To join Diploma wallah Group contact:- 9508550281

Date 25-09-2024

1) Engineering materials :- It is the study of various industrial material their properties, function uses and effects for the equipment - Components of the machines.

or

It is multidisciplerini field of science in which we study the various properties of material and its uses - application based on the required properties in science and Technology.

Melting point of some materials

(i) Iron (Fe) - 1539°C
(ii) Aluminium (Al) - 660°C
(iii) Copper (Cu) - 1085°C

Brittle material → Glass, Brick etc.
Ductile material → Iron rod.

* Types of engineering material

There are two types of engineering materials
(i) Metal
(ii) Non-metal

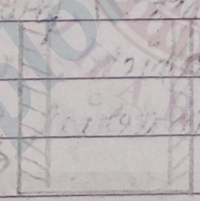
Sagar
Website:- Diplomawallah.in

To join Diploma wallah Group contact:- 9508550281

Date 26-09-2024

1) Engineering materials :- It is the Study of various Industrial material their properties, function, uses and effects for the equipment - Components of the machines.
or
It is multidisciplerini field of science in which we Study the various properties of material and its uses - application based on the required properties in Science and Technology.

Melting point of some materials
(i) Iron (Fe) - 1539°C
(ii) Aluminium (Al) - 660°C
(iii) Copper (Cu) - 1085°C



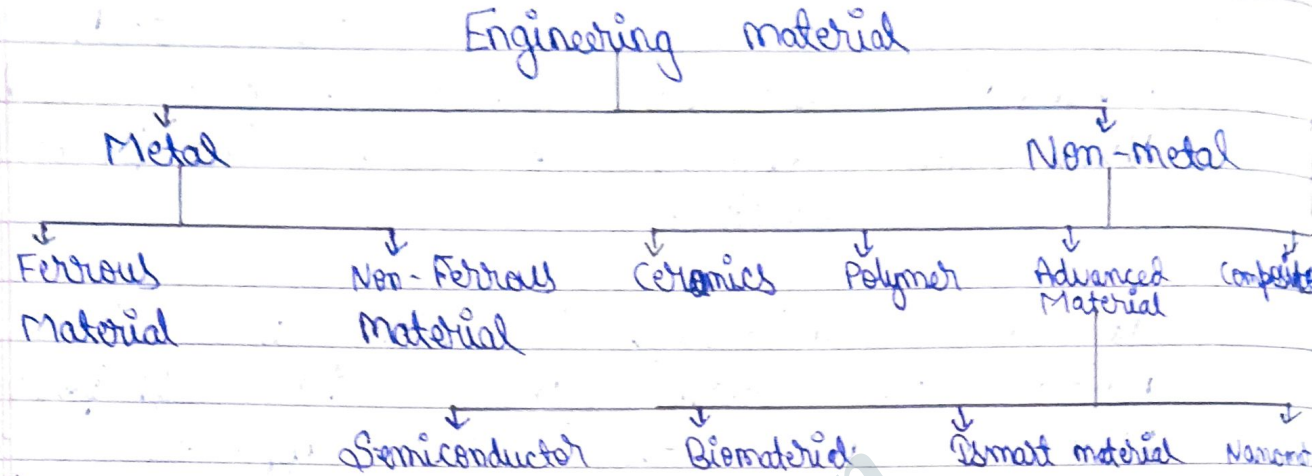
Brittle material → Glass, Brick etc.
Ductile material → Iron rod.

* Types of engineering material

There are two types of engineering material
(i) Metal
(ii) Non-metal

Website:- Diplomawallah.in

To join Diploma wallah Group contact:- 9508550281



Date 07-09-2024

* Selection of engineering materials

It is the process of choosing the best material for a specific engineering application depending upon the environment. The selection has an important impact on the performance of system component / process. There are following factors which are helpful for the selection of material :-

i) Properties of the material.
ii) Availability of the material.
iii) Substainability.
iv) Structure.
v) Environmental impact.
vi) Cost of the material.

