

COURSE OVERVIEW PE0149

**Distillation - Column Operation, Control and Troubleshooting
(E-Learning Module)**

Course Title

Distillation - Column Operation, Control and Troubleshooting
(E-Learning Module)

Course Reference

PE0149

Course Format & Compatibility

SCORM 1.2. Compatible with IE11, MS-Edge, Google Chrome, Windows, Linux, Unix, Android, IOS, iPadOS, macOS, iPhone, iPad & HarmonyOS (Huawei)

Course Duration

30 online contact hours
(3.0 CEUs/30 PDHs)



Course Description



This E-Learning is designed to provide participants with a detailed and up-to-date overview of distillation column operation, control and troubleshooting. It covers the chemical and physical principles; the states (phases) of matter and the common separation techniques; the heat transfer and its application; the units of heat, HE processes applications, steam generation, petroleum processing and separation processes; the catalytic reforming, fractional distillation, phase equilibrium data, boiling point diagram and flash distillation; and the main components of distillation unit including distillation column tray types and other causes of tray inefficiency.

During this interactive course, participants will learn the distillation process, column design method and heat-balance calculations; the reboiler types and arrangements, thermosyphon selection criteria, condensers, air coolers, fin fans, levels, pressures, flows and temperatures; the effects of temperature on level; the tower pressure control methods, tower operating pressure optimization, jet ejector troubleshooting and measuring deep vacuums; the packed towers and tray columns; preparing for inspection; and the flow diagram for troubleshooting and distillation column scanning.

Course Objectives

The course should serve the following overall learning objectives

- Apply systematic techniques on distillation column operation, control and troubleshooting
- Carryout process, illustrate design to finalize the specification, apply proper troubleshooting, review design of new plant and understand the unit
- Discuss the chemical and physical principles including the states (phases) of matter and the common separation techniques
- Illustrate heat transfer and its application as well as explain the units of heat, HE processes applications, steam generation, petroleum processing and separation processes
- Describe catalytic reforming, fractional distillation, phase equilibrium data, boiling point diagram and flash distillation
- Recognize the main components of distillation unit including distillation column tray types and other causes of tray inefficiency
- Illustrate distillation process, column design method and heat-balance calculations
- Identify the reboiler types and arrangements, thermosyphon selection criteria, condensers, air coolers, fin fans, levels, pressures, flows and temperatures
- Discuss the effects of temperature on level and apply tower pressure control methods, tower operating pressure optimization, jet ejector troubleshooting and measuring deep vacuums
- Identify packed towers and tray columns, prepare for inspection and illustrate flow diagram for troubleshooting and distillation column scanning

Who Should Attend

This course provides an overview of all significant aspects and considerations of distillation column for those who are involved in the operation, control and troubleshooting of such system. Process engineers, production engineers, operations engineers, maintenance engineers, process analysts, shift supervisors, DCS and field operators and other technical staff will definitely benefit from the technical and operational aspects of the course.

Training Methodology

This Trainee-centered course includes the following training methodologies:-

- Talking presentation Slides (ppt with audio)
- Simulation & Animation
- Exercises
- Videos
- Case Studies
- Gamification (learning through games)
- Quizzes, Pre-test & Post-test


Every section/module of the course ends up with a Quiz which must be passed by the trainee in order to move to the next section/module. A Post-test at the end of the course must be passed in order to get the online accredited certificate.

Course Certificate(s)

Internationally recognized certificates will be issued to all participants of the course.

Certificate Accreditations


Certificates are accredited by the following international accreditation organizations: -

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USA International Association for Continuing Education and Training (IACET)

Haward Technology is an Authorized Training Provider by the International Association for Continuing Education and Training (IACET), 2201 Cooperative Way, Suite 600, Herndon, VA 20171, USA. In obtaining this authority, Haward Technology has demonstrated that it complies with the **ANSI/IACET 1-2013 Standard** which is widely recognized as the standard of good practice internationally. As a result of our Authorized Provider membership status, Haward Technology is authorized to offer IACET CEUs for its programs that qualify under the **ANSI/IACET 1-2013 Standard**.

Haward Technology's courses meet the professional certification and continuing education requirements for participants seeking **Continuing Education Units (CEUs)** in accordance with the rules & regulations of the International Association for Continuing Education & Training (IACET). IACET is an international authority that evaluates programs according to strict, research-based criteria and guidelines. The CEU is an internationally accepted uniform unit of measurement in qualified courses of continuing education.

Haward Technology Middle East will award **3.0 CEUs** (Continuing Education Units) or **30 PDHs** (Professional Development Hours) for participants who completed the total tuition hours of this program. One CEU is equivalent to ten Professional Development Hours (PDHs) or ten contact hours of the participation in and completion of Haward Technology programs. A permanent record of a participant's involvement and awarding of CEU will be maintained by Haward Technology. Haward Technology will provide a copy of the participant's CEU and PDH Transcript of Records upon request.

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British Accreditation Council (BAC)

Haward Technology is accredited by the **British Accreditation Council** for **Independent Further and Higher Education** as an **International Centre**. BAC is the British accrediting body responsible for setting standards within independent further and higher education sector in the UK and overseas. As a BAC-accredited international centre, Haward Technology meets all of the international higher education criteria and standards set by BAC.

