Metallurgy for Non Metallurgists
5 – Day Training Program

Introduction

This program will provide an integrated practical overview of metals and alloys and relating it to the mechanical and physical characteristics of metals; starting from materials testing and physical/mechanical properties, through corrosion properties and strength/deformation principals, and to ferrous and non ferrous alloys and heat treatment.

The course will then include ferrous alloys (plain and alloy steels, Stainless steels and cast irons) and non ferrous alloys (for corrosion and high temperature applications, such as nickel, cobalt and titanium based alloys).

The nature of hot and cold working of metals and heat treatment, including annealing, normalising, tempering and case hardening will be explained.

The fundamentals of corrosion and corrosion prevention will also be presented in practical terms with examples to illustrate the key points.

The behaviour of metals under various loading conditions (static, dynamic, fracture) will be presented and related to design methodology and procedures; rules of thumb, standards, and best industry practices.

Each of the major topics will be presented as individual units, and in the context of the overall usage of metal components and structures and failure mechanisms, and Mechanical integrity.

Objectives

Upon completion of this course, participants will have gained an understanding of the important principals of engineering involving properties and characteristics of metals and alloys, including fabrication and heat treatment of commercial steels and nonferrousalloys.

Participants will acquire sufficient knowledge and skills to independently evaluatepossible metallurgical and design solutions, to recognise crucial metallurgicalphenomena and intelligently discuss their metal problems with design engineers,metallurgists and fabricators.

Who Should Attend?

This program is intended for those who use or supervise activities requiring the use of metal parts or structures

Those with little or no prior formal background who function as:

- Supervisors
- Engineers
- Planners
- Inspectors
- Designers
- Researchers
- Investors

DAILY OUTLINE

DAY 1

Testing and Mechanical Properties of Metals

- Tensile tests
- Impact tests
- Hardness tests
- Compression of mechanical properties

The Crystalline Structure of Metals

- Bonding in metals
- Solidification crystal growth and structures of metals
- Defects in metals during solidification

DAY 2

Specimen Preparation and Microscopic Examination

- The preparation (Mounting Grinding, Polishing and Etching) of metal specimens
- Metallurgical and Electron Microscopes

Dislocations and Strengthening Mechanisms in Metals

- Edge Dislocation (line imperfections) in crystals
- Strengthening of metals by Grain Size Reduction, Solid Solution and Strain Hardening
- Softening of metals by annealing
- Comparison of Cold and Hot working of Metals

DAY 3

Binary Equilibrium Diagrams

- Solubility and cooling curves
- Thermal Equilibrium Diagrams (Eutectic Type, Solid Solution Type and Combination Type)

Ferrous Alloys

Definitions and classifications and some uses of ferrous alloys including;

- Carbon steels
- Alloy steels
- Stainless steels
- Cast irons

Fabrication of Metals

A selection of metal fabrication methods, including;

- Forming
- Casting
- Welding

DAY 4

Heat Treatment of Plain Carbon Steel

- Hardening of carbon steel (by quenching)
- Annealing
- Normalising
- Tempering
- Austempering
- Surface treatments
- Heat affected zone (HAZ) in welding

Non-Ferrous Alloys

- Nickel and cobalt
- Titanium alloys

DAY 5

Corrosion in Metals

- The electrochemical cell
- Types of electrochemical corrosion
- Pitting
- Crevice
- Stress corrosion
- Hydrogen induced, etc.

Protection against Electrochemical Corrosion and Inspection

- Coatings
- Internal
- External
- Polymers
- Galvanizing, etc.
- Inhibitors, Types and usage
- Cathodic protection, Impressed current, Sacrificial
- Inspection
- Standards