SNS COLLEGE OF TECHNOLOGY

(An autonomous institution)

Department of Mechanical Engineering

Unit – III

III

Topic

Welding

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Welding

The AWS definition for a welding process is

“A Materials joining process which produces coalescence of materials by heating them to suitable temperatures with or without the application of pressure or by the application of pressure alone and with or without the use of filler material".

Welding

Classification of welding process:

1. Fusion welding
2. Plastic welding.

Fusion welding: The metal at the joint is heated to a molten state and then it is allowed to solidify. Pressure is not applied during the process and hence it is called “non pressure welding”. Filler material is required for this welding.

Plastic welding: The metal parts are heated to a plastic state and are pressed together to make the joint. It is called as “pressure welding”. No filler material is required

Terms used

Alloy → is an element added to a metal.

Arc → is what is between the end of the electrode and the base metal. The resistance causes heat.

Bead → the deposited filler metal on and in the work surface when the wire or electrode is melted and fused into the steel.

Welding

Electrode → Electrodes come either covered with flux, or just bare wire. In the field an electrode is called a "rod" in stick welding, and "wire" for MIG and Flux Cored Arc Welding.

Electrode Holder → A hand clamp that holds a welding rod and conducts electricity out of the rod in DCEN, or into the rod in DCEP.

Filler Metal → This is metal added to the weld pool. A weld can be made with or without filler metal. Thin gauge metal is sometimes welded by melting the two base metals together.

Welding

- **Nozzle** → A brass attachment that is about three inches long and shaped as an open cylinder. It is put over and insulator and seals at the top giving the shielding gas one direction to go out over the weld.

- **Penetration** → Is the FUSION or depth into the PARENT METAL from its surface, or the amount of FUSION through an open faced joint.

- **Shielding Gas** → Gases such as argon or helium are inert, meaning they will not combine with other elements. This makes them good for keeping atmospheric contaminants out of the WELD POOL.

