Brazing and Soldering

- Both brazing and soldering are the metal joining processes in which parent metal does not melt but only filler metal melts filling the joint with capillary action. If the filler metal is having melting temperature more than 450°C but lower than the melting temperature of components then it is termed as process of brazing or hard soldering. However, if the melting temperature of filler metal is lower than 450°C and also lower than the melting point of the material of components then it is know as soldering or soft soldering.

Soldering

- The soldering filler metal is called solder. The most commonly used solder is lead and tin alloy containing tin ranging from 5 to 70% and lead 95 to 30%. Higher the contents of tin, lower the melting point of alloy. Other filler metal are tin-antimony solder (95% tin and 5% antimony), tin-silver solder (tin 96% and silver 4%), lead-silver solder (97% lead, 1.5 tin and 1.5 silver), tin-zinc solder (91 to 30% tin and 9 to 70% zinc), cadmium-silver solder (95% cadmium and 5% silver). These are available in the form of bars, solid and flux cored wires, preforms, sheet, foil, ribbon and paste or cream.

Need

- Inability of conventional welding processes to produce a sound joint:
  - Metallurgical incompatibility (Al-Steel)
  - Cracking (CI, High carbon steel)
  - Sensitive to high temperature (HAZ)
  - Entirely different combinations (glass/Al)

Role of brazing, soldering and braze welding

- Low heat input
- No melting of base metal
- Ability to weld any combination of metals and non-metals

Brazing and Soldering

- Brazing and soldering are the joining processes in which base metal does not melt only filler metal melts and the same is used to fill the joint with capillary action.

Brazing

Soldering

Strength of brazed, soldered and weld joint

- The strength of brazed joint is higher than soldered joint but lower than welded joint.
- However, in between welding and brazing there is another process termed as 'braze welding'.

Brazing

- Joins materials by heating them in presence of filler metal.
- Filler metal having liquidus > than 450 ^{0}C and below the solidus of base metal.
- Brazing is different from braze welding.

Basic principle of Brazing and soldering

IMPORTANT POINTS FOR BRAZING

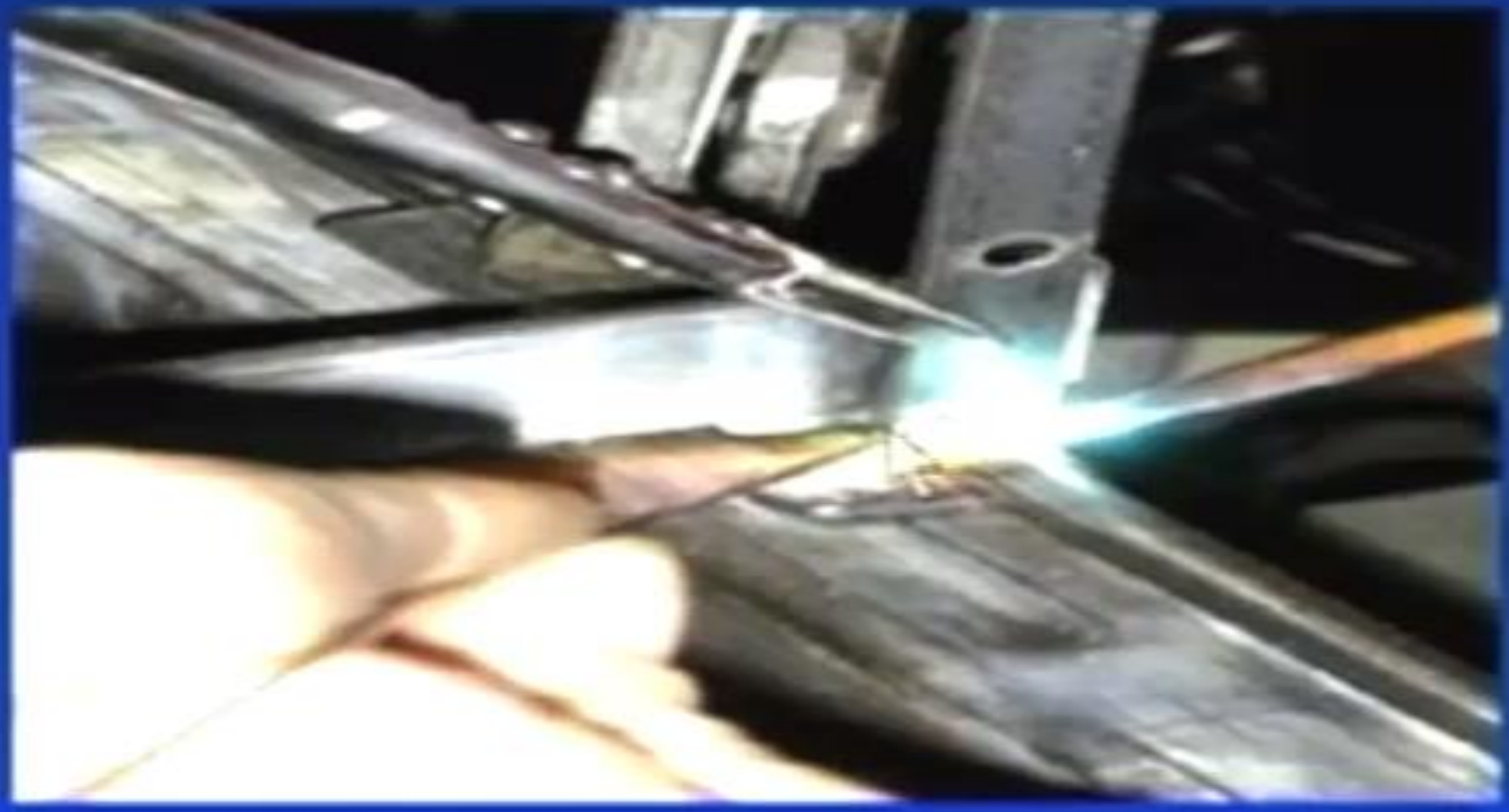
- Filler melting point above 450 ^{0}C
- Capillary action
- No melting of base materials

