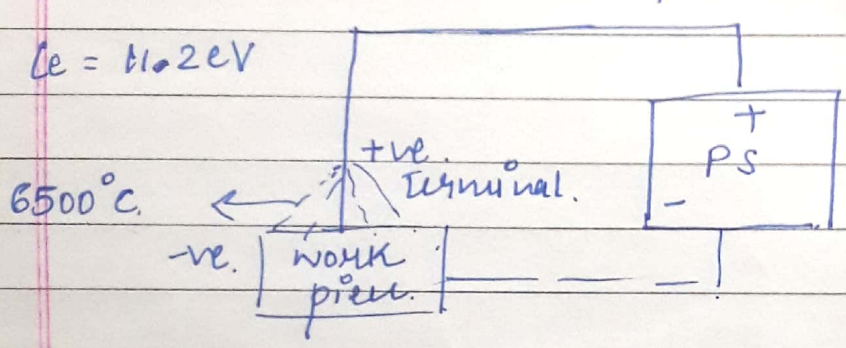
Welding

Physics behind ARC welding :- (when distance b/w +ve & -ve) terminal is less.

~~On~~ increasing voltage electron will come out to surface from (-ve) terminal to the (+ve) one. The gaseous ~~part~~ molecules present b/w the electrodes will hit the electrons (collision) and COME fails and Energy don't get transfered instead generate heat. and work function decreases and at final. 2/3rd heat is generated on +ve terminal. and 1/3rd on -ve Terminal. experimentally.



Oxygen shouldn't react with molten metal. As on high Temperature oxidation takes place so

need to generate → Inert gas. environment

Generate Inert atmosphere.

or

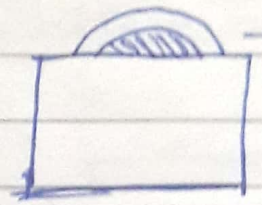
Reducing atmosphere.

To generate reducing atmosphere. we need to coat electrode with oxides of inert gas or with the carbonates even carbides can be used.

$CaCO_3 \xrightarrow{\text{high temp}} CaO + CO_2$.

or further to gets generated

Shielded Metal Arc Welding Drag/Stick
Manuel metal arc welding proces. (MMAW)



→ complex compound due to arc welding

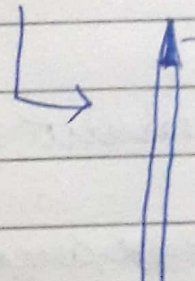
Advantages of SMAW (Shielded metal arc welding).

cheapest, portable, Electrode can develop at any composition

Limitations / Anamolies

High skilled labour.
length of electrode.
consistency is difficult to maintain at diff points

Electrode.



Stab.

Different lengths available L-250
L-350
L-450.

Different Diameters = 2.5, 3.5, 3.15, 4, 5

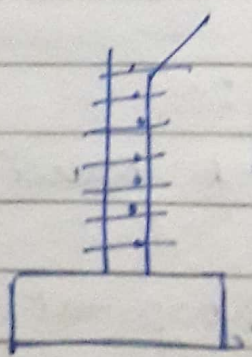
current required for a particular diameter:

$I = 40 \times \phi$.

if less current given arc will n't generate and on more I not in control

$H = i^2 R T$

$R = \rho L / A$



Different points

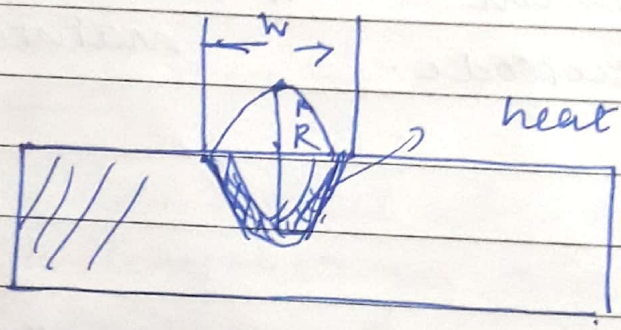
Cross section area of electrode.

Substitute of SMAW

PESMAW → plasma Enhanced shielded metal arc
Tubular electrode is used.
we feed the gas in tube.
welding on a plate is called beat or plate

Lancing - making a hole.

BEAD GEOMETRY AND SHAPE RELATIONSHIPS



Crown area is called as reinforcement area.