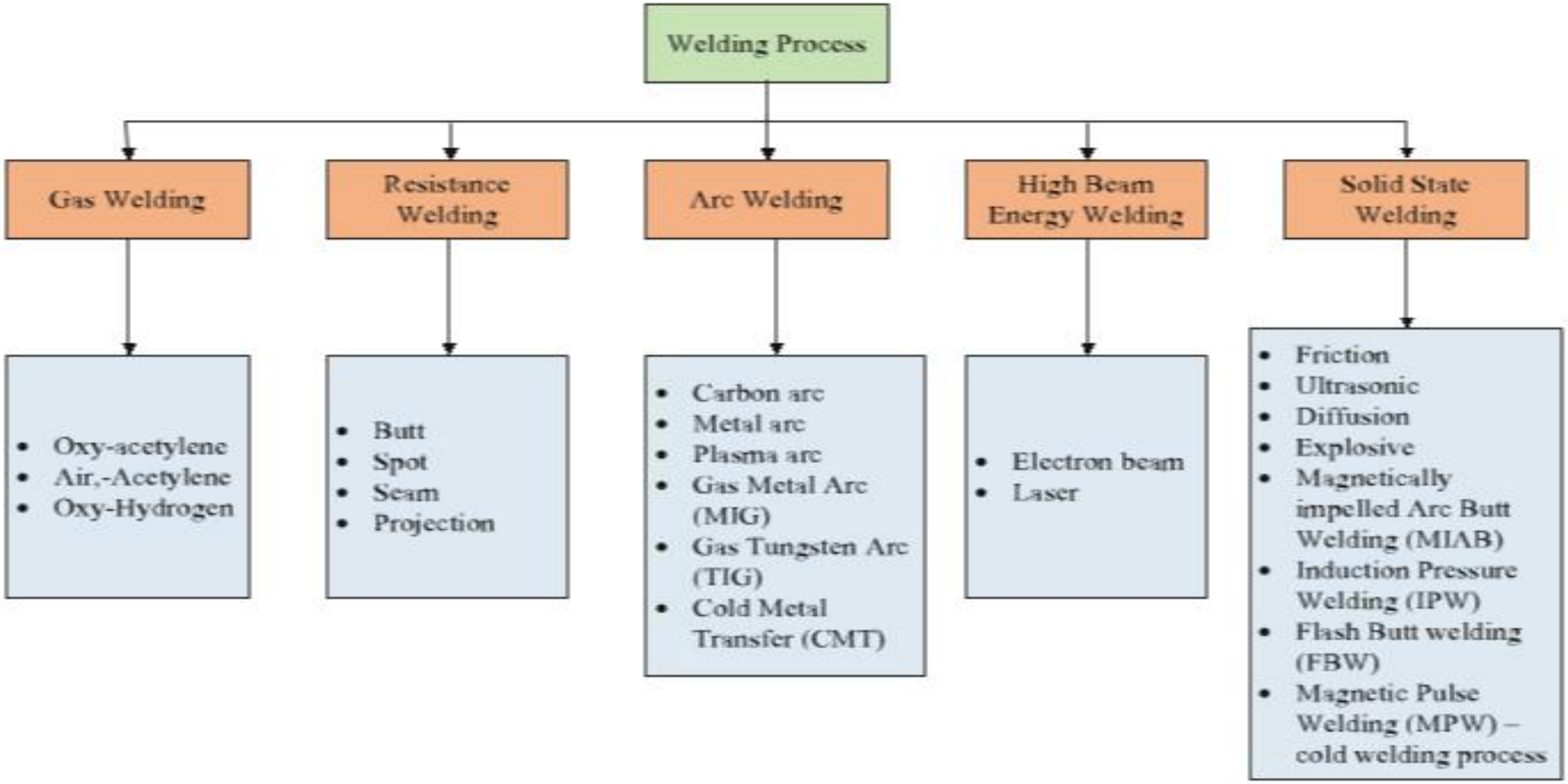
Welding

Depth of Fusion → How deep your filler metal penetrates into the metal from the surface.

Flux → Cleans the surface and when burned makes a Shielding gas that protects the weld pool, or puddle from atmospheric contaminants that cause defects.

Slag → when the FLUX on a welding ROD melts it produces the SHEILDING GAS to protect the weld, and then forms a hardened protective coating over the weld. This has to be chipped off and thoroughly cleaned, usually by brushing.

