrodes. The Creation of arc takes place between the gap when there is a connection of the electrode tip with the workpiece and is separated which is created by the energized circuit. The electrode will act as the cathode and the workpiece will act as the anode. Now the electrode tip and workpiece touch each other and withdraw at the certain distance then the electron will start propagating and strike the anode with huge kinetic energy as the electron will have high velocity. Electron will strike the surface of anode(workpiece) and create intense heat of 6500 Fahrenheit temperature is generated at the electrode tip. There will be air molecules between electrode and workpiece and that air molecules contain both positive charged protons and negative charged electrons will be present. When the electrons will be emitting from the cathode, it will remove electrons from the air molecules and this will be the secondary electrons which are produced from air molecules when electrons strike on it with high energy which is ejected from the cathode. There will be positive charge also after the dissociation of air molecules . So positive charge will be attracted by cathode. Negative electrons ejected from the cathode and electrons(secondary electrons) evolved from the air molecules will strike the workpiece. 65-75% of heat will be generated at workpiece. The heat of this much temperature will melt the workpiece and the electrode which creates a molten metal pool which is called "crater". After the welding process, Crater solidifies and creates a strong fusion bond.

Metals with that much high temperature lead to reaction with the air element that is nitrogen and oxygen. Contamination of molten metal pools with the nitrides, oxides and air will destroy the toughness and strength. Protection of metal pools is necessary because of contamination so it is protected by gas shield, slag or vapor. This is known as shielding. This is used for prevention from contamination of air with molten metal. Improvising of weld takes place by shielding. The Addition of deoxidizer acts as shielding. Extruded covering attach with the filler metal rod protects the point of contact and the slag is used for the protection of fresh weld from the contamination of air. Creation of arc takes place in between the two electrodes in which electric current is flowing through a column of ionized gas. Intense heat in the Arc welding is produced by the positively charged anode and the negatively charged cathode. In the Plasma column with an accelerated rate, positive and negative ions are glanced off of each other. The arc produced in arc welding is not only used for the heat required for the joining of metal and electrode by melting but also used for the transport of the molten metal to the workpiece from the electrode tip.

Various mechanisms take place for the transfer of metals are following.

- Due to surface tension, the drop from the metal(molten) which is touching to the pool(metal) is drained.
- Heat produced results as the molten metal to eject drops from the electrode tip to the pool(molten) by electric pinch propeller.

In the consumable electrode method, Transportation of the metal(molten) and the electrode tip to the pool(work) takes place in the Arc column. Metal Arc is described as those systems in which the tip of the electrode is melted to be a part of the arc welding. Due to ionisation of gas melting takes place therefore just switching on the current of welding with the cold electrode will not be able to start the formation of arc. So the ignition of the arc must be at the prior of the welding. This needs to be done by supplying high voltage that must be enough which can create a discharge or by moving the tip of the electrode to the metal pool(work) system and thus removing that after the contact area gets heated.

The following equipment used as:

- DC or AC machine.
- Electrode holder.
- Electrode.
- Chipping hammer.
- Cables and cable connector.
- Wire brush.
- Earthing clamps.
- Safety goggles.
- Helmet.
- Aprons, sleeves.
- Hand gloves ,etc.

Working

- At the starting, ON the DC or AC electric power supply
- When base metal and the electrode comes near about(2-4mm apart) where we need to join two metals, spark begins to generate between the electrode and the metal.
- Heat is created because of Arc production. The Base metal , flux coating and electrode core melts due to heat produced by the arc. Shielding the environment is provided because of the flux coating from the air, oxides, nitrides contamination to the weld. When molten metal and slag get cooled between the pool of two metals which are joined together . Two metal pieces are joined together after the solidification and this bond formed is very strong.
- For protection from atmospheric contamination, shielding gas is used.
- When the Welding process is completed the metal piece is placed in the appropriate coolant to cool down or left for the cooling in the open air.

Advantage

- High welding capacity and speed.
- A Good welding environment is provided.
- Weld quality is consistent.

- Metals were joined by strong bonds.
- Simple Equipment is used for welding.
- Less expensive power sources.
- Reliable and fast process.
- Multiple functionality of equipment.
- Transportable.
- A Standard domestic current can be used by welders.

Disadvantage

- Skilled operators are needed.
- It cannot be used for thin metals
- More waste is produced than other welding types.
- In some projects, due to waste cost is increased.

Application

- Most manufacturing industries use Arc welding for well built joints.
- It is also used for the fabrication of the vehicles and steel structure.
- Automobile.
- industries Construction.
- Building Construction.
- Shipbuilding.
- Aerospace.
- Maintenance.
- Repair works.
- Because of its good welding efficiency and simplicity, arc welding are mostly used.