GAS WELDING (3)

Gas welding is a non-pressure fusion welding process and includes all process in which gas is used as a source of heat to melt the ends of the pieces to be joined on solidification. A filler metal is needed in welding of sheets above 1.5mm thickness but no filler metal is needed for welding below 1.5mm thickness. A filler metal is added in the form of a filler rod and must be having the same composition as that of parent metal.

Various gas combinations like oxy-acetylene, oxy-hydrogen, oxy-propane and oxy-coal gas may be used for producing a hot flame for welding of metal. The oxy-acetylene is widely used as it produces very high temperature (3200°C) and can be used for welding of a variety of ferrous and non-ferrous materials. The hydrogen gas and some other gases may be used but the temperatures obtained are lower than oxy-acetylene flame. Approximate temp. obtained from different combinations are :-

(i) Oxy-Acetylene (3200°C)
(ii) Oxy-Hydrogen (2400°C)
(iii) Oxy-Propane (2200°C)
(iv) Air-Acetylene (2400°C)
(v) Air-propane (1750°C)

GAS WELDING

Gas welding Tools and Equipment :—

In case of gas welding, gases are supplied & mixed properly in required amount before burning. For this purpose, some tools and equipment are needed. These are described below:—

1. **Gas Cylinder :—** Two cylinders are used in case of gas welding, one is filled with oxygen at a pressure of 150 kgf/cm² at 20°C and other is filled with an inflammable gas, in case of oxyacetylene welding, it is acetylene at a pressure of 1.5 kgf/cm². If acetylene is stored at a high pressure, it may be risky.

2. **Hose pipe and Fittings :—** Hose pipe is used to carry the gases from cylinders to welding torch. It should be strong, durable and non-porous to resist handling wear and gas pressure. A color code is used in case of hose pipe, generally red colour is used for acetylene and green colour pipe is used for oxygen.

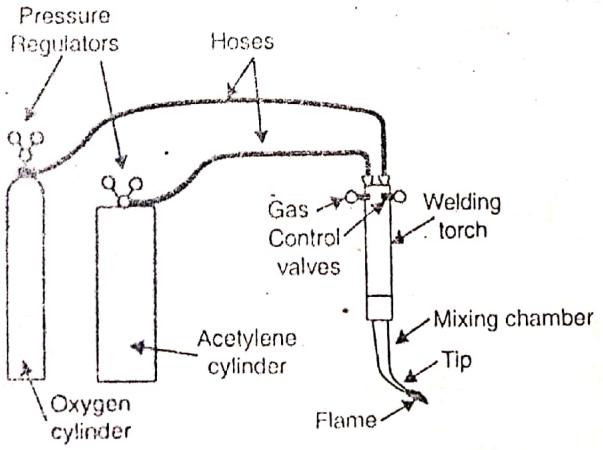


Fig. 20.4. *Gas Welding Equipment.*

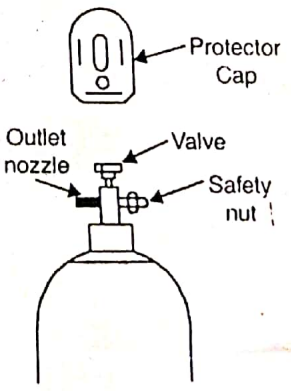


Fig. 20.5. *Oxygen Cylinder.*

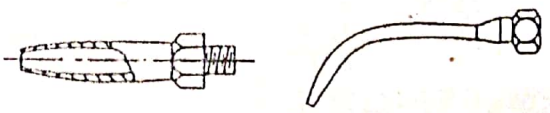
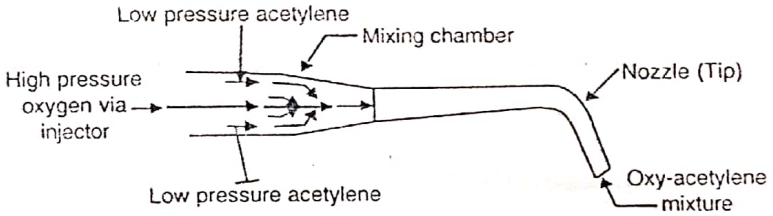


