Unit - 6

Engineering Materials & Heat Treatment of Steel

* Properties of material -

(1) Hardness - which resists penetration.
(2) Strenght - which resists external load without breaking
(3) Elasticity - material can regain its original shape & size after removal of load. (Rubber band)
(4) Plasticity - It can not regain its original shape & size after removal of load. (deform permenantely)
(5) Malleability - It can converted into a thin sheet metal without any failure (Rupture)
(6) Ductility - It can be drawn into a thin wire without any rupture (Copper,
(7) Brittleness - without any deformation, it breaks
(8) Toughness - It can bent, twist & stretched without failure
(9) Creep - Plastic deformation due to constant load applied for long time.
(10) ~~Fatigue~~ - Stiffness - It is difficult to bend the meterial. (wood, silicon carbide.

* Classification of material -

Ferrous

Fe content is Present
Mild Steal, cast iron, High C Steel etc.

Non-Ferrous

Fe (Iron) is absent
Gold, Silver (metal)
Plastic, rubber (material)
wood.

(1) Metal And Alloys - all ferrous & non ferrous material are metal
-> mixing two or more metal known as Alloys.

(2) Ceramics - Are made of clay & permanentaly hardened by heat.
Ex Tiles, cement etc

(4) Organic Polymers - Having carbon content as a back born.
ex PVC (Poly venyle chlorides)

(5) Composites - made of more then one metal.
ex CC, fiberglass etc.

(6) Semiconductors - Are those whose conductivity is present between conductor and insulator.
ex Si, Ge.

(7) Biomaterials - made from glass, ceramics, living cells & tissues.

* Mild steel - C → 0.15 to 0.25 %, strong, good weldability. Production cost low.

Medium carbon steel - C → 0.3 to 0.6 %. good strength. less weldability.

High carbon steel - C → 0.65 to 1.5 %, hard & tough by heat poor weldability.

Cast iron - C → 2 to 4 %, Production cost is less. used to create railway track.

Titanium alloy - low density, high strength, high melting point,

→ Application - space vehicles, Airplane structure.

→ Limitation - costly.

* Heating treatment of Steel-

Heating and cooling metals in a controlled way to change their mechanical properties.

Objective → Improve hardness or softness
→ Increase strength or ductility
→ Relieve internal stresses
→ Refine grain structure
→ Improve wear & corrosion resistance.

Furnace— Muffle furnace, Conveyer furnace, Bath furnace, induction heating furnace.

Process

(1) Annealing— To soften steel, improve ductility & machinability, Relieve internal stresses.

Heat the sheet above its Critical temp (723°C)
Hold it at that temp for a certain time. (Soaking)
Cool it very slowly, usually in a furnace.

(2) Normalizing— To Refine grain structure, improve Strength & toughness. (Stronger)

Heat steel above critical temp.
Hold for soaking. then cool it in open air (faster the annealing)

(3) Hardening - To increase hardness & strength. Make surface wear-resistance.

Heat steel above critical temp.
then Rapidly cool (quenching) in water, oil, air.

(4) Tempering— To reduce brittleness of hardened steel. Improve toughness & flexibality.

→ Reheat hardened steel to a lower temp (150-650°)
Hold for some time
Cool it in Air

Case hardening –

→ To make outer surface hard but core soft. Ideal for parts needing wear resistance on the outside. (gear, camshaft) without cracking.

⇒ Heat steal in a carbon rich atm.
Carbon atom diffuse into surface.
Then harden the surface by quenching