(i) Properties of material

It is the characteristics of material that influences the behaviour and performance

Website:- Diplomawallah.in

To join Diploma wallah Group contact:- 9508550281

Of the material.

Pencil : → Graphite
↳ Types / Grade = 18

(Sand + cement) → Strength ↑ → Carrying ↑ and Capacity ↑

(ii) Availability of the material :- Material must be Available (better to have multiple sources).

(iii) Substainbility :- The recognition that by embracing A sustainable approach, we can alleviate the adverse effects of resource depletion, Pollution, and waste.

(iv) Structure :- Choosing the most suitable materials for a given project based on factors such As design requirements, load capacity, environmental Impact ~~and other~~

(v) Environmental impact :- The effect that the Service environment has on the part.

(vi) Cost of the material :- material must be Priced approximately (not cheap but right).

Website:- Diplomawallah.in

To join Diploma wallah Group contact:- 9508550281

→ Types of properties of engineering material

① Physical property (Physical apperance)
② Chemical property (Structure)
③ Mechanical property (Elasticity, malleability, plasticity, Strength, Fatty
④ Thermal property (Temperature, melting point., Conduction, Convection and radiation)
⑤ Electrical property (Resistance, Resistivity etc).
⑥ Magnetic property.
⑦ Optical property (Reflection, Refraction, Defraction etc)

* Physical property

Physical properties are characteristics of Material based on physical nature such As Colour, dimension, apperance, density, Porosity. It affects the quality of the Material.

① Dimension :- It represent the size of the Material it is measured in S.I unit Scale such as mm, cm, A° etc

$A^{\circ} = 10^{-10}$ m, nano metre etc.

② Colour :- It depends upon the wavelength of light that materials absorbs. It is The important characteristics to identify The characteristics to quality of material

To join Diploma wallah Group contact:- 9508550281

③ Appearance :- It is the general characteristics of a material which includes - lustre, grains, marks or texture etc.

→ Lustre is the ability of material to reflect The light. metals have metallic lustre. Similarly, the quality of textile material or clothes can be studied by its textile.

→ Grain physical properties depend on size and structure of a studied object or amount of matter in it.

→ Texture is the way something feels when you touch it. Papers feels smooth. Sandpaper feels rough. Rough and smooth describe Texture.

④ Density :- Density is defined as mass / volume. Every material has specific density. So, density is used in ① To check the quality of material
② To study of the purity of Material
③ Pour.
④ Metallurgical studies.

⑤ Porosity :- It is the ratio of total volume of pors to the total volume of the Material. Porosity of refractory material prevents The thermal conduction due to air pocket

Website:- Diplomawallah.in

To join Diploma wallah Group contact:- 9508550281

It leads to thermal Spalling.

Thermal Spalling :- It is the process by which the material surface cracks and break off due to variation of temperature.

Porosity in metals leads to dry cough.
Porosity in ceramics also leads to weaking of material.

* Chemical properties

It is related to the structure of the material and their managements there are following types of chemical properties:

Fe + C (10% - 2%) ⟶ Steel.
90%
Alloy

Fe + 2% - 6.67% ⟶ Cast Steel.

1) Composition
2) Crystal Structure
3) Micro Structure
4) Stereospecificity
5) Corrosion resistance.

Website:- Diplomawallah.in

To join Diploma wallah Group contact:- 9508550281

Composition - It is made up of various constient Atoms - Ions, It is prestend by the different chemical formula of different material.

Al_2O_3, PVC $\left(-CH_2-\underset{Cl}{CH}\right)_n$, steel.

The percentage of various alloying materials improves and intances of the material.

• ③ Crystal Structure

The atomic arrangement of a atoms ions or molecules of a material is called Crystal structure.

Totally depend on atom arrangement
- → Shape
- → Properties

Boits → Space between two atoms.

→ There are the following Crystal structure are important from the subject point of the view

- (i) SCS → Simple Cubic Structure.
- (ii) BCC →
- (iii) FCC →
- (iv) HCP →

To join Diploma wallah Group contact:- 9508550281

SCC - Solids can either be Crystaline or Non Crystaline material.