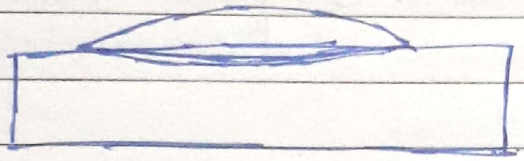
$$\%D = \frac{Ap}{Ar + Ap} \times 100.$$

(Total bead area percent dilution)

At = Total bead area = Ar + Ap

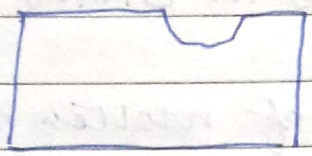
Use of welding :-
* Joining
* Surfacing
* Gauging
* cutting.
* lancing
→ scoop out the metal surrounding from defective part

In case of surfacing lower dilution and higher reinforcement need to be maintain on mode. dilution the composition of materials goes down.

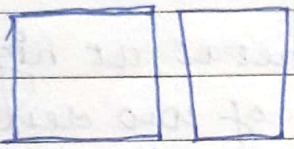


for surfacing.

on Gauging



on cutting



Rate of Heat Input in Bead Geometry.

$$RHI = \frac{\eta V I \cos\phi}{S} \text{ J/mm}$$

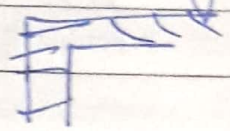
* on reversing polarity with electrode at -ve than more heat to the workpiece Hence high penetration and low reinforcement.
* electrode at +ve for surfacing cutting / Gauging / ~~Welding~~ workpiece at the most (High) penetration.
* more plasma → more heat value → more penetration.
* Instead of brass orifice powder feeding done Tubular is of mild steel → composition of powder needed to be maintained

Teacher's Signature.....

Spatter → spark during welding

Air plasma enhancing penetration rises up to 4 times.

SMAW coating produces O_2 which improves cutting efficiency and surface quality.



Role of fluxes in SMAW

1. prevention of molten material.
2. Removing impurities.
3. oxidation of metal at high temp gets restricted
4. provides a slag of low density.
5. provides property of fuse quickly.
6. flux ease the initiation of arc.
7. flux shouldn't melt before wire.
   flux should have the capability to low down the melting point of wire.
8. Add alloy elements to the weld metal, to raise the tensile strength to reduce aging or to produce nuclei for grain size.
9. facilitate specific operations, as overhead welding, fillet welding. etc.
10. It permits use of different types of currents.
11. Reduce spatter or fume.

Flux minerals

1. Quartz : viscosity, current carrying capacity and slag detachability.
2. Aluminium oxide :- impact properties & medium penetration.
3. Metal carbonates :- reducing atmospheres.
4. Titanium dioxide :- highly fluid but quick freezing slag, are stability and impact properties.
5. ferromanganese and ferrosilicon : deoxidize the molten weld metal.
6. clays and gums :- strength to the coating.
7. calcium fluoride - shielding gas, fluidity and solubility of the metal oxides.
8. Iron powder :- Increase productivity.
9. Alloying metals :- Increase mechanical properties of the slag.

Surfacing.

constant voltage power source → Mechanised setup
Process parameter.

SAW (controls weld characteristics.

→ WFR (Wire feeder)
→ Nozzle to plate distance. (NPD) welding occurs in this area.
→ Welding speed
→ voltage.

During NPD

* Resistance increases but heat increase would be negligible: voltage also changes., width vary.

on rising welding speed.

dilution ↓ses. penetration ↓ses.
voltge. ↑ses

Limitation of process

position

power consumption will be high during process.

In Advanced submerged welding cond only power source required and just increasing a little current can melt of feed not wire.

cooling rate high
- martensite forms.

* when peak temp ↓ses of molten material then cooling structure ↓ses, no ~~hard~~ pearlite formed, Toughness will increase.

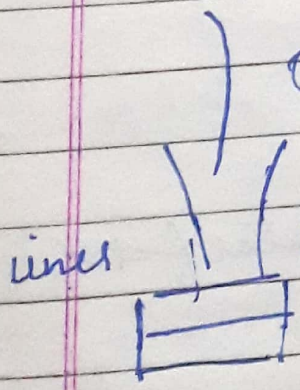
* on ↑sing heat flux will melt more and more. alloyment elements will enter which flux contains so there would be need to manage the chemistry of these elements.

MIG / MAG] → GMAW

Metal active gas.

Metal inert gas

This minimize the chance of resistivity.



* Automatic welding → const. current power source is u (when there is no mechanisation)

* Mechanisation exist then const. voltage panel soure is used SAW, GMAW.

#
⇒ copper coating wire is used to get
⇒ protects from rusting
⇒ high current transfer rate
⇒ solubility of CO_2 at high temp is very poor.

process of GMAW
N-P dist, welding speed, Oxygas flow rate, wire feed

Diameter of wire is also a parameter but it is fixed before welding.

