

# METALLURGY FOR THE NON-METALLURGIST

# **MCE064**

### **COURSE DESCRIPTION**

Metals and alloys are used in a great variety of applications. Understanding how metals behave and how they can be obtained by processing raw materials is valuable to employees in this area. Extraction of metals applying various technologies, including physical separation, hydrometallurgy, pyrometallurgy and electrometallurgy. This course is an important learning platform where a comprehensive overview of metallurgy and advances in the field are shared among the participants both formally and informally. This course provides important, practical knowledge to the nonmetallurgist. The objective of the course is to provide a comprehensive overview of the subject ranging from topics relevant to conventional or modern technology.

# **COURSE GOAL**

To enhance the participants' knowledge, skills and abilities necessary to understand how metals are recovered from nature and processed into usable forms, the characteristics of different metal alloy systems, factors that affect selection of the proper material, mechanical properties and various testing methods, how the properties of metals can be altered through heat treatment and mechanisms of corrosion and comparative corrosive potential.

# **COURSE OBJECTIVES**

By the end of this course, participant will be able to:

- Instill the WOW factor that is inherent in working with and fabricating of metals.
- Recognize potential impacts of metal fabrication on the metallurgy of metals.
- Recognize potential impacts of the metallurgy of metals on metal fabrication.
- Recognize that all trades such as welders, machinists, engineers, shot-peeners, foundry mold casters, pressure vessel, pipeline fabricators and electricians have inter-related effects on how their fabrications and work will handle the actual work environment either before or after repairs or construction.
- Understand the basics of metallurgy.

#### WHO SHOULD ATTEND

- Welders.
- Machinists.
- Shot-peeners.
- Vessel and piping metal fabricators.
- Tool and die makers.



- Engineers.
- General metal contractors.
- Millwrights.
- NDT technicians.
- Corrosion technicians.
- Others who would like to know more about basic metallurgy.

# **COURSE DURATION**

5 Working Days

# **COURSE OUTLINES**

- 1. Metals: A History:
  - The first primitive refining techniques.
  - Brief descriptions of cultural significance of metals.

#### 2. Extractive Metallurgy:

- Hydrometallurgical.
- Pyrometallurgical.
- Electrometallurgical techniques.

#### 3. Solidification of Metals:

- Crystal structure.
- Concepts of solidification and solid solubility.
- Basic binary phase diagrams.

#### 4. Metal Forming:

- Forging.
- Rolling.
- Extrusion.
- Swaging.
- Rolling.
- Stamping.
- Coining.
- Spinning.



#### 5. Mechanical Properties and Their Measurement:

- Definitions of mechanical properties and explanations of testing procedures.
- Introduction to concepts of standardization and quality control.

#### 6. Steels and Cast Irons: Applications and Metallurgy:

- Description of the allotropic nature of iron and its effect on the properties of steels and cast irons.
- Listing of selected applications of steels and cast irons.

#### 7. Heat Treatment of Steel:

- Hardness and hardenability of steel.
- Specific processes and their applications.
- Heat treating procedures.
- Equipment.
- Quenchants.
- Hardness measurements.

#### 8. Case Hardening of Steel:

- Carburizing.
- Nitriding.
- Carbonitriding.
- Procedure for measuring case depth.

#### 9. Strengthening Mechanisms:

- Techniques used to harden the nonferrous metals.
- Age hardening.
- Strain hardening and related metallurgical concepts for aluminum.
- Titanium.
- Copper.
- Other nonferrous metals.

#### 10. Nonferrous Metals: Industrial Applications and Properties:

- Light metals.
- Aluminum.
- Beryllium.
- Magnesium.
- Titanium.



- Copper and its alloys.
- Lead, tin, and zinc.
- Precious metals.

#### 11. Joining:

- Techniques of welding.
- Brazing.
- Soldering.

#### 12. Corrosion and Corrosion Prevention:

- Causes of corrosion and the environmental factors which contribute to it.
- Types of corrosion are discussed.
- Together with techniques for minimizing it.

#### 13. Quality Control and Failure Analysis:

• Procedures for predicting and/or evaluating the performance of metals in service.

#### 14. Materials Characterization and the Selection Process:

- Explanation of the designation systems for classes of metals and alloys in worldwide use today.
- Descriptions of factors which affect the selection of a material for a application.
- Brief comparison of polymers and ceramics related to metals.
- Case studies of material selection problems.

