Cast Irons

- Carbon – Greater than 2% carbon
- Its also Contain small amounts of silicon, sulphur, manganese and phosphorous

- **<u>Features of cast iron</u>**

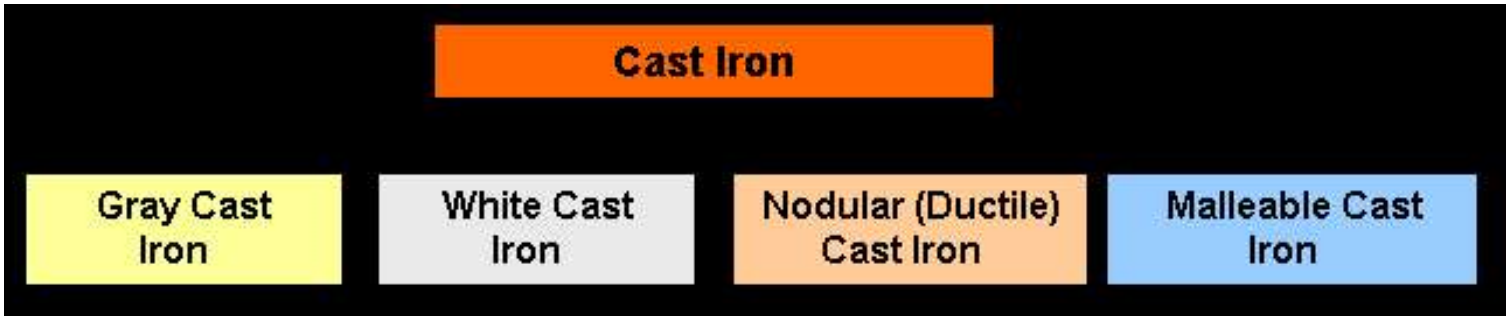
✓ Least expensive . Plentiful resources available.

✓ Good mechanical rigidity and good strength under compression

✓ Good machinability can be achieved

Composition of Cast Irons

- Carbon -3.0 to 4.0%
- Silicon- 1.0 to 3.0%
- Manganese – 0.5 to 1.0%
- Sulphur- upto 0.1%
- Phosphorus – upto 1.0%



Non-Ferrous Materials

- All the metallic elements other than iron are referred as non ferrous materials
- Non – ferrous materials are not produced in as great tonnages and are more costly than ferrous metals
- Non- ferrous materials are employed in current engineering due to the following characteristics

  - Lighter in weight
  - Higher electrical and thermal conductivity
  - Better resistance to corrosion
  - Ease of fabrication

Various Non-Ferrous Materials

- Copper
- Aluminium
- Lead
- Magnesium
- Nickel
- Tin
- Titanium
- Zinc.

Copper and its alloys

- Copper is one of the oldest and most widely used metals in industry

Melting point	1083°C
Young's Modulus	122.5Gpa
Tensile Strength	220Mpa
Corrosion resistance	Very good

Principal Properties of pure copper

- **Properties of copper**
  - Copper possess very high electrical conductivity .
  - Very high thermal conductivity
  - Very soft , ductile
  - It can be worked in hot or cold condition , but it can not be welded

Applications

- Manufacturing power cables, telephone cables , cables for computer networks
- Printed circuit boards
- Mainly used in the manufacturing of important alloys such as brass and bronze

Copper alloys

- Brasses (Copper –Zinc alloys)
- Bronzes (Copper- tin alloys)
- Gun-metals (Copper-tin-zinc alloys)
- Cupro nickels (copper- nickel alloys)

Brasses (Copper-Zinc alloys)

- Its an alloy of copper and Zinc
- Sometimes, small amounts of other metals such as tin, lead, aluminium and manganese may be added
- Upto 36% Zinc
- Soft ductile and easily cold worked

- **Characteristics**
  - Brasses is stronger than copper
  - Lower thermal and electrical conductivity than copper
  - Very often 1 to 3% of lead is added to brass for improving its machining properties

Bronzes (Copper- tin alloys)

- Alloy of copper and tin
- High strength alloys with a good corrosion resistance than brasses
- It can be shaped or rolled in to wires , rods and sheets

Applications

- Pump valves
- Bearings
- Marine castings
- Hydraulic values
- Gears

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Aluminium and its alloys

- **Characteristics:**
  - Light in Weight (one-third the weight of steel)
  - Soft ductile
  - High strength to weight ratio
  - High thermal and electrical conductivity

Melting Point	600°C
Young's modulus	70.5 Gpa
Tensile strength	45 Mpa
Corrosion resistance	Very good

Principal properties of pure Aluminium

Aluminium and its alloys

- **Applications:**
  - Making parts of aero plane, window frames, surgical instruments Etc.
  - It is used as a reducing agent in the manufacturing of steels