Types of Welding



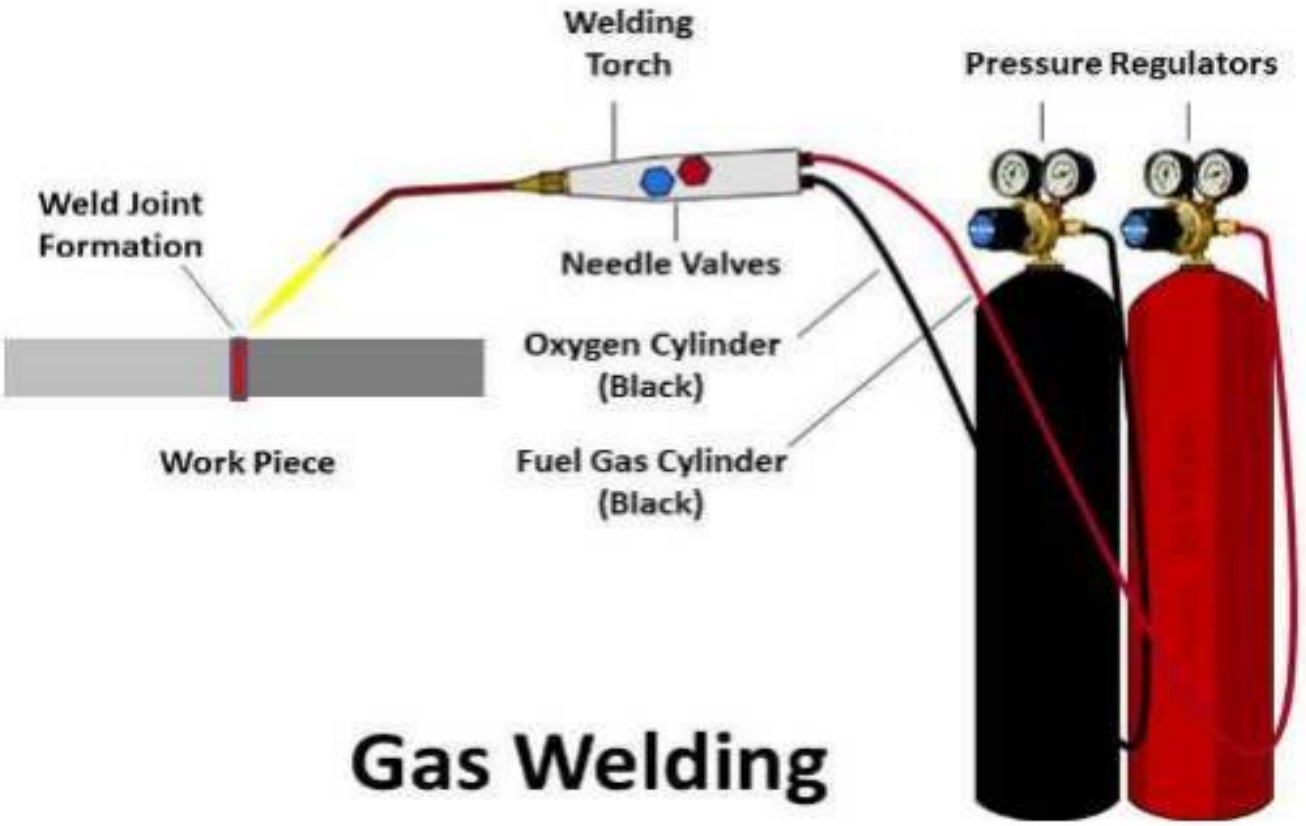
Gas Welding

GAS WELDING:

1.Oxy – acetylene welding

2) Oxy – hydrogen welding

3) Air – hydrogen



Gas Welding

Oxy acetylene Welding:

- The edges of the metal to welded are melted by using a gas flame.
- No pressure is applied.
- The flame is produced at the tip of the welding torch.
- The welding heat is obtained by a mixture of oxygen and combustible gas.
- The gases are mixed in the required proportion in a welding torch which provides control for the welding flame.
- The gases used are **acetylene, hydrogen, propane and butane**.
- Common gas is **oxy acetylene.**
- The flame only melts the metal and **additional metal to the weld is supplied by filler rod.**

Gas Welding

- A **flux** is used during welding to prevent **oxidation and to remove impurities.**
- Metal 2 mm to 50 mm thick are welded.
- The temperature of the flame is about 3200 oC.
- There are two types of oxy acetylene systems,
  one is High pressure and
  the other is Low pressure system.

Gas Welding

Oxy Hydrogen Welding:

- Similar to OA welding process.
- The oxygen and hydrogen gases are mixed with the required proportions for producing heat.
- It was once used extensively to weld low temperature metals like Al, Lead and Magnesium. Presently this process is not used.

Gas Welding

Air Hydrogen Welding:

- ✓ Similar to OA welding process.
- ✓ Air is used instead of oxygen.
- ✓ The air is taken from the atmosphere is compressed in a compressor and mixed with acetylene to the required proportion in the torch.
- ✓ The temperature is low and used in welding of lead.

Gas Welding

GAS WELDING EQUIPMENTS:

1) Gas cylinders: Oxygen in Black colour, Acetylene in maroon colour.

2) Pressure regulators: Each cylinder is fitted with pressure regulator. It is used to control the working pressure of the gases. Oxygen 0.7 to 2.8 kg/cm2 Ace 0.07 to 1.03 kg/cm2

3) Pressure gauges: Each cylinder is fitted with two pressure gauges. One is for cylinder pressure and the other one is working pressure for welding.

4) Hoses: Each cylinder is connected to the torch through two long hoses. It should be flexible, strong, and light. Oxygen is fitted with black colour and Ace in red colour.

Gas Welding

5) Welding torch: Oxygen and ace enters the torch through the hose is separate passage. Both the gases are mixed in the mixing chamber of the torch. When it is ignited a flame will be produced at the tip of the torch called nozzle. Two control valves are used to control the quantity of oxygen and ace to adjust the flame.The nozzles are made of copper and available in different sizes depending upon the type of metal to be welded.

6) Goggles: It is used the protect eyes from the flame heat, ultraviolet and infrared rays.

7) Welding gloves: It is used to protect hand from the injury by heat and metal splashes.

8) Spark lighter: It is an igniter to start the burning of the oxy ace gases.

9) Wire brush: It is used to clean the weld joint before and after welding

Gas Welding

GAS WELDING TECHNIQUE:

In gas welding the **speed and quality of the welding** can be improved by proper selection of **torch size, filler material, method of moving the torch, angle at which the torch is held**.