Usage of these processes

These processes are favoured under following conditions.

- Joining of metals having entirely different physical characteristics
- Joining of metals of poor weldability in fusion welding
- HAZ effects are not acceptable
- Locations of joint doest not allow the usage of other conventional technique
- Service conditions are not severe in terms of stress and temperature

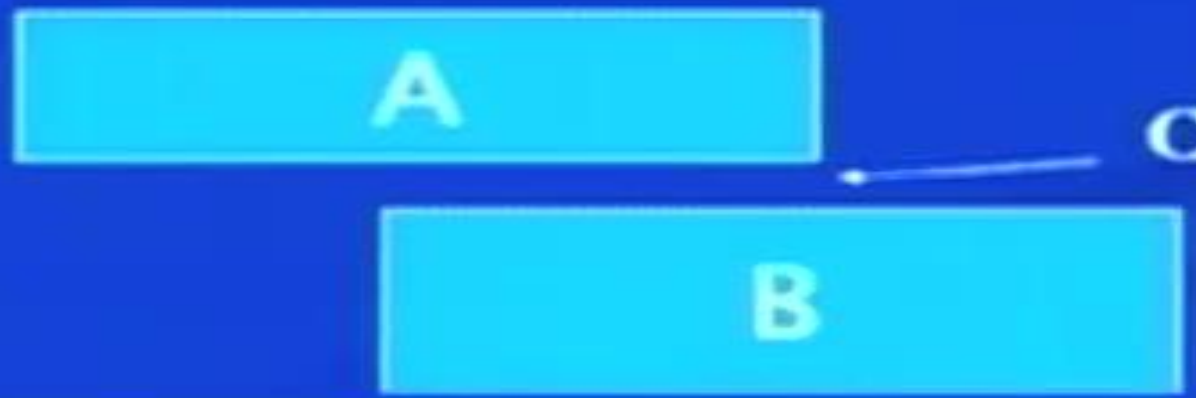
Typical use of gas brazing



Brazing operation

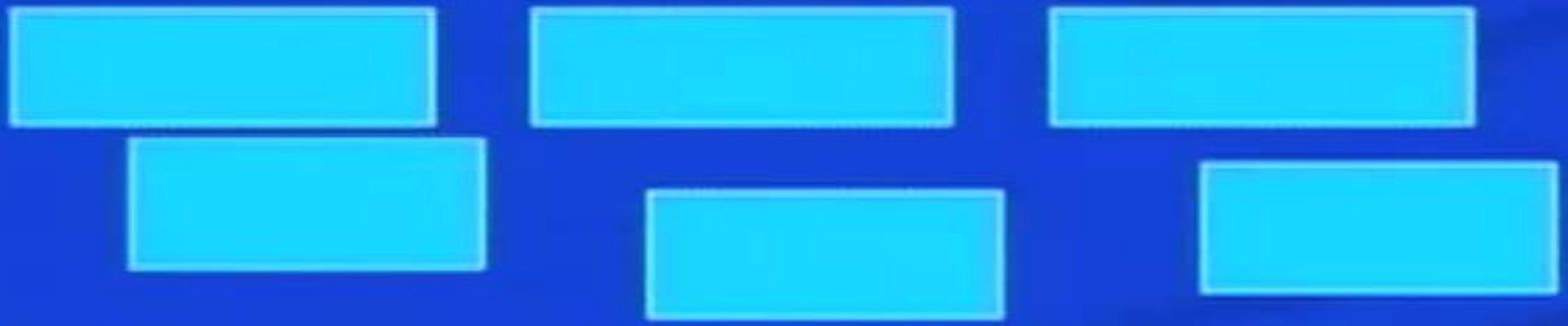
Joint design

- Lap joint is commonly used in both brazing and soldering.
- Clearance affects to capillary action and therefore distribution of filler metal.



Effect of clearance

- Too less clearance or too much gap both reduce the drawing / sucking of liquid metal by capillary action between the faying surfaces.



0.025 to 0.25mm

Need of flux

1. Surface contaminants
2. Oxides
3. Oil grease
4. Oxidation of base metal
5. Oxidation of filler metal
6. Fluidity of molten filler

Role of flux in brazing

- Dissolve oxides from the faiyng surfaces.
- Reduce surface tension of molten filler metal so as to increase its wetting action and spreadability.
- Protect the base metal and molten braze filler from oxidation during joining operation.

Brazing Fluxes

- Borax and boric acid are common fluxes for brazing with Cu fillers.
- Form of fluxes: Paste or liquid solution leading which are easy to application to the surface in any position.

Brazing filler metal

- The most commonly used filler metal for brazing is copper base zinc alloy.
- It generally consists of 50-60% Cu, approx. 40% Zn, 1% Ni, 0.7 % Fe and traces of Si and Mn, and is termed as 'spelter'.
- Ni (10%) can be added in filler alloys to achieve specific high temperature properties.

Brazing materials

- Silver brazing filler metal may consists of 30-55% Ag, 15-35% Cu, 15-28% Zn, 18-24% Cd, 2-3% Ni or 5% Sn.
- Form of Silver brazing fillers: wire, strip, rods and powders.
- Form of Copper brazing fillers: rod, strip and wire.

