

1) Engineering Materials



Ferrous Metals

- Cast iron,
steel etc.



Non-Ferrous Metals

- Contain metals
other than iron.
- Cu, Ni, Ag, Au etc.

- Non-Ferrous Metals are costly than
Ferrous Metals. (High Resistive, corrosive, high
electrical or thermal conductivity for Non-Ferrous)

Ferrous Metals :-

Fundamentally there are 5 types
of Ferrous metals -

- Pig iron
- Cast iron
- Steel
- Alloy steel
- Wrought iron

Pig Iron :-

Ores → Purification/Refining process +
Blast Furnace (cupola Furnace) ⇒
Cast iron.

The pig iron obtained from crude form of iron.

However, it is used as raw material for production of other metals wrought iron, steel etc.

Cast iron is obtained from blast furnace is known as Cupola Furnace.

The content of carbon in cast iron is 2 to 4.5 %.

The carbon present is free-state form (Graphite). Cast iron is brittle material and hence, can't be used in sudden shocks or Impact load.

* Properties of Cast Iron:-

i) Brittle in the nature

Ex-cast iron, piece of chalk. i.e., poor ductility / poor malleability

ii) High Compressive strength

iii) Good Casting characteristic

- iv) Self-lubricating property
- v) Excellent machinability
- vi) Good wear/ corrosion resistance.

Ductility :-

It is property by which metal can be drawn into wires, rods, pipes without fracture in it.

Ex- Cu, Al, Brass , Au,Ag etc. (Non-Ferrous)
Steel (Ferrous)

Malleability :-

It is property by me which metal can be form in sheets, plates without Fracture in it.

Ex- Ag, Au, steel etc.

*** Cast iron show high compressive strength.

The ability of material to resist compress called Compressive strength.

* Types of Cast iron:-

There are different types of cast iron -

- a) Grey Cast iron
- b) White " "
- c) Nodular " "
- d) Alloy " "
- e) Chilled " "

* Steel :- It is soft, ductile, malleable and high tensile strength.

- It can be welded easily.
- It can be machined easily.
- It can be Fabricated, worked easily.

* Steel manufacturing process:-

There are many process by which steel manufactured -

by using pig iron as raw material.

- i) Cementation process
- ii) Crucible "
- iii) Bessemer "
- iv) Bessemer "
- v) L-D "

There are various types of steel. However, most of steel manufactured, nowadays

Plain carbon steel -

It is called so because its various properties depend on content of carbon present in it i.e., higher carbon

There are 4 types of Plain carbon steel -

- i) Dead mild steel : 0 to 0.05
- ii) Mild steel / Low carbon steel : 0.05 to 0.3 } quantity
- iii) High carbon steel : 0.8 to 1.5 } of carbon
- iv) Medium carbon steel : 0.3 to 0.8

Consist of iron + carbon + Mg + Si + Phosphorus

Mild steel is used as work-piece / Job
M/c. shop, welding, fitting.

High carbon steel is used in cutting tools at low cutting speed.

Ex - chisel, files, snips, hacksaws blade, drill, tap, dies.

Cast

* ~~Pig~~ iron and steel both are made of carbon and iron.

Cast

Difference b/w ~~Pig~~ iron and steel -

(Brittle)

(Malleable and ductile)

Cast iron

steel

i) 2 to 4.5% carbon content.

0 to 1.5% carbon content.

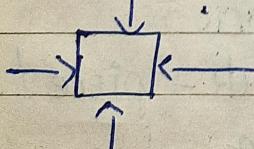
ii) It is free state.

It is combined state.

iii) Flakes of C are shattered.

Flakes of carbon are present in 1 mm and closer to each other.

iv) High compressive strength.



High tensile strength.



v) It casted easily.

It can forged easily.



* Alloy steels

When

Alloy steels contain iron + carbon and other combined elements depend on requirement.

Property of alloy steel depend on type of element added, no. of alloy element, quantity of alloy element etc.

Alloy steel are manufactured for specific purpose and special requirement.

There are various type of alloy steel-

- i) High speed steel (HSS) :- It is used for making cutting tools which are used to cut material at higher speed.

When cutting tool is made from high carbon steel and higher cutting steel and heavy dose, the temp. of cutting zone become very high.

Due to high temp., tools material become soft and tool not able to efficiently longer period.

The ^{HSS} has ~~success~~ ability to retain it's hardness at higher temp. and it can cut material cutting steel is 2 to 3 higher than high carbon steel.

To retain hardness at high temp. \Rightarrow Red hardness.

Red Hardness :-

It is ability of material to retain or maintain it's hardness at high hardness.

There are various type of high speed steel, however, the most commonly used combination used.

18:4:1 - HSS which contains 10% tungestan, 4% Cr, 1% Vanadium.

18:4:1 - HSS

+

C = 0.8 to 1.2%

It also contains carbon to 0.8 to 1.2%.

-	<u>Mild steel</u>	<u>High carbon steel</u>	<u>HSS</u>
i)	It is plain carbon steel	i) Plain carbon steel.	ii) It is alloy steel.
ii)	0.05 to 0.3% carbon contains	ii) 0.8 to 1.5 %.	ii) 0.8 to 1.2 %.
iii)	Used in work piece	iii) Used in cutting tools	iii) Cut material at higher temp.

* Stainless steel :- or Rustless

It is defined as the steel which is correctly heat treated ; finished and resist to corrosional attack from Corrosion medium.

This are also called corrosion resistance steel.

The principal alloying material like Ni, S etc. are added.

This steel contains 12%. True.

It is widely used for making utensils, racks, steel containers, household appliances etc.

* wrought iron :-

It is purest form of iron which contains atleast 99.0% iron only.

It is obtained by refining pig iron into furnace known as Puddle / Puddling furnace.

It is soft, ductile and malleable material which can be converted in form of wires, rods, sheets easily.

Due to lack of carbon it cannot be made hard by heat treatment processes.

It does not fuse (melt) like cast iron at higher temp. and hence not suitable for casting purpose (never cast).

Its melting point is higher around 1500°C .

It can be welded easily, fabricated easily, machined easily. And it has high tensile strength.

It is commonly used for making steel and water pipe-lines, chains, Crane hooks, ship building industry, nuts, bolts, grills etc.

* Copper Alloy :-

Copper alloys are mainly divided in 2 categories -

- i) Cu+Zn (Brass)
- ii) Cu+Sn (Bronze)

* Brass :-

Brass is most widely used alloy of Cu + Zn.

Brass has ~~more~~ ^{lower} thermal conductivity.

The most commonly used copper alloy is Brass.

Depending on proportion of Cu and Zn there are different type of brass.

Brass has more strength than copper but lower thermal, critical conductivity. It is very resistant to atmospheric corrosion.

Brass is ductile and malleable. It has high tensile strength.

Types of Brass:-

- i) Cartridge Brass.
- ii) Muntz metal
- iii) Naval brass
- iv) Delta brass
- v) Meehanite Brass.

Bronze :-

Bronze is an alloy of Cu + Zn. Depending on proportion of Cu intake, there are different type of Bronze.

It is soft, ductile, malleable and have high tensile strength.

It can convert it into wires, rods, sheets easily.

It has corrosion resistant property.
Bronze superior to Brass.

Types :-

Depending on proportion of proper different type of Bronze are :-

- i) Phosphor bronze
- ii) Gun bronze
- iii) Bell bronze