Two techniques are used.

1) Leftward or forward welding

2)Rightward or backward welding.

1. Leftward or forward welding: The torch moves from **right to left.** The torch is held on right hand and the welding rod is held on left hand. The torch angle 60 to 700 and welding rod at 30 to 400

. It allows the preheating of the plate immediately ahead of the molten pool. It is suitable for welding Mild Steel plates up to 5 mm thick.

2. Rightward or backward welding: The torch moves from **left to right.** The torch is held at angle 40 to 50o and welding rod at 30 to 40o. Better shielding. It is suitable for welding Mildsteel plate more than 5 mm.

Gas Welding

FILLER RODS FOR GAS WELDING:

Filler rods/welding rods used in gas welding to supply additional metal to make the joint.

It is metal rod made of the same material as parent material. The diameter of the filler rod is depending upon the thickness of the metal to be weld.

$d = t / 2 + 1.$

Filler rods are coated with copper to prevent oxidation of the molten metal.

Gas Welding

ADVANTAGES AND LIMITATIONS OF GAS WELDING:

Advantages:

1) Temperature of the flames can be easily controlled.
2) Filler metal deposits can be controlled easily
3) All types of metals can be welded
4) Cost of the equipment is less
5) It can be used in factory or in the field 6) Maintenance cost is less.

Limitations:

1) It is not suitable for joining thick plates
2) It is slow process
3) Strength of weld is not so good as arc welding
4) Handling and storing needs more care.

Gas Welding

COMPARISION OF ARC WELDING AND GAS WELDING:

Arc welding	**Gas welding**
Heat is produced by electric arc	Heat is produced by the gas flame
The arc temperature is about 4000oC	The flame temperature is about 3200oC
Filler rod is used as electrode	Filler rod is introduced separately
It is suitable for medium and thick work	It is suitable for thin work
Arc weld joints have very high strength	Gas weld joints do not have much

Gas Welding

Reactions:

$$C_2H_2 + O_2 \text{ -----> } 2CO + H_2 + HEAT$$

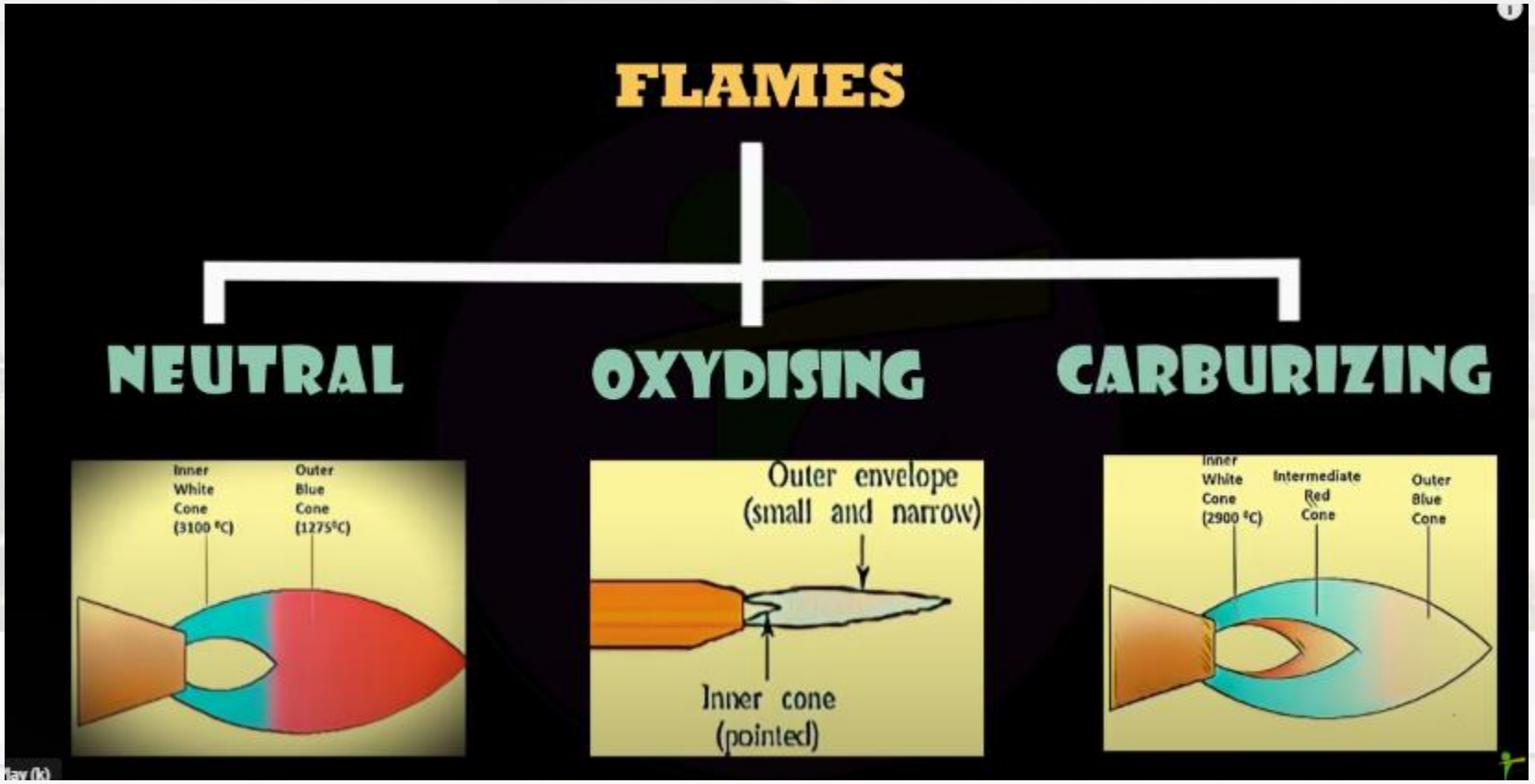
$$2CO + O_2 \text{ -----> } 2CO_2 + HEAT$$