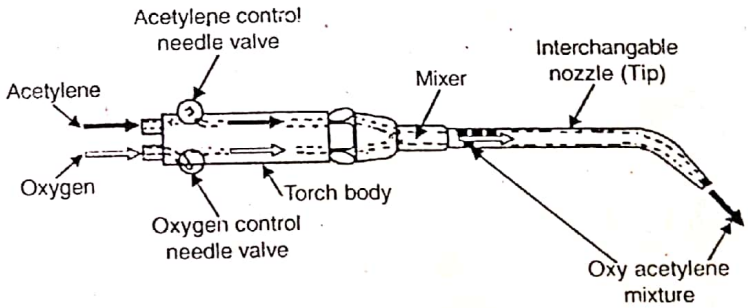
Fig. 20.6. *Welding Nozzles.*

Welding Torch:- welding torch is connected at the end of hose pipe. It consists of a welding tip at the end where flame is generated, It also consists of a mixing chamber where both the gases are mixed in desired proportions. pressure regulators are also provided on the torch so that the supply of any of two gases can be varied to generate different types of flames such as neutral, carburizing and oxidising flame.

Welding tip:- welding tip is the end part of welding torch just before the burning place of gases. the welding tip is replaceable and available in various sizes & shape. the selection of welding tip depends upon the properties and thickness of metal to be welded.



(a) Low Pressure Welding Torch



(b) High Pressure Welding Torch

Fig. 20.8. *Welding Torches.*

Stop valve:- stop valve are provided on the cylinders they are used to stop or start the supply of gas to welding torch through hose pipe. Gas cylinders are kept away from the welding place and longer hose pipe are used. when the system is left unattended, stop valves are closed from safety point of view.

Spark lighter:- Spark lighter is used to create spark to ignite the mixture of gases at the welding tip. A momentary spark is sufficient for this purpose.

Pressure Gauge:- A pressure gauge is mounted on each cylinder. It tells the instantaneous pressure of gas. A mark is made on the gauge and if pressure fall below the mark, it is the indication of Empty cylinder.

Types of Flames:-

The types of flame generated depends on the relative amount of supply of oxygen and acetylene. Generally three types of flames are:-

1. **Neutral Flame:-** A neutral flame is produced when oxygen to acetylene ratio is 1.1
   - the temperature is of the order of about (5900°F) (3200°C)
   - the flame has nicely defined inner cone (light blue in colour) and is surrounded by other envelope which is dark blue in colour than the inner cone.
   - It is called neutral because it will not oxidise or carburize the metal
   - It is used for welding of mild steel, stainless steel, copper, cast iron and Aluminium.

2. **Oxidizing Flame:-** A oxidizing flame is produced when oxygen to acetylene ratio is 1.2 to 1.5 respectively.
   - the inner cone is more pointed, outer flame Envelope is much shorter.

- Temperature is of the order of about 6300°F (because of excess O_2 so complete combustion take place)
- The flame is harmful for steel because it oxidizes the steel
- Only in the welding of copper and copper based alloys oxidizing flame is desirable because in these cases a thin protective layer of slag forms over the molten metal.

Reducing Flame:-

Reducing flame is produced when oxygen to acetylene ratio is 0.9 to 1.

- In this flame, acetylene feather exists between the inner cone and outer envelope.
- Temperature is of the order of about 5500°F (less because it does not completely consume the available carbon)
- Metals that tend to absorb carbon should not be welded with reducing flame. Carburizing flame is used in the welding of lead and for carburizing purpose (surface hardening).