Brazing methods

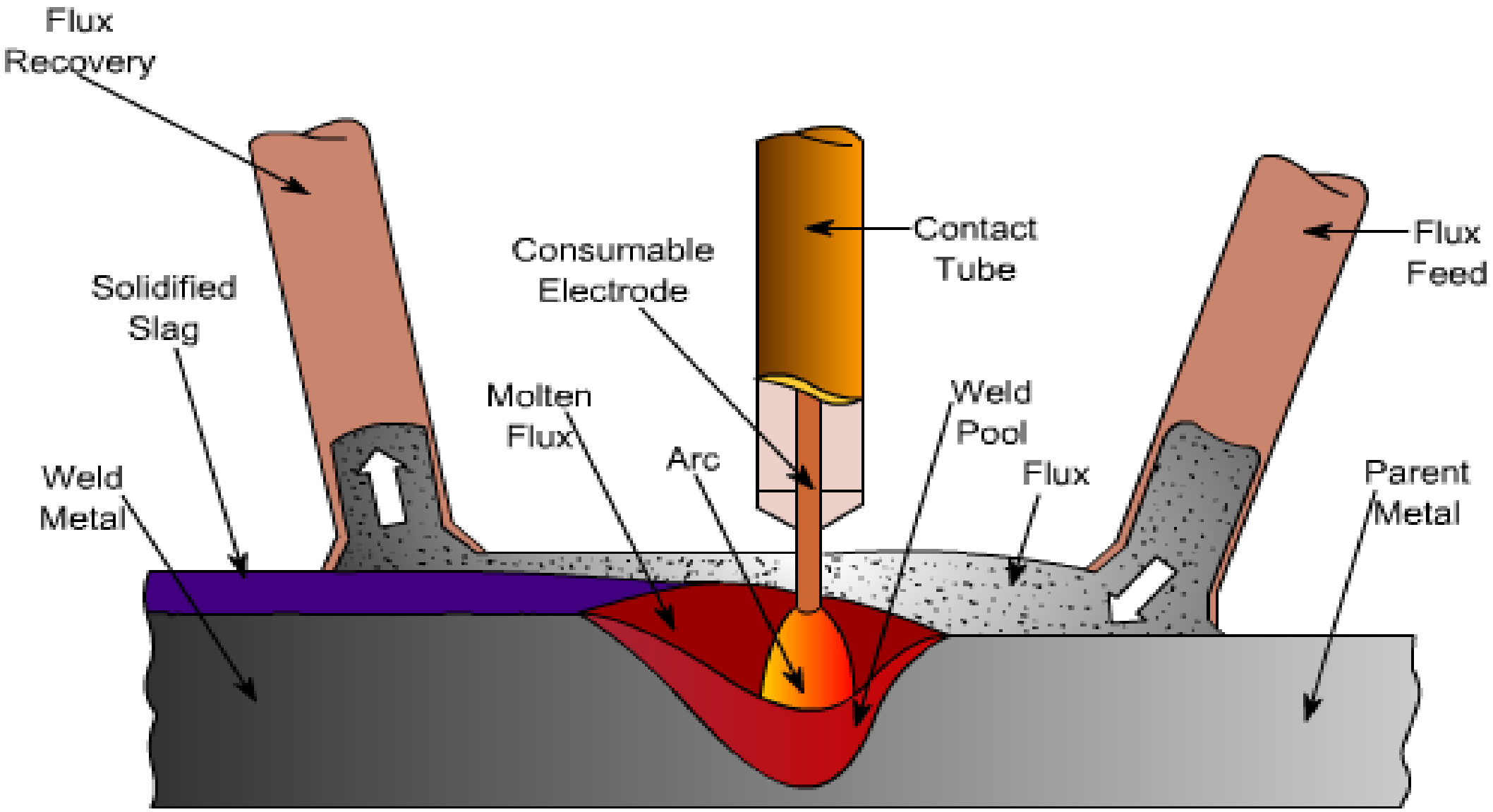
- Torch brazing
- Dip brazing
- Furnace Brazing
- Infra-red brazing
- Induction brazing

Introduction

- Submerged arc welding is an arc welding process which uses heat generated by an arc struck between bare consumable electrode wire and the workpiece for welding.
- The arc and weld zone are completely covered under a blanket of granular, fusible flux
- During welding this flux melts and provides protection to the weld pool from the atmospheric gases.