$$H_2 + 1/_2 O_2 \text{ -----> } H_2O + HEAT$$

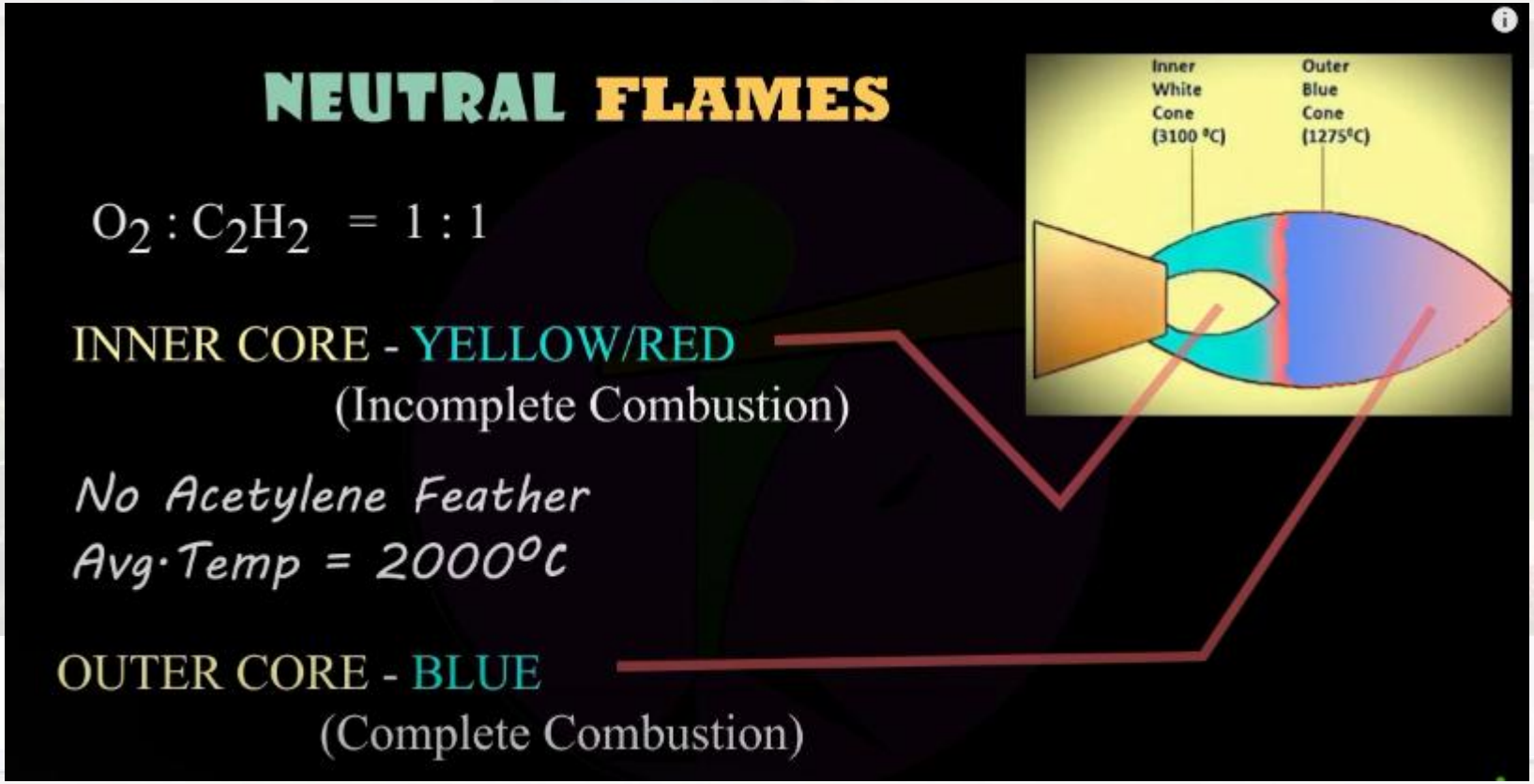
C_2H_2 : O_2

$1 m^3$: $2.5 m^3$

Gas Welding


FLAMES
NEUTRAL
OXYDISING
CARBURIZING
Inner White Cone (3100 °C)
Outer Blue Cone (1275°C)
Outer envelope (small and narrow)
Inner cone (pointed)
Inner White Cone (2900 °C)
Intermediate Red Cone
Outer Blue Cone

Gas Welding


NEUTRAL FLAMES
$O_2 : C_2H_2 = 1 : 1$
INNER CORE - YELLOW/RED
(Incomplete Combustion)
No Acetylene Feather
Avg·Temp = 2000°C
OUTER CORE - BLUE
(Complete Combustion)
Inner White Cone (3100 °C)
Outer Blue Cone (1275°C)

Gas Welding


NEUTRAL FLAMES
used for cutting & joining
of all Fe & non-Fe materials
exept Brass(bez zinc evaporates)
Inner
White
Cone
(3100 °C)
Outer
Blue
Cone
(1275°C)
Cutting
Joining

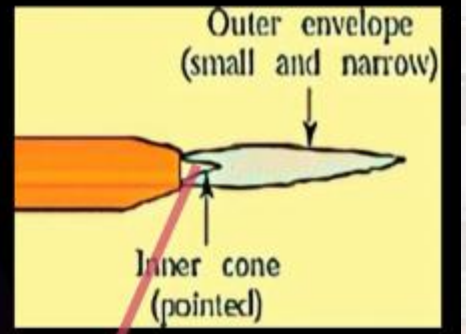
Gas Welding

OXYDISING FLAMES

$O_2 : C_2H_2 = 1.5 : 1$

INNER CORE - Small Length & Sharp
(Complete Combustion)

