

Heat Treatment of Metals

MSE-S305

Introduction to Steel
&
Scope for its Heat Treatment

Introduction to Steel

- **Steel** is basically an alloy of *Iron (Fe)* and *Carbon (C)* to which other alloying elements - such as Cobalt, Manganese, Chromium, Nickel, vanadium, Copper, etc.
- **Alloying Elements** can be deliberately added to maintain certain application specific properties, While carbon is always present in the Steel but other alloying elements are optional.
- **Alloying Elements** are added or used for developing some special characteristics and properties of Steels for user specific applications. Thus steel can be classified on the basis of alloying elements.

Introduction to Steel

➤ On the basis of alloying elements, Steel can be classified into two major categories.

1. Plain carbon Steel (only Iron and Carbon)

2. Alloy Steel (Iron, Carbon and other alloying elements)

➤ Structural steels is also a type of steel used for making structural materials in different shapes for various applications. Many constructional steel shapes acquire the form of an elongated beam having a profile of a specific cross section.



Introduction to Heat Treatment of Steels

- **Heat Treatment** is essentially a thermally assisted process for attaining the desired Mechanical properties by changing the microstructure of Steel.

- Heat Treatment involves the heating and cooling of the given sample to obtain the desired mechanical properties without changing the chemical composition.

- Heat treatment is done to improve the following:
 - a) To improve the mechanical properties such as ductility, strength, toughness and hardness etc.
 - b) To improve the machinability.
 - c) To improve electrical and magnetic properties.
 - d) To increase wear resistance also resistance to heat and corrosion too.

Role of Heat Treatment

- **Mechanical properties of steel are the function of its microstructure.**
- **To develop the desired properties in steel heat treatment plays an important role. Which can be changed or developed in a given composition by suitable heat treatment.**
- **Purpose of heat treatment can be defined as to bring about a constructive change in the microstructure of the Steel or in the internal physical state of the Steel for making it property - wise perfect for definite uses and applications.**

Types of Heat Treatment Processes

➤ Thermal Heat Treatment Processes

- ✓ Annealing
- ✓ Normalizing
- ✓ Hardening
- ✓ Tempering and stress relieving etc.

➤ Thermo-Chemical Heat Treatment Processes

- ✓ Carburizing
- ✓ Nitriding
- ✓ Carbo-Nitriding
- ✓ Nitro-Carburizing
- ✓ Cyaniding etc.

➤ Thermo-Mechanical Heat Treatment Processes

Introduction to Phase Diagram

Some Definitions

Phase

A phase in a material is a region that differs in its microstructure and/or composition from another region.

Phase Diagrams

Phase Diagrams are *graphical plots of phases*, which are present in an alloy system at different Temperature, Pressure and Composition. These graphical representations are used to explain the relationships between the various phases that come into view within the system under *equilibrium conditions*.

To identify the state of a system in equilibrium, it is necessary to specify *three* independent variables (*Temperature, Pressure and Composition*).

Key Points about Phase Diagrams

- Generally, in the phase diagram, *Temperature* is plotted against *Composition*.
- All the phase diagrams have temperature as the ordinate (*Y-axis*) and percentage composition by weight as the abscissa (*X-axis*).
- Every point on the phase diagram shows a definite *Composition and Temperature*.
- Phase diagram shows the various phases present at different *Temperature and Composition*.
- The phase diagram indicates the *phases present* and the *phase changes* that occur during heating and cooling.