Course Fee

As per proposal

Course Contents

- Chemical & Physical Principles
- States (Phases) of Matter
- State of Matter
- Solid, Liquid, Gas: Three Basic States of Matter
- Physical Property
- Chemical Property
- Physical Changes
- Pure Substances vs. Mixtures
- Homogeneous vs. Heterogeneous Solutions
- Common Separation Techniques
- Properties & Definitions
- Heat Transfer & Its Application
- Temperature and Heat
- Units of Heat
- HE Process Applications
- Evaporation
- Boiling
- Condensation
- Relationship of BP & VP of Liquids
- Definitions
- Partial Pressures
- Perfect Gas or Ideal Gas
- What is Steam
- How Steam is Generating
- Dry Steam & Its Fraction
- Dry steam vs. Wet Steam
- Flash Steam
- What is Distillation?
- Composition of Petroleum
- Petroleum Processing Overview
- Separation Processes



- Separation Processes – Absorption
- Petroleum Processing Overview
- Conversion Processes
- Finishing Processes
- Petroleum Processing Separation Processes
- Catalytic Reforming
- Fractional Distillation
- Phase Equilibrium Data
- Boiling Point Diagram
- Flash Distillation
- Steam Distillation or Steam Stripping
- Rectification
- Combination Rectification and Stripping
- Introduction - Distillation Definition
- Main Components of Distillation Unit
- Distillation Tower Simplified Sketch
- Distillation Column
- Distillation Column Tray Design
- Distillation Column Trays – Inside View
- Down Common Backup and Flooding
- Tray Efficiency
- Distillation Column Tray Types
- Tray & Theoretical Stages
- Practical Distillation & Performance Constrains
- Dry-tray Pressure Drop
- Flooding
- Downcomer Clearance
- A- Down Common Backup and Flooding
- Puking
- Practical Distillation & Performance Constrains
- Weeping
- ΔP across Distillation Column
- ΔT across Distillation Column



- Tower Pressure Drop & Flooding
- Dry-tray Pressure Drop
- Other Causes of Tray Inefficiency
- New High Capacity Trays
- Distillation Process
- Normal Operation of Bubble Plate
- Vapor Velocity
- Vapor Velocity Effects
- Velocity Distribution
- Factors Influencing Plate Efficiency
- Tray & Theoretical Stages
- Sieve-plate Towers
- Course Recap
- Distillation Column
- Distillation Series of Flash Stages
- Series of Flash Stages
- Series of Flash Stages
- Operating Lines
- Column Design Method
- Process Design Basic
- Feed Line
- Reflux Ratio
- Minimum Reflux Ratio
- No. of Ideal Stages
- Exercise -1
- Exercise – 1: Solution
- How Trays Work
- Down Common Backup and Flooding
- Tray Efficiency
- Downcomer Backup
- A- Down Common Backup and Flooding
- Indications of Flooding
- Corrections to Flooding

- Low Feed Rate
- Corrective measures to low feed rate
- Feed temperature problems
- Reflux Rates
- Condenser Problems
- Over fractionation
- Practical Distillation & Performance Constrains
- Downcomer Clearance
- Vapor-Flow Pressure Drop
- Total Height of Liquid in Downcomer
- Jet Flood
- Incipient Flood
- Incipient Flood Point
- Tower Pressure Drop & Flooding
- Dumping and Weeping
- Dry-tray Pressure Drop
- Other Causes of Tray Inefficiency
- New High Capacity Trays
- Reboilers Function
- Floating Heat Exchangers
- The Reboiler
- Heat-Balance Calculations
- Reboiler Types & Arrangements
- Distillation Column Reboilers Types
- Thermosyphon Reboilers
- Forced-Circulation Reboilers
- Kettle Reboilers
- Thermosyphon Selection Criteria
- Course Recap
- Condensers
- Steam Condenser
- Condensing & Heat Transfer Rates
- Steam Reboilers

- Condensation and Condenser
- Condensing Heat Transfer
- Condensation and Condenser Design
- Air Coolers- Liquid to Air H-X's
- Air Coolers
- Air Cooled HE/ Fin Fans
- Fin Fans
- Fin Fans Air Coolers
- Instrumentation
- Process Control Instrumentation
- Levels, Pressures, Flows and Temperatures
- Level Control
- Level Indication
- Level Discrepancies
- Effects of Temperature on Level
- Level Explanation Calculation
- Level & Plugged Taps
- Foam Affects Levels
- Foam Affects Levels - Split Liquid Levels
- Pressure Transducers
- Pressure Control
- Flow Control
- Major Loops: i.e. Level Control
- Level & Flow Control at Same Time
- Tower Pressure Control Methods
- Optimizing Tower Operating Pressure
- Pressure Control
- Reflux Drum
- Partial Condensation
- Course Recap
- Steam Stripper
- Steam Stripper & Heat of Evaporation
- Heat of Evaporation

- Stripper Efficiency
- Pump-around & Vacuum System
- The Pumparound
- Purpose of a Pumparound
- Controlling Pumparound
- Vapor Flow
- Fractionation Problem
- Vacuum System
- Theory of Vacuum Operation
- Measuring Deep Vacuums
- Steam Jet Ejectors
- Advantages Using Steam Jet Ejectors
- Jet Ejector Troubleshooting
- Case Study
- Measuring Deep Vacuums
- Course Recap
- Packed Towers
- Tray Columns - Packings
- How Packed Towers Work
- How Packed Towers Work - Vapor Distribution
- Maintaining Functional & Structural Efficiency
- Tray Columns – Type of Packings
- Randomly Packed Towers Column Diameter
- Types of Packing – Comparison
- Comparison Trays versus Packing
- Course Recap
- Inspection, Troubleshooting Examples & Case Studies
- Introduction
- Inspection Basics
- Preparing for Inspection
- Flow Diagram for Troubleshooting
- General Appraisal of the Problem
- Problem in the Column



- Some Problems Outside the Column
- Distillation Column Scanning
- Gamma Scans for Packed Towers
- Application of Simulators in TS
- Case Study
- Course Recap