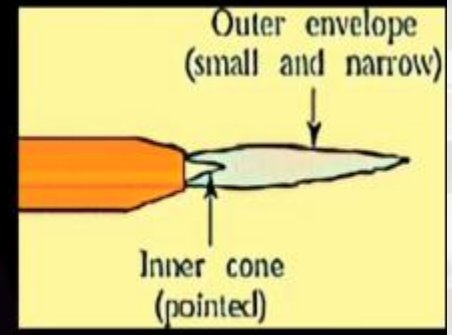
No Acetylene Feather
Avg·Temp = 2100°C

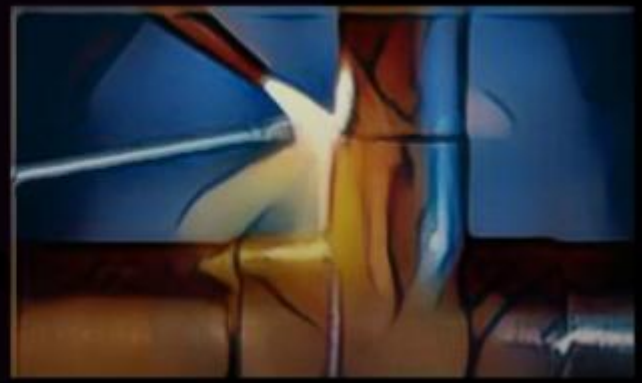


Gas Welding

OXYDISING FLAMES

used for cutting & joining
of all Fe & non-Fe materials, Al, Mg
including Brass

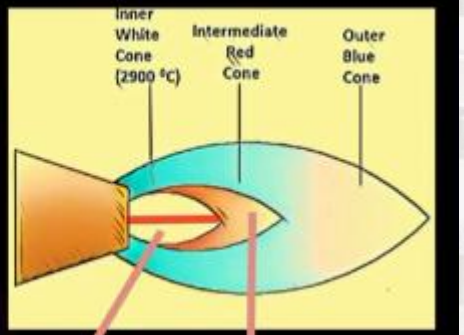




Gas Welding

CARBURIZING FLAMES

$O_2 : C_2H_2 = 0.85 : 1$



INNER CORE - Large Length

(Bez of O_2 shortage)