GMAW

Advantages

Joining ability
higher welder efficiencies and operator factor
higher electrode efficiencies.
Excellent weld bead appearance
All-position welding capability.
Lower heat input
Less slag
Less welding fumes.

Limitation:

→ higher heat input axial spray restricts its use. to thicker base material.
→ higher heat input axial spray restricts its use than base material.

GTAW (Gas Tungsten ARC welding)

No flux / No

* Tungsten is utilised as electrode.
* just remove wire feeder from SAW & electrode (W) is used in that place
* low value current (5 amp) can be used in the process.

Advantage It is autogenous welding process, constant current & power, no filler is used to fill the weld gap b/w metals.
whereas in nyliogenous welding process, we use consumable (filler like consumable wire) to fill the weld gap.

Advantages

→ High Quality & Precision
→ Pin point control.
→ Aesthetic Weld Beads.
→ No flux or slag.
→ No smoke or fumes.

Teacher's Signature.....

Tungsten inclusion :- Tungsten defect in material in GTAW welding as it has very different properties than compare to other elements and has very high melting point, which don't melt easily

TIG Disadvantages

→ Slower travel speeds than other processes
→ lower filler metal deposition rates.
→ Hand eye coordination is required skill.
→ Brighter UV Rays than other processes.
→ Equipment costs can be higher other than process

Aluminium welding - Electrode +ve.
CO_2 is not used in GTAW and other gases are used Because it fails to grab O_2 from atmosphere
C → transports to W Electrode → forms Tungsten carbide

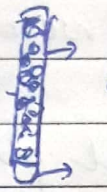
In GTAW process
→ arrangement ⇒ high frequency generator

Distance b/w Electrode and workpiece ( ).
diameter of (electrode).

Role of Shape of Tungsten electrode.

FCAW (flux core arc welding)

In this we use electrode (having flux inside).
Good Quality than SAW & SMAW but not as GTAW



Less cross section area means more resistance hence more heat at low current.

Two types

(FCAW)

Self shielding consumably.
Gas shielded FCAW consumably

self shielded means flux has the capability to protect molten metal

Use of metal as flux

outcomes of SMAW (Advance) process.

1. change in direction of plasma.
2. lower peak temperature of weld metal.
3. Lower cooling rate of weld metal.
4. Improved toughness of weld metal.
5. Improved tensile strength of weld metal.

Teacher's Signature.....

6. lower melting of base materials
7. higher metal deposition rate at same current.
8. lower (weld) heat affected zone.
9. lower heat losses
10. Improved microstructure.

PAW (plasma arc welding process).

consumable material plays very important role in PAW

→ properties of electrode :-

Pressure in PAW - 60 Bar.
low oxidation
high Temperature
good thermionission property.
low thermal expansion.
high electrical conductivity.
lower resistivity.
high melting point.
high latent heat of vapourisation.

What are the other materials of hafnium in Plasma are welding (PAW).

Gas feeding should be done before arc initiation

Type

Cladding operation to be done (corrosion resistance) = deposit layer on medium C. steel. Suggest the process and power source. (0.71.C)

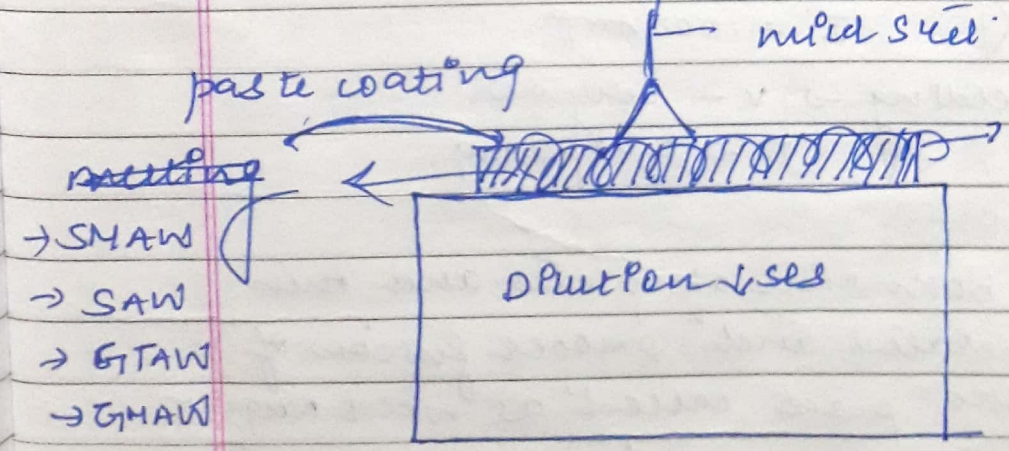
Stainless steel taken. having 25% chromium.