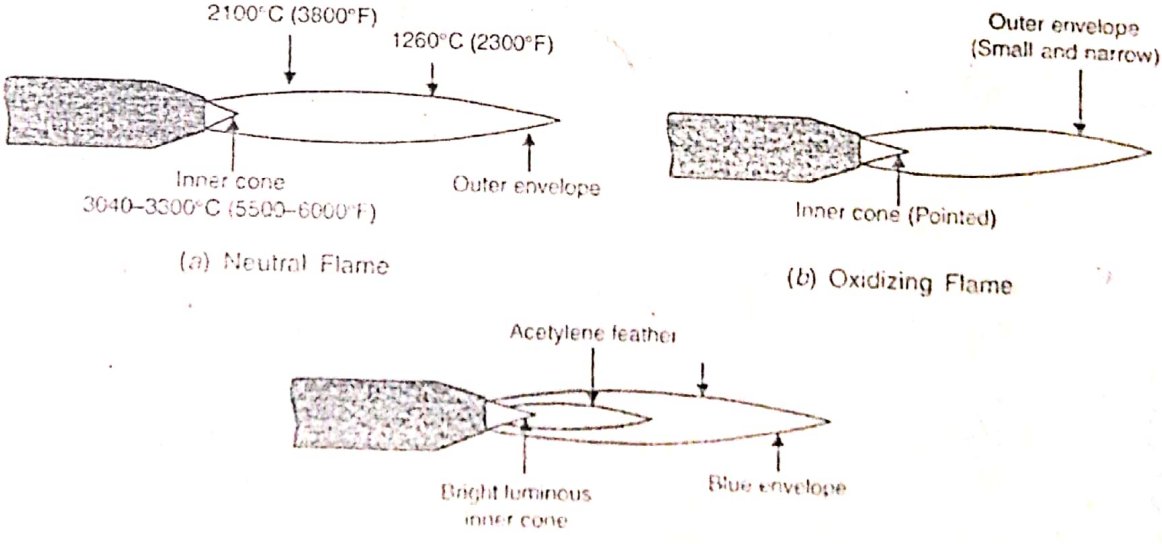


Fig. 20.2. *Types of Flames*

Chemistry of oxy Acetylene Flame :-

Combustion of gas mixture takes place in two main stages :-

Stage 1 : oxygen and acetylene in equal proportions by volume burn in inner white cone and forms carbon monoxide, while the hydrogen is liberated.

$$2C_2H_2 + 2O_2 \longrightarrow 4CO + 2H_2 \quad \text{— (i)}$$

Stage 2 : the carbon monoxide produced in stage 1 (inner cone) uses the oxygen from the air and results in carbon dioxide and water vapours.

$$4CO + 2H_2 + 3O_2 \longrightarrow 4CO_2 + 2H_2O \quad \text{— (ii)}$$

Combining (i) and (ii)

$$2C_2H_2 + 5O_2 \longrightarrow 4CO_2 + 2H_2O$$

So it can be seen that about two fifth of the oxygen necessary for the complete combustion of acetylene is received from the cylinder and rest from the surrounding air atmosphere.

Oxy - Acetylene welding :-

oxy - acetylene welding is done by melting the edges of the plates to be welded and the filler - rod by Gas - Flame. In this process, acetylene is mixed with oxygen in correct proportion in welding torch and ignited, the flame is produced at the tip of the torch which is hot enough to melt and join the metal. A flux is added to remove impurities and oxides present on the surface of metal to be joined and to obtain good joint.

$$2C_2H_2 + 5O_2 \longrightarrow 4CO_2 + 2H_2O + \text{Heat generation}$$

This process is suitable for joining metal (3000 ~ 3300°C) sheets and plates of thickness 2 to 50 mm with materials having thickness more than 15 mm.

A filler metal rod is added to molten metal pool for greater strength having the same composition as parent metal.

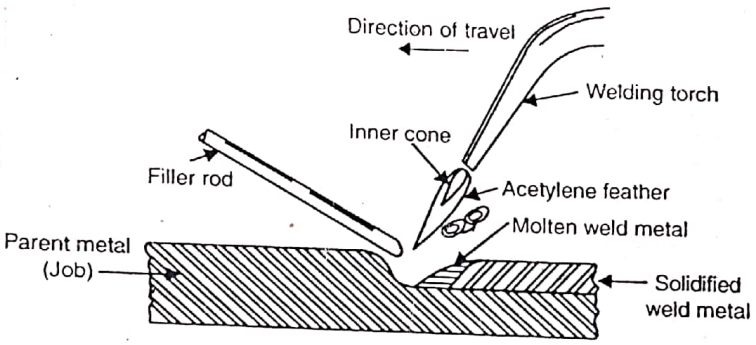


Fig. 20.1. *Oxy-Acetylene Welding.*

Advantages:-

1. It can be applied to a wide variety of manufacturing and maintenance situations.
2. Rate of heating and cooling of weld deposit and job is slow.
3. No electric current is required and equipment have less cost.
4. Operator is having better control because source of heat and filler metals are seperate.

Disadvantages:-

1. Flame temperature is less than the temperature of the arc.
2. Refractory metals (eg tungsten, molybedeum, tantalum ~~titanium~~ etc) and reactive metal (titanium and zirconium) cannot be gas welded.
3. Gas flame takes longer time to heat up metal than an arc.
4. Heat affected zone is wider.
5. Storage of gases is not safe. More safety is needed.

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Application of Gas welding :—

① It is used for welding of mild steel, stainless steel, copper, cast iron, high carbon steels, etc.

② For joining thin materials.

③ In automotive and Aircraft industries.

④ In sheet metal fabricating plants.