- **Aluminium VS Copper**
  - The price of the aluminium is much lower than that of copper
  - If equal weights of aluminium and copper conductors of a given length are compared, it is found that aluminium conducts 201% as much current as does copper

Types of Aluminium alloys

- Heat-treatable aluminium alloys
  - Al-Cu alloys
  - Al-Cu- Ni alloys
  - Al-Mg-Si alloys
  - Al-Zn-Cu alloys
  - Al-Li alloys
- Non-heat treatable aluminium alloys
  - Al-Mn alloys
  - Al-Mg alloys
  - Al-Si alloys

Precipitation Strengthening Treatment (Age Hardening)

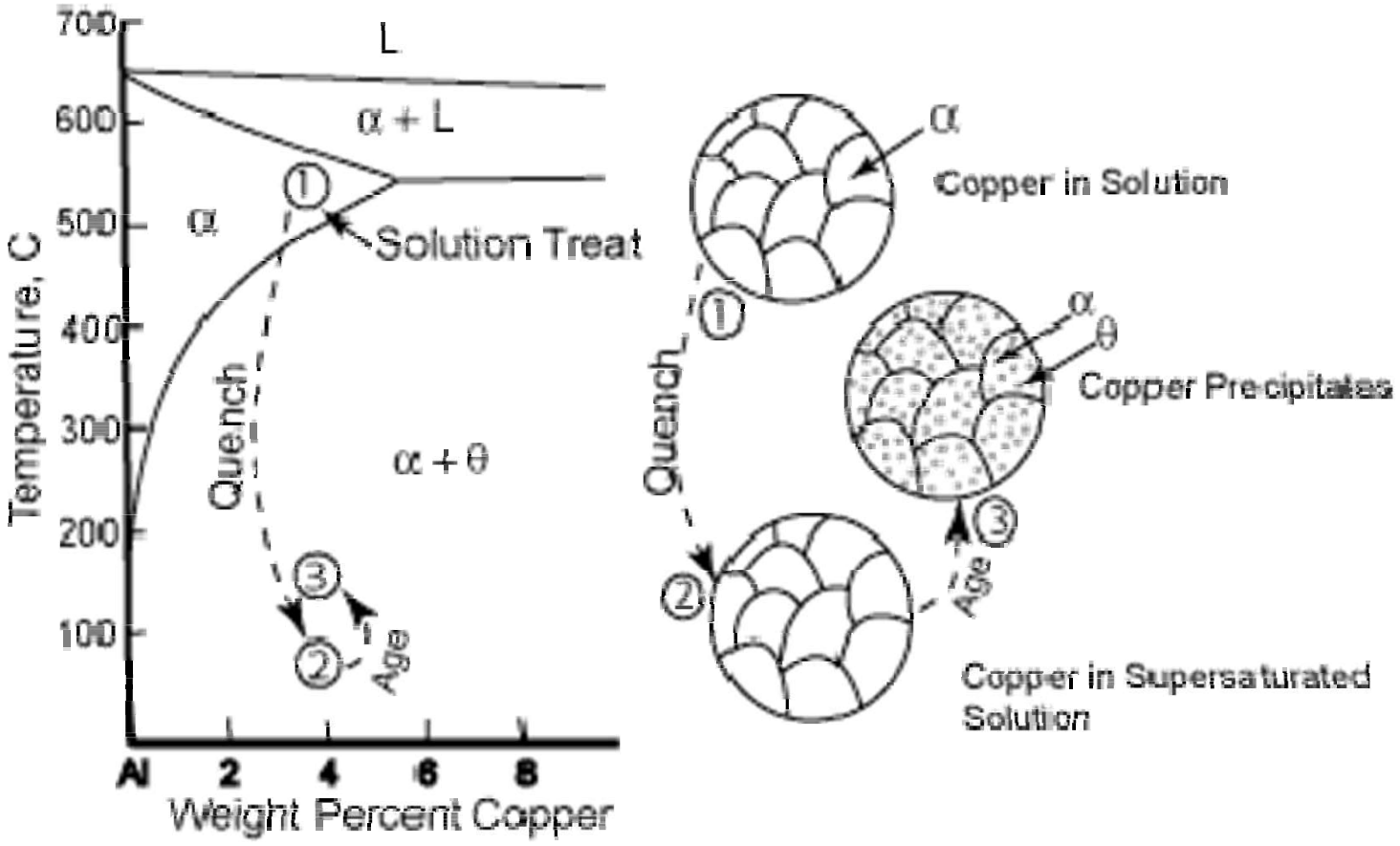
- It is the important method of improving the physical properties of some of the non-ferrous alloys by solid state reaction
- Its is mostly applicable to the alloys of aluminium, magnesium and nickel.