(i) Crystaline Solids :- In this the atoms are arranged in systematic pattern.

(ii) Non - Crystaline material (Amorphous material) :- In this atoms are not arranged in Regular pattern or systematic order.

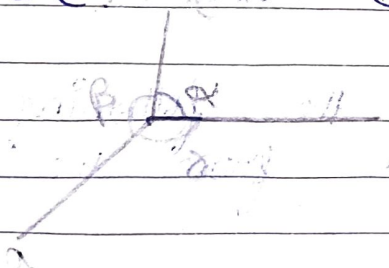
Bravais lattice :- There are 7 type of Pattern.

1. Cubic Structure
2. Tetragonal Structure
3. Orthogonal
4. Rhombohedral
5. Hexagonal
6. Monoclinic
7. Diclinic

Short form
CTO RHPTT

(1) Cubic Structure,

$a = b = c$ $\alpha = \beta = \gamma = 90^\circ$



(2) Tetragonal

$a = b \neq c$, $\alpha = \beta = 90^\circ$

Website:- Diplomawallah.in

To join Diploma wallah Group contact:- 9508550281

③ Orthogonal → $a \neq b \neq c$ $\alpha = \beta = \gamma = 90^\circ$

④ Rhombohedral → $a = b = c$, $\alpha = \beta = \gamma \neq 90^\circ$

⑤ Hexagonal → $a = b \neq c$, $\alpha = \beta = 90^\circ$, $\gamma \neq 90^\circ$

Two were 90° and other one is 120°.

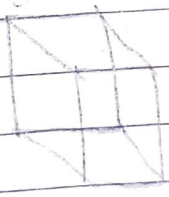
⑥ Monoclinic → $a \neq b \neq c$, $\alpha = \beta = 90^\circ \neq \gamma$

⑦ Triclinic
$a \neq b \neq c$, $\alpha \neq \beta \neq \gamma \neq 90^\circ$

* Atomic Packing pattern (APP) :- It is also called relative density of Packing, it is the Ratio of volume of atoms in a unit Cell. the mathematically;

$$A.P.F \rightarrow \frac{\text{Volume of atoms in unit cell}}{\text{volume of unit cell}}$$

① SCS → Simple cubic structure



Website:- Diplomawallah.in

No. of atoms at every corner $= 8 \times \frac{1}{8} = 1$ atom

$$a = r + r$$
$$a = 2r$$
$$r = \frac{a}{2}$$

Coordination number (CN) → It is the value or number of atoms which surrounds the individual atom.

1 atom is surround by 6 atom in it.
∴ CN of atom is 6.

$$N = \frac{1}{8} \times 8 = 1$$
$$r = a/2$$
$$CN = 6$$

$$APF = \frac{\text{volume of atoms in unit cell}}{\text{volume of atom of unit}}$$

$$= \frac{1 \times 4/3\pi r^3}{a^3}$$
$$= \frac{4/3\pi \times r^3}{(2r)^3}$$
$$= \frac{4}{3} \times \frac{\pi}{8} \times r^3$$
$$2$$

Diplomawallah.in

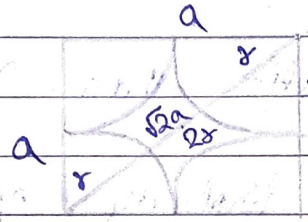
$= \frac{\pi}{6}$

$= \frac{3.14}{6}$

$= 0.52$

$= 52\%$ (Space occupied)

BCC



$= \sqrt{a^2 + (\sqrt{2}a)^2}$

$= \sqrt{a^2 + 2a^2}$

$= \sqrt{3a^2}$

$= \sqrt{3}\,a$

$\sqrt{3}a = 4r$

$r = \frac{\sqrt{3}a}{4}$

FCC

$= \frac{1}{8} \times 8 + \frac{1}{2} \times 6$

$= 1 + 3$

$= 4$

CN of FCC = 12

APF = 0.74

= 74%

Diplomawallah.in

* Mechanical properties

Resist → External force.