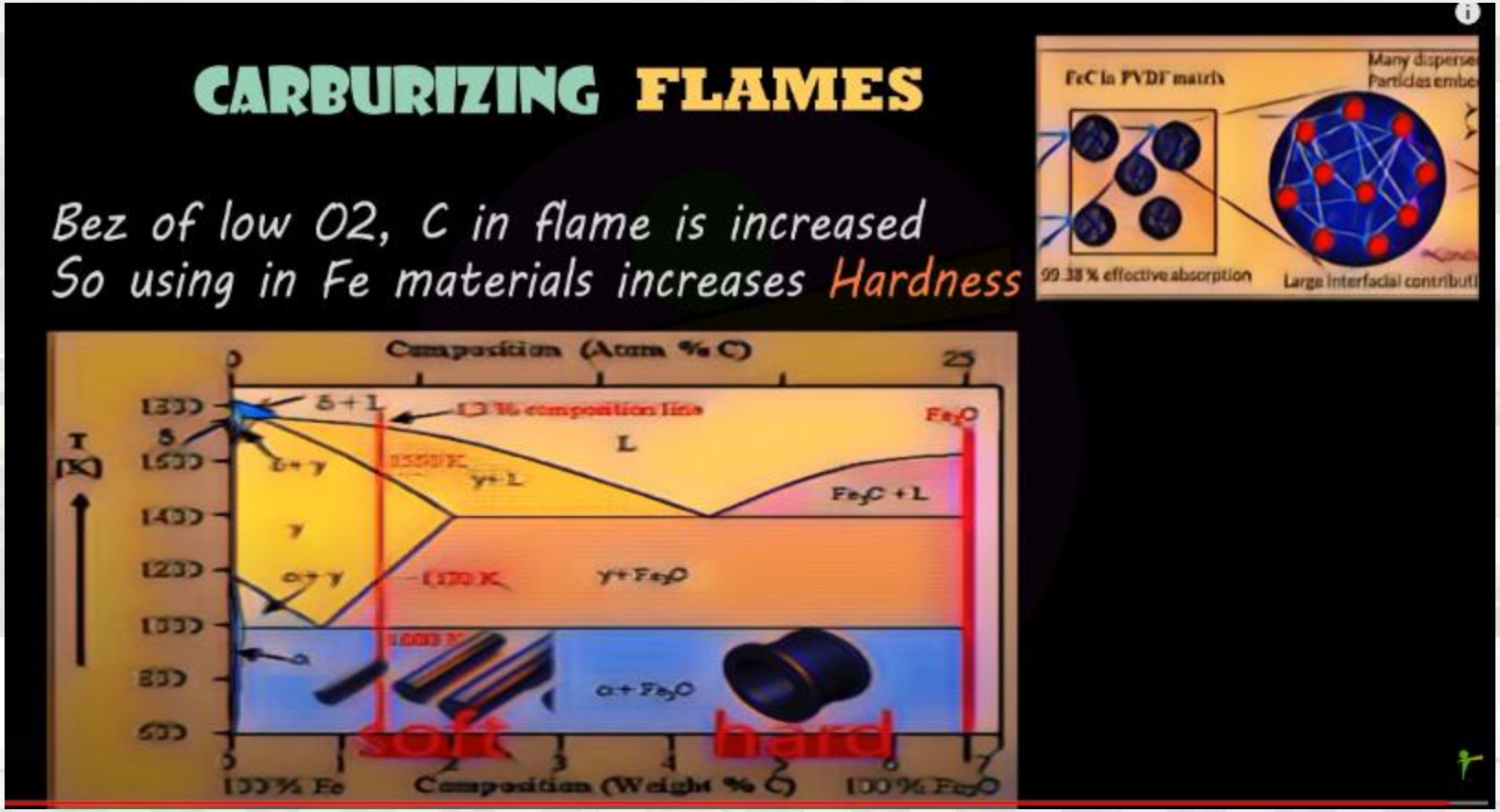
MIDDLE CORE - Acetylene Feather

(Incomplete Combustion)

Avg·Temp = 1800°C

(Bez of low Avg·Temp High mp can't joined)

Gas Welding


CARBURIZING FLAMES
Bez of low O2, C in flame is increased
So using in Fe materials increases Hardness
FeC in PVDF matrix
Many dispersed Particles embe
99.38 % effective absorption
Large interfacial contributi
Composition (Atm % C)
T (K)
soft
hard
100% Fe
Composition (Weight % C)
100% Fe3O

Gas Welding

SOLDERING:

- Soldering is a process of joining two metal parts with a third metal.
- The third metal has a very low melting point. It is known as Solder.
- It is used as a filler rod.
- Most of the solders are alloys of tin and lead.
- They melt at a temp of about 215oC.
- The work pieces are not melted.
- Electrically heated soldering irons are available.
- The two sheets are properly cleaned to remove oil, grease, oxides and dirt.
- This is done by chemical cleaning, filing, or by emery cloth.
- Two sheets are positioned.
- A flux is applied using a brush.

Gas Welding

The flux prevents oxidation.

The flux used is in the form of liquid or paste.

The flux used are zinc chloride and hydrochloric acid.

The soldering iron is heated to proper temp.

It is dipped in the flux and then rubbed on the solder.

This is known as tinning of the tip.

Applications: Used in electrical appliances, computers, automobile radiators.

Gas Welding

BRAZING:

It is the process of joining two similar or dissimilar metals by using a fusible alloy called “spelter”.

Spelter is a harder filler rod.

Its melting temp is about 600oC.

This is below the melting point of the work materials.

The most commonly used spelters are copper alloys and silver alloys.

For brazing ferrous metals copper alloys made of copper, zinc and tin are used.

Silver alloys made of silver and copper are used for any metals

