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For Training and Development

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Course: Materials of Construction for Process Equipment & Piping Systems “ Selection and In_Service Performance

Code	City	Hotel	Start	End	Price	Language - Hours
508	Jakarta (Indonesia)	Hotel Meeting Room	2024-12-09	2024-12-13	4450 €	En - 25

Introduction

Appropriate material selection is the cornerstone of pressure equipment and piping design, operation and maintenance. Engineers must select materials of construction that provide adequate strength at operating temperatures and pressures, in compliance with applicable construction codes and with regard to their resistance to corrosion and other likely degradation mechanisms, as well as to cost-effectiveness. The acceptability of materials is controlled by the relevant Codes. The ultimate selection of the correct material is the responsibility of the design or fabrication engineer. By listing the design’s allowable stresses, the Codes do limit the materials that can be chosen. Only those materials that meet certain requirements as listed in the specifications should be used. The mechanical integrity, safety, and cost-effective operation of plants depend on the in-service performance of the materials of construction throughout the plant life cycle.

Metallurgy is a complex science but a general understanding of the major principles is essential to the plant engineers and inspectors This course provides comprehensive and practical understanding of engineering materials and guidance on the methods and best industry practices for the selection of the appropriate materials of construction for specific applications while simultaneously satisfying service requirements, construction Code requirements, and least life cycle costs over the entire plant life.

This course will provide a practical overview of ASME BPVC Section II – Materials, as well as some relevant information from the BPVC Section VIII Div.1 and B31.3 Process Piping

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This course builds on a focused and practical coverage of engineering materials properties and selection and provides a structured approach to predict, monitor and assess the materials performance in service with the objective of ensuring plant integrity, safety and cost-effective operation

Seminar Objectives

The key objectives of this course are as follows:

- Assist participants to clearly understand that the appropriate selection of materials of construction for pressure equipment is the cornerstone of safe, reliable and costeffective plant operation.
- Enhance participants' awareness of key requirements of relevant design and operation standards and industry practices such as ASME B&PVC and B31.3; ASTM Material Specifications, API 571, 580, 581, 578 and 579, and others.
- Provide guidelines to participants to identify and locate in-service degradation and appropriate tools for condition assessment and making sound run/repair/replace decisions. Make participants recognize that although all flaws detected by inspection must be evaluated, not all flaws need to be repaired. The proper application of API Std 579-1/ASME FFS-1 for fitness-for-service assessment may obviate the need for some repairs and result in reduced maintenance cost and

downtime

Who Should Attend?

This course is particularly valuable for refinery, petrochemical and process plant mechanical and process engineers, technical professionals, inspectors, maintenance personnel, as well as for project and consulting engineers and engineering and technical personnel involved in plant mechanical integrity and reliability.

Organisational Impact

- The company will achieve improved financial performance through the proper selection of materials of construction based on total life cycle cost principles.
- The company will be able to achieve measurable improvement in mechanical integrity through improved materials performance and reduced likelihood of failures.
- The company will be able to enhance its ability to use risk-based inspection and maintenance resulting in lower life cycle costs while complying with codes and standards, and other regulatory requirement.

Personal Impact

- Participants will be more able to actively contribute towards reducing the probability of serious failures in pressure equipment and piping systems.
- Participants will enhance their competence and productivity thereby enhancing their competence and performance level and making additional value added contributions to their organizations.

Competencies Emphasized

Delegates will enhance their competencies in the following areas:

- Engineering materials properties and selection criteria for specific applications with view to achieving optimum life cycle costs while complying with codes and regulations.
- Construction codes, standards and recommended practices covering design of pressure equipment and piping systems.
- Identification and assessment of active degradation mechanisms and the failures they may cause.
- Hazard identification and risk analysis and management.
- Application of risk-based methodologies in inspection and maintenance.
- Fitness-For-Services assessments.

Training Methodology

The course combines sound engineering principles, methods, and applicable codes & standards and best industry practices. Actual major incidents as well as industry experience will be reviewed in depth to reinforce every topic.

Seminar Outline

Day 1: Engineering Materials – Types and Properties

Engineering Materials I – Overview

- Metals – Ferrous and non-ferrous
- Carbon steel
    - Alloying elements added to iron base – carbon, manganese, and silicon
    - Effect of alloying elements on end properties and on fabrication processes
    - Impurities and their effect – sulfur, phosphorus
- Alloy steel
    - Effects of alloying elements
    - Stainless steels

- Specialty alloys
  - Corrosion resistant alloys
  - High temperature alloys
  - Erosion resistant alloys

Engineering Materials II

- Refractory materials – Types and applications – Examples: Titanium and zirconium
- Clad Materials – Types; production methods; and typical applications
- Composite materials – Classes, types and applications
- Non-Metallic materials – Plastics, ceramics
- Surface engineered coatings/overlays – Types, specifications and applications
  - Organic coatings
  - Metallic coatings
  - Corrosion resistant cladding
  - Corrosion resistant / hard-surface welding
  - Thermal spray coatings
  - Plasma transferred arc (PTA) welded overlays

Metallurgy Basics

- The structure of metals and alloys
- Imperfections in metals and alloys
- Chemical composition – Unified numbering system (UNS)
- Physical properties – melting temperature, the thermal conductivity, electrical conductivity, the coefficient of thermal expansion, and density
- Mechanical properties – Base metals, filler metal and completed welds
- Tensile and yield strength, ductility, hardness and toughness
- Heat treatment and effect on material properties