1) Elasticity :- It is the property of material to regain its original shape after deformation when the external forces are removed.

Steel is more elastic than rubber.

2) Plasticity :- It is the property of a material which retains the deformation produced under the load applied permanently.

Deformation → Change dimension after force applied.

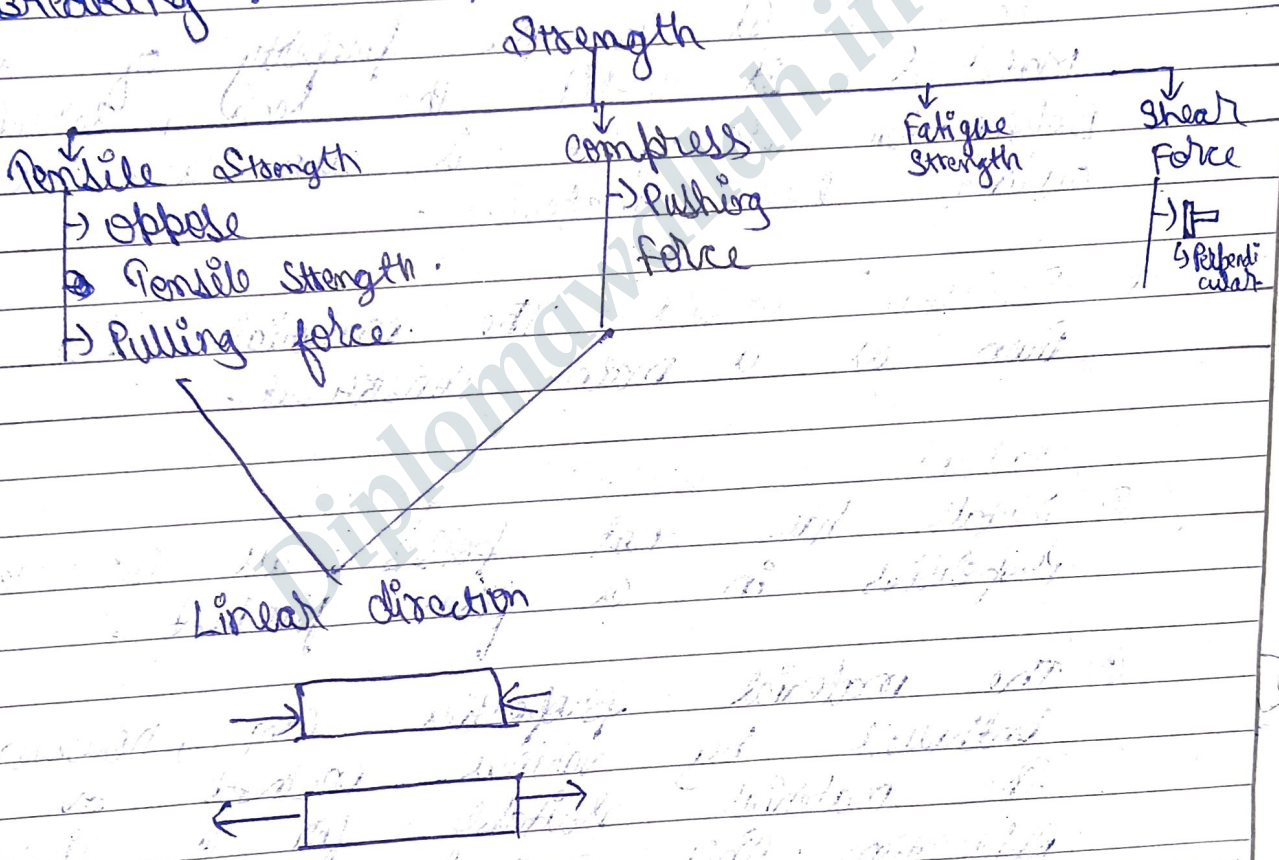
3) Ductility :- It is the property of the material enabling it to be drawn into wire with the application of high Tensile force (or load).
ex :- Mild steel (MS), lead, zinc, tin.
↓
It is not Brittleness.