Gas Welding

The metal parts are thoroughly cleaned. The parts are assembled with a gap between them so that the filler material may flow inside the joint. Now the flux (borax powder) in the paste form (mixed with water) is applied over the joint, this is done before heating the parts. Then the parts are heated below their melting point. The heating may be done in a furnace or by oxy-acetylene flame. The flux melts and flows in the gap between the surfaces. When the spelter is applied to the joint it gets melted. It flows in the gap between the work piece and solidifies. Thus a hard brazed joint is formed.

Gas Welding

Comparisionof Soldering and Brazing:

Soldering	Brazing
Filler material is known as solder	Filler material known as spelter
Low melting point alloys used	High melting point alloys used
Alloys of tin and lead are used	Copper and silver base alloys used
Strength of the joint is relatively low	Relatively high strength
Fluxes are Zinc chloride and hcl acid	Flux is borax powder
Mostly used for elec connections, tins and cans	Joining of dissimilar metals,

Gas Welding

Soldering	Brazing
It is a low-temperature analog to brazing.	It is used to join a wide variety of similar or dissimilar metals.
It uses filler alloys with melting temperatures below 450 °C (840 °F).	It is done at temperatures above 450 °C but below the critical temperature of metal.
It is mainly used in electronic industries to form a permanent connection between the electronic components.	It is mainly used to join all kinds of metals used in electronic circuitry, pipe fittings, automotive
Base metal does not require preheating.	Base metal requires preheating.
Soldering creates stronger joints.	The joints are relatively weaker than with soldering.
The soldering process is comparatively cheaper than other metal-joining methods.	The brazing process is a bit pricey than soldering.

Thankyou