Material Forming and Fabrication

- Forming and forging

- Casting
- Welding processes – main technologies and consumables currently used in industry
- Weldability – Carbon equivalent; Shaeffler and WRC diagrams
- Preheat and Post-Weld heat treatment (PWHT) – Code (B&PV and B31) rules
- Weld imperfections (discontinuities) commonly encountered with welding processes

Overview of ASME B&PVC Section IX 'Welding and Brazing Qualifications'

- This Section contains rules relating to the qualification of welding and brazing procedures as required by other code sections for component manufacture
- Welding procedure specification (WPS)
- Procedure qualification record (PQR)
- Welder performance qualification (WPQ)

Day 2: Materials Selection and Application

Material Selection Process and Guidelines

- Life cycle cost considerations
- Factors in material selection in petroleum refineries- type of refinery; type of crude oil processed; service conditions in specific process unit/application, expected service
- Oxidation resistance – scale formation
- Guidelines on the maximum temperature of use of carbon steel and alloy materials
- Creep properties – The Larson-Miller parameter (LMP)
- Fatigue properties – Fatigue design (S-N) curves

Materials Standards and Codes

- ASME Boiler and Pressure Vessel and Piping Construction Codes
    - Allowable stresses

- Constraints and limitations
- P-Number identificat

- ASTM â€“ Some common material specifications for piping, plates, forgings and castings
- API RP 941 – Steels for hydrogen service at elevated temperatures and pressures in petroleum refineries and petrochemical plants
- NACE MR 0175/ISO 15156 'Petroleum and Natural Gas Industries – Materials for Use in H2S-containing Environments in Oil and Gas Production – Parts 1, 2 and 3′
- Oxidation resistance – scale formation
- NACE MR0103 'Materials Resistant to Sulfide Stress Cracking in Corrosive Petroleum Refining Environments'
- PIP (Process Industry Practices) Standards – Example: PIP Piping Material Specification 1CS2S01 Class 150, Carbon Steel, Socket Weld, 0.125 C.A. Process.
- Fatigue properties – Fatigue design (S-N) curves
- Overview of ASME B&PVC Section II 'Materials Specifications' – This Section compiles material specifications and material properties for materials used in the construction of ASME components. It contains four parts:
    - Part A-Ferrous Material Specifications
    - Part B-Nonferrous Material
    - Part C-Specifications for Welding Rods
    - Part D-Properties-(Customary)

Material Selection for Specific Equipment

- Refineries and petrochemical plants
- Power plants
- Pressure vessels
- Piping valves and fittings
- Pumps

Day 3: Degradation of Materials In-Service

Material Ageing and Degradation – Overview

- Ageing is not about how old equipment is; it’s about knowledge of its condition, and how that is changing over time
- Indicators or symptoms of ageing Failure Modes and Mechanisms in Materials
- Degradation processes – (e.g. corrosion, erosion)
- Excessive elastic deformation – (e.g. buckling)
- Fracture – (e.g. fatigue, brittle fracture)

Overview of API RP 571 Damage Mechanisms Affecting Fixed Equipment

- This document provides background information on damage that can occur to equipment in the refining and other process industries. It covers over 60 damagemechanisms. It is also an excellent reference for inspection, operations, and maintenance personnel.

Metallurgical Failure Analysis

- Overview
- Case study

Positive Material Identification

- Objectives and methodologies (e.g. X-Ray Fluorescence and Optical Emission Spectroscopy)
- ASTM- E1916
- Pipe Fabricator Institute
- PFI-ES42
- API 578
- MSS SP-137-2007

- Material Test Reports

Day 4: Inspection Strategies and ,on-Destructive Examination Methods

Mechanical (Structural) Integrity – Overview

- Definition, scope, and key elements – hardware and software issues, human factor,
- Potential threats to technical integrity in a hazardous environment
- Regulatory requirements – SH&E, OSHA, SEVESO II
- Life cycle implications – design/operation/maintenance, management of change Inspection Strategies and Methods
- Real function of inspection
- Planning and strategies Inspection Strategies and Methods (continued)
- Overview of API RP 580 and RBD 581 – Risk-Based Inspection
- Overview of API RP 577 Welding Inspection and Metallurgy Non-Destructive Examination (NDE) Methods and Their Application
- Capability of the applicable inspection method vs. discontinuity
- New developments in NDE methods
- Overview of ASME B&PVC Section V 'Nondestructive Examination'
- This section contains requirements and methods for non-destructive examination

Day 5: Fitness-For-Service Evaluation

Introduction to Fracture Mechanics

The Scandinavian Academy for Training and Development employs modern methods in training and skills development, enhancing the efficiency of human resource development. We follow these practices:

- **Theoretical Lectures:**
  - We deliver knowledge through advanced presentations such as PowerPoint and visual materials, including videos and short films.
- **Scientific Assessment:**
  - We evaluate trainees skills before and after the course to ensure their progress.
- **Brainstorming and Interaction:**
  - We encourage active participation through brainstorming sessions and applying concepts through role play.
- **Practical Cases:**
  - We provide practical cases that align with the scientific content and the participants specific needs.
- **Examinations:**
  - Tests are conducted at the end of the program to assess knowledge retention.
- **Educational Materials:**
  - We provide both printed and digital scientific and practical materials to participants.
- **Attendance and Final Result Reports:**
  - We prepare detailed attendance reports for participants and offer a comprehensive program evaluation.
- **Professionals and Experts:**
  - The programs scientific content is prepared by the best professors and trainers in various fields.
- **Professional Completion Certificate:**
  - Participants receive a professional completion certificate issued by the Scandinavian Academy for Training and Development in the Kingdom of Sweden, with the option for international authentication.
- **Program Timings:**
  - Training programs are held from 10:00 AM to 2:00 PM and include coffee break sessions during lectures.