4) Brittleness :- It is the property of a material which breaks down with a force applied ex :- Cast iron (CI), lead, Glass, Ceramic.

Diplomawallah.in

5) Malleability :- It is a property of a material which can rolled or hammered into thin sheet by the use of applied load or force. for example :- Copper, aluminium, Steel etc.

6) Strength :- It is the ability of a material to resist the externally applied force without breaking.



7) Resilience :- It is the property of the material to absorb energy and to resist the shock and impact load. for example :- Spring in bike.

diplomawallah.in

8). Creep :- When the material is subjected to a constant load at a high temperature for a long period of time, it will undergo a slow permanent deformation.

Constant force applied in the dimension changing.

9) Hardness :- It is the property of a material it resist the scratch, scratching, deformation etc, It is also used as a cutting tool material.

* Ferrous metals :- The material in which iron as a main constituent.

Control of material properties.

① Metals have not posses all the required properties in a fixed product.

② The material properties can, however we controlled by various method to make the material suitable for a given application. This method include
(i) Alloying.
(ii) Mechanical working.
(iii) Heat treatment.

Forging : Heat
↓
Then → applied force.

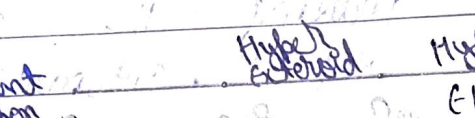
Diplomawallah.in

Types of ferrous metal

① Steel

Alloy = Fe + C + extra
80 - 90% <2%.C 2.5%...

② Cast Iron (2 - 6.67%.C)



Steel Cast iron

Steel :- It is an alloy of an iron and Carbon where Carbon percentage is of 2%. The percentage of Carbon increase the Hardness and Strength of the steel. other Elements are also present to improve the required properties of steel. other Elements (chromium, Sulphur etc).

* Types of Steel

① Low Carbon Steel → (Mild Steel or dead Carbon Steel) C - 0.45% ↑Most malleable ↑Most ductile

② Medium Carbon Steel → C → 0.45% - 0.8%

③ High Carbon Steel → C → 0.8% - 2%

Generally → Brittleness ∝ Hardness

$\Delta \propto \frac{1}{\text{Brittleness}}$

Diplomawallah.in

Low Carbon Steel :- It is the alloy of iron, Carbon and some other limit in which iron as prime constituent and Carbon is the secondary constituent. The percentage of carbon is upto 0.5%. It is more low ductile or malleable in compare to other Carbon Steel. It is used in the making the soft utensil, making the toys, automobile etc.

Medium Carbon Steel.

Compolition → Fe + C + Extra (S, Co, V,
(80-90%) (0.04-0.08%) ↓ 0.2%

Properties :- Mild hardness, ductility, malleability
Uses :- Cryer, automobile, construction (nut), manufacturing and railway.

High Carbon Steel

Composition :- Fe + C (1.8 - 2%) + (Cr, V, Mn
↓ 0.8 - 1.2%.

Properties :- Hardness, Brittleness and strength very high.

Uses :- Cutting tools, Construction (Beam), Automobile (Hook), manufacturing (spring).

Diplomawallah.in

By adding the some other elements Silicon, Chromium, Sulphur etc we improve the Properties of the material.

(A) Effect of impurities on the Steel.

① Silicon

Si - (0.05 - 0.3%)

Fe + C + Si

Properties → Hardness ↑ and toughness ↑

It removes the gases and oxides, and Prevent blow holes.