Alloys that are hardened by precipitation treatment:

- Aluminium – copper
- Copper –tin
- Magnesium – aluminium

- This processed is called precipitation hardening because the fine precipitate particles of the new phase are formed in this hardening process

Precipitation Strengthening Treatment (Age Hardening)



Precipitation Strengthening Treatment (Age Hardening)

- **Solution treatment:**
  - Alloy is heated above the solvus temperature to obtain its solid solution
  - The alloy is held at this temperature until a solid solution α is formed
  - Temp: 500°C to 548°C
- **Quenching Process**
- **Ageing Process**
  - Solid solution is heated below the solvus temperature
  - At this ageing temperature, the diffusion of unstable α may take place and precipitate particles can form
  - Then, if we hold the alloy for a sufficient time at the ageing temperature, the stable α + $CuAl_2$ structure is produced
  - The fine precipitate particles of $CuAl_2$ increase the hardness and strength of the alloy

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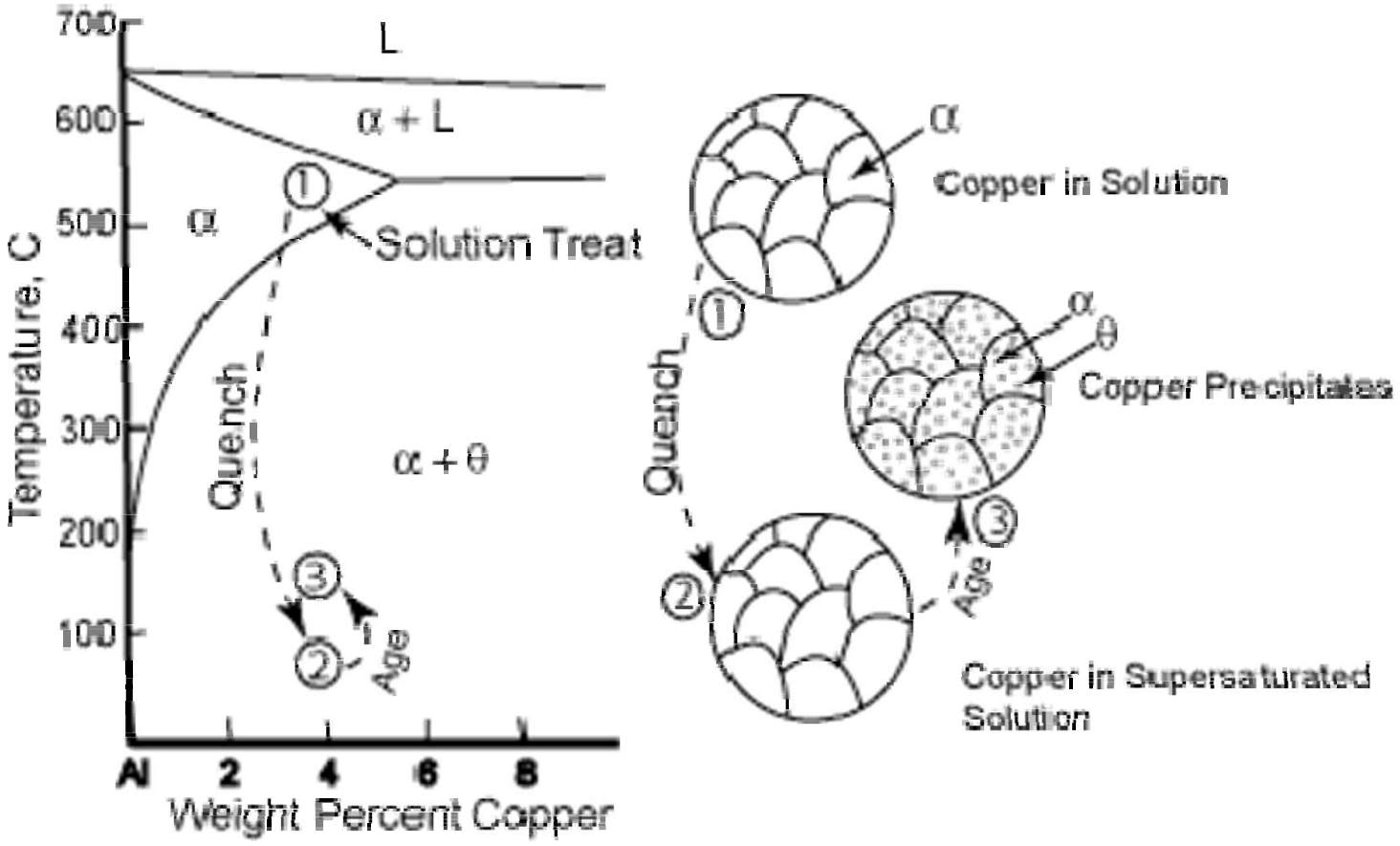

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