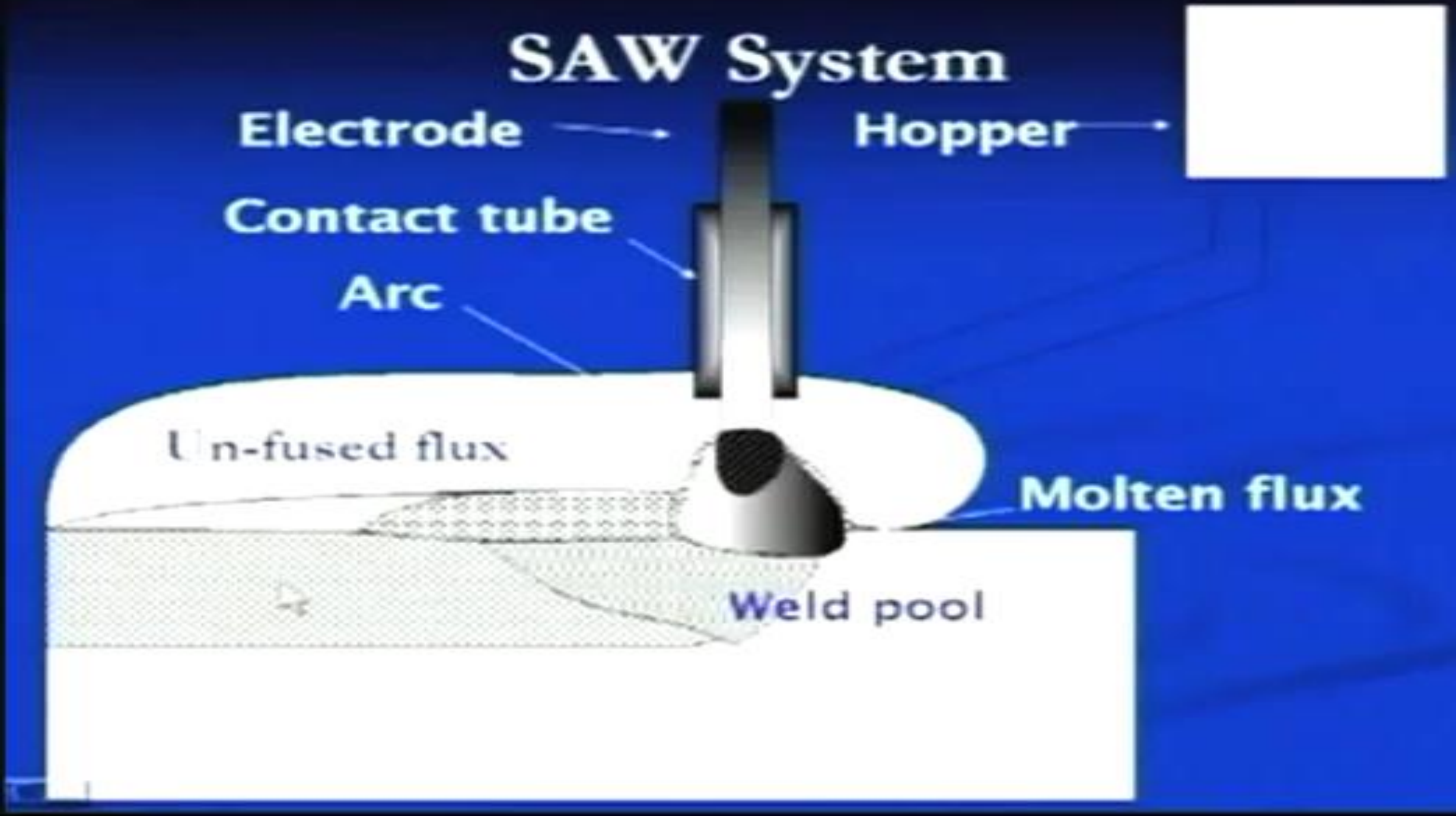
Introduction

- The molten flux flows down continuously and fresh flux melts around the arc.
- The molten flux reacts with the molten metal forming slag which in turn results in:
  - Improves properties of weld joint
  - Molten floats on the top of solidifying weld metal to protect it from atmospheric gas contamination
  - Retards cooling rate.


Flux
Recovery
Solidified
Slag
Consumable
Electrode
Contact
Tube
Flux
Feed
Molten
Flux
Arc
Weld
Pool
Flux
Weld
Metal
Parent
Metal

SAW System

- Welding power source
  - Constant voltage power source
  - Constant current power source
- Welding head
  - Wire spool
  - Wire straightening and rolling to feed the wire
  - Wire feed unit
  - Contact nozzle/tube
  - Flux delivery hopper


SAW System
Electrode
Hopper
Contact tube
Arc
Un-fused flux
Molten flux
Weld pool

Capability of process

- Extremely high welding currents can be used without the danger of spatter & atmospheric contamination gives deep penetration with high welding speeds.
- This makes the process very suitable for the welding of high strength steel at welding speeds much higher than conventional manual metal arc welding.

Controlling composition of weld

- The desired composition of the weld metal can be more economically obtained through adding alloying elements in the flux and using a relatively unalloyed wire as compared with welding with alloyed wire and ordinary flux.