② Sulphur

S - (0.25%)

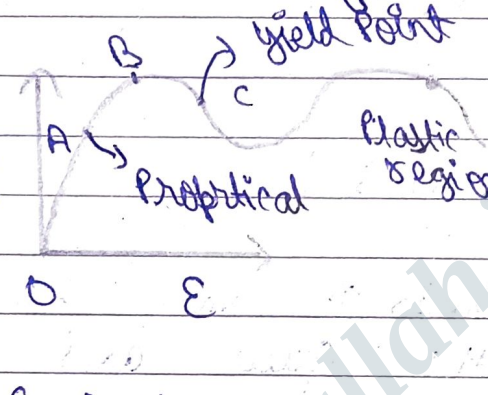
It occurs in a steel either of iron Sulphide or Manganese Sulphide. Iron Sulphide because of its low melting points reduces red shortness.

③ Manganese (≤ 0.6%)

It acts as deoxidising and purifing Agent in steel. It increase the ductility And tensibility. In high speed steel (HSS), It is used to toughen the metal And to increase its Critical temperature.

Diplomawallah.in

(4) Phosphorus (upto 0.25 %) :- It increases the brittleness and old shortness. It improves the resistance to corrosion it increases the yield point of low carbon steel.



σ → Stress
ε → Strain

* Effects of material in steel

S → Machinability.
Cr → Corrosion resistance / Increase the Hardness.
V → Increase the strength / hardenability.
Mo (Molinadium) → Improve the creap.
P → Machinability in free cutting steel.
Co → Contributes to hardness
Ni → Hardenability
W (Tungsten) → Heating resistance.
Si → Magnetic permeability since resistance to high temperature oxidation.

Diplomawallah.in

* High Speed Steel (HSS)

- This steels are used for cutting the Metals at much higher Speed than Ordinary Carbon Steel.
- The Carbon Steel to donate do not Retain (~~रिटेन~~) sharp cutting edge under Heavier load at higher Speed.
- Most of the HSS contains tungsten as The main alloying element, But other Elements like Cobalt (Co), Chromium (Cr) Vanadium (V) may be present in Some Proportion.

→ Types of HSS

i) 18-4-1 high Speed Steel :-

Composition → 18% W + 4% Cr + 1% V
(Tungsten) (chromium) (Vanadium)

It is one of the best tool steel. It is used for drill, lathe, planner and Shaper tool, millingcutter, reamer, threading dice, Punches etc.

Diplomawallah.in

(ii) ~~Molybdenum~~
(ii) Molybdenum HSS

This Steel Contains 6% tungsten, 6% molybdenum 4% Chromium and 2% vanadium.
It has excellent toughness and Cutting Ability.
It is better and cheaper than other Types of steel. It is mainly used for Drilling and ~~Hyperstyping~~ Operation.

(iii) Super high Speed Steel (Cobalt high Speed steel)
Cobalt - 15% → more heating effect.
Tungsten - 20%
Chromium - 4%
Vanadium - 2%
It increases the cutting efficiency at higher Temperature.
Since it is expensive so it is used for Heavy cutting operation which imposed high Pressure and temperature on the tool.

Q Spring Steel :- It is used for to make the spring, which can stored the maximum Amount of work or energy without permanent Deformation. Steel should have high elastic Limit as well as high elastic.

→ Leaf Spring

Diplomawallah.in

In bike, train → Helical Spring etc.

Spring absorb the shock load. It is used in Automobile, two-wheeler and railways.
Spring made up of
(a) High Carbon Steel.
(b) Chromium, Vanadium steel (less than 1%)
(c) Silicon, manganese steel.

* Cast iron
It is obtained by remelting the pig iron with coke and limestone in cupola furnace.

It is an alloy of iron and carbon in which
The carbon content in cast iron varies from 2 - 6.67 %. It also contains small amount of other element to improve enhance the properties.
→ Carbon present in Cast iron.
① Free carbon - Graphite form.
② Combined carbon - Cementite form.

Since the cast iron is the brittle material So it cannot be used to make the components which are subjected to shock load.

Cast iron

Property :- It has good casting characteristic high compressive strength, Bear resistance and insert machinability.

Types of Cast iron

(i) Grey Cast iron.
(ii) White Cast iron.
(iii) Child Cast iron.
(iv) Malted Cast iron.
(v) Malleable Cast iron.