Chromium depletion takes place. ...

Before cladding a buttering layer has to be deposit so that Cr won't combine with C content present, inorder to prevent the formation of Cr. carbide.

Q Is hardfacing possible with GTAW or plasma.

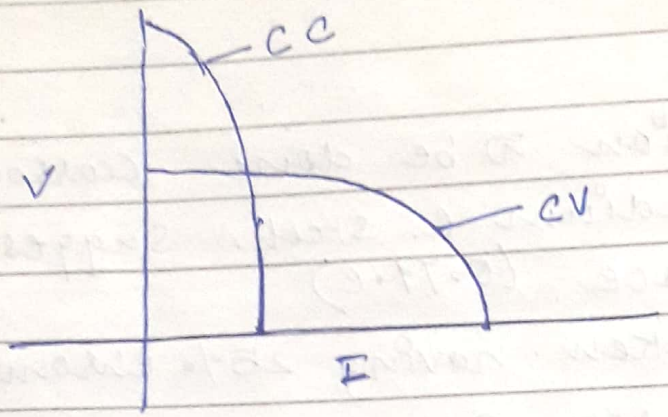
NO, but cladding can be done through plasma.



on reducing dilution chemistry improves and mixes in metal with minimum fusion and good composition. which is called as paste coating.

Teacher's Signature.....

Power sources for arc welding



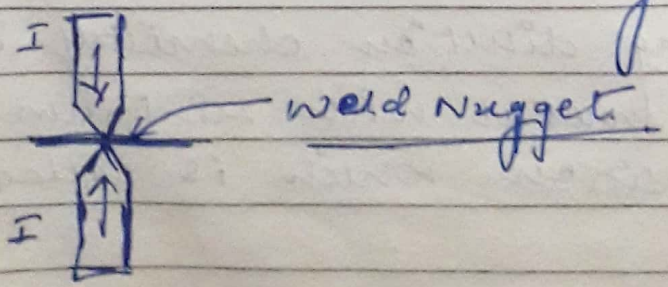
CC - constant current (used in manual)
CV - constant voltage.

Arc welding :- V → 90.
I → upto 3000 amp

plasma cutting :- V → 170
I = 1000 Amp

Resistance welding → V - very low.
I → 20000 Amp.

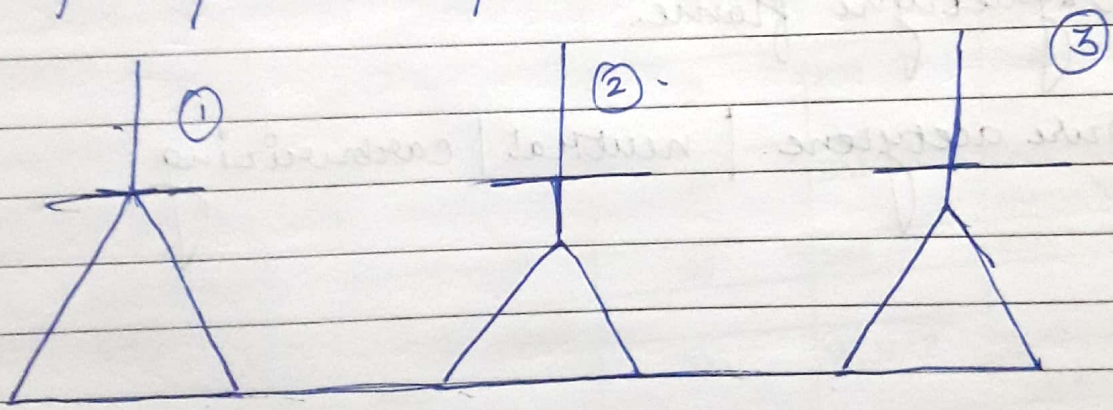
press from both side of plates and thin fin is generated and proper fusion of plates take place called as weld Nugget used in Resistance welding.



Q.ne Why CC is used in manual process??

Hand fluctuation during welding in manual proc cause change in voltage. which ↑ses with change i current which results in to heat fluctuation ($H = i^2RT$) and leads to the formation of marters and other impurities therefore to avoid. such results constant current is maintained in manual process.

Q.ne Self regulation of arc. uses??



is in equilibrium cond.

on constant voltage power source. because of fluctuations it results in to short circuit self. regulation of arc. give jerks of current supply by which voltage and current fluctuates a bit and avoid. short circuiting during welding.