COURSE OVERVIEW PE0406
Operating Crude Treatment Facilities - Advanced (E-Learning Module)

Course Title
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Course Reference
PE0406

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 course is designed to provide participants with a detailed and advanced overview of operating crude treatment facilities. It covers the wellhead, flow line and inlet manifold as well as intermediate casing, tubing head, christmas tree, flow control and chokes; the choke selection and sizing, flow-rate calculation, flow test, manifold's configurations and design and selection of gas oil separation plant and surface production facilities; and the separation and sweetening, stabilization, sweetening and mercaptans removal, heating control loop block diagram and oil and gas separation.

Further, the course will also discuss the horizontal separator, vertical and spherical separator, selection of horizontal separator, model of a vertical separator and three-phase oil & gas separation; the procedures for sizing horizontal three-phase separator and crude oil desalting and treatment; the factors to be studied prior selection of oil treatment method; the heat exchangers, produced- water treating systems, produced-water treating equipment and typical produced-water treating system; the settling tanks and skimmer vessels, vertical skimmer schematic, skimmer sizing equations, process equipment troubleshooting and some of troubleshooting of process equipment; and the separators troubleshooting, three general types of control configuration and combination of feedback & feedforward control configuration.

During this interactive course, participants will learn the maintenance execution and shutdowns best practice; the four phases of shutdown maintenance, meeting structure, biosecurity control zones and safety critical handover procedure; the flare operation, typical flows to flare systems, flare system major components and typical flare header system; the gas compression, types of compressors, emergency shutdown valve on incoming pipeline, induced gas flotation (IGF) and cyclonic separation; the factors affecting hydro cyclone performance; the crude oil storage tanks, tank design data and calculations, tank shell testing and tank volume calculation; the tank accessories, valve types, external piping design, stress analysis, piping & flanges and selection of piping materials; the flanges, bolts, gaskets, valves, piping flexibility, piping layout and insulation; the classification of pump; the calculation of hydraulic friction loss factor; and the pump head requirements.

Course Objectives

At the end of this course, the Trainee will be able to:-

- Apply and gain an advanced knowledge on operating crude treatment facilities
- Explain in detail the operation principles of crude treatment facilities (gathering centers, EPFs, heavy oil treatment facilities, etc.)
- Describe the operational modes and capacities for each stream, train, and system including impact on upstream and downstream facilities
- Demonstrate how to manage oil process system operations (oil receiving systems, separation systems, storage and export systems, etc.)
- Demonstrate how to manage gas process system operations (gas compression system, CRU, TV compressor, flare system, gas export to booster stations, etc.)
- Demonstrate how to manage water process system operations (water knockout system, Induced Gas Floatation (IGF), hydro-cyclones, Corrugated Plate Interceptor, etc.)
- Explain in detail the process parameters and variables (flow, level, pressure and temperature)
- Describe instrument, control and protection systems associated with crude treatment facilities, including emergency shut down levels
- Review and verify the requirements of crude treatment facilities operational procedures and standards for equipment checks, monitoring, controlling, adjusting, starting, stopping and troubleshooting
- Provide expertise and lead crude treatment facility operational process to ensure smooth and efficient operations
- Communicate with wider Operations Facilities and Engineering teams to address operational related issues and challenges to minimize impact on upstream and downstream processes and contribute to KOC operational performance improvement
- Identify and implement requirements for equipment and systems to carry out handover (preparation) for maintenance and reinstatement after maintenance for the entire facility

- Discuss wellhead, flow line and inlet manifold as well as intermediate casing, tubing head, Christmas tree, flow control and chokes
- Carryout choke selection and sizing, flow-rate calculation, flow test, manifold's configurations and design and selection of gas oil separation plant and surface production facilities
- Illustrate separation and sweetening, stabilization, sweetening and mercaptans removal, heating control loop block diagram and oil and gas separation
- Determine horizontal separator, vertical and spherical separator, selection of horizontal separator, model of a vertical separator and three-phase oil & gas separation
- Employ procedures for sizing horizontal three-phase separator and crude oil desalting and treatment as well as identify the factors to be studied prior selection of oil treatment method
- Determine heat exchangers, produced- water treating systems, produced-water treating equipment and typical produced-water treating system
- Discuss settling tanks and skimmer vessels, vertical skimmer schematic, skimmer sizing equations, process equipment troubleshooting and some of troubleshooting of process equipment
- Employ separators troubleshooting, three general types of control configuration, combination of feedback & feedforward control configuration, maintenance execution and shutdowns best practice
- Identify the four phases of shutdown maintenance, meeting structure, biosecurity control zones and safety critical handover procedure
- Apply flare operation and recognize the typical flows to flare systems, flare system major components and typical flare header system
- Discuss gas compression, types of compressors, emergency shutdown valve on incoming pipeline, induced gas flotation (IGF) and cyclonic separation
- Identify the factors affecting hydro cyclone performance as well as crude oil storage tanks, tank design data and calculations, tank shell testing and tank volume calculation
- Recognize tank accessories, valve types, external piping design, stress analysis, piping & flanges and selection of piping materials
- Determine flanges, bolts, gaskets, valves, piping flexibility, piping layout and insulation
- Classify pump, calculate hydraulic friction loss factor and identify pump head requirements

Who Should Attend

This course provides an advanced overview of crude treatment facilities operation for engineers, supervisors and operators.

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: -

- 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.

- 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

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 Contents

- Wellhead, Flow Line & Inlet Manifold
- Wellhead and Flow Control Equipment - Flowing Wells
- Wellheads
- High-Pressure Wellhead
- Wellhead Equipment
- A Typical Wellhead
- Casing Heads
- Casing Hangers
- Intermediate Casing
- Tubing Head
- Christmas Tree
- Christmas Trees Assembly
- Flow Control
- Chokes
- Types of Chokes
- Adjustable Chokes
- Adjustable Choke Usage
- Factors that Cause Producing Changes
- The Advantage of Using an Adjustable Choke
- Choke Selection and Sizing
- Flow-Rate Calculation

- Quiz 1
- Arrangement and Working of Multiport Flow Selector (MPFS) Valve in Production Manifold
- Field Production Phase
- Flow Test
- Manifold's Configurations
- Electronic Position Fixing (EPF) Devices
- Operational Modes and Capacities for Each Stream, Train and System
- Implementation of Monitoring