Date 25-10-2024

* Heat treatment

Heat treatment is an operation or a combination of operation involving the heating and cooling an alloy to open the Required properties without changing the Chemical composition.
The aim of heat treatments is to achieve the following objective
(i) To increase the hardness of metal.
(ii) To relief the stresses.
(iii) To improve the machinability.
(iv) To soften the metal.
(v) To modify the structure of material
(vi) To improve its properties.
(vii) To change the grain size.

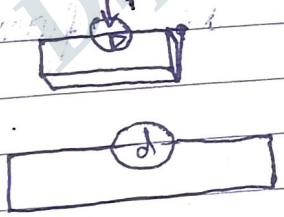
Diplomawallah.in

(viii) To increase the qualities of metal.
(ix) To provide better resistance to corrosion and ~~wear~~ (घिसाई).

Types of Heat Treatment Process

(i) Annealing.
(ii) Normalising.
(iii) Spherodising.
(iv) Hardening.
(v) Tempering.
(vi) Surface hardening or Case hardening.
  (a) ~~Carburising~~ Carburizing.
  (b) Sym Cyaniding.
  (c) Nitriding.
  (d) Induction
  (e) Flame Hardening.

Hardness



$$BHN = \frac{P}{\frac{\pi}{2} D \left(D - \sqrt{D^2 - d^2} \right)}$$

Viscous Hardness test → using diamond

Diplomawallah.in

(i) Annealing :- Annealing is a process of Heat treatment which improves the Grain size and properties of the Material. It also relief the internal Stresses which is caused during the Mechanical working. The main objective of annealing is

(a) To soften the steel. So that it can be easily machined and Cold work.

(b) To change the electrical, ~~and~~ magnetic and other physical properties.

(c) To refine the grain size and structure To improve the mechanical properties

(d) To relief the internal stresses

(e) To improves the gases trapped in Metal during initial casting.

We left the steel in furnace for cooling.

Date 14-11-2024

Types of Annealing :-

(i) ~~Full~~ Full annealing.

(ii) ~~Process~~ annealing

~~Full annealing~~

(ii) Tempering :- The steel hardened by Rapid Quenching (oiling) is very hard & brittle

It also quantense internal stresses which Are ~~it~~ Severe and unequally distributed To cause crack or rupture of hardened Steel.
The tempering is done for the following Reason.
(a) To reduce brittleness of hardened steel And thus to increase ductility.
(b) To remove the internal stresses caused By the rapid pulling of steel.
(c) To make the steel tough to resist The soft and fatty.

(iii) Hardening :- It is a process of heating The metal
(a) To a temperature form 30°c - 50°c above the upper critical point for hypoeutectoid [C → 0.8%] and by The same temperature above the Lower Critical point for hypereutectoid Steel.
(b) Keeping the metal at this temperature for a considerable point depending upon The thickness.
(c) Quenching in suitable cooling medium Like water, oil and brine. The main objects of hardening are (ii)
i) To increase the hardness of metal So, that it can resist blow.
ii) To enable it to cut other metal.

Diplomawalah.in

(iv) Surface hardening or Case hardening :- It is desirable that a steel being used should have a hardened surface to resist wear and tear. At the same time it should have soft and tough interior (core) so that it is able to absorb any shock load etc. This is achieved by

This type of heat treatment is applied to gears, railway wheel etc.

(v) Normalising :- The process of normalising consist of heating the steel from 30°C - 50°C above its UCT (upper critical temperature) it is held at this temperature for about 15 minutes and then allowed to cool down in atmospheric air. It provides a homogenous structure consisting of ferrite and pearlite for a hypo hypereutite steel and pearlite and cementite - for hypereutectoid steel.

The main objectives of normalising are:
(i) To refine the grain structure of steel to improve machineability (properties) and tensile strength.
(ii) To remove the strains caused by the cold working process (Hammering).

Diplomawallah.in

(iii) To remove the dislocation caused in the internal structure of steel due to Hot working.

(iv) To improve the certain mechanical and Electrical properties.

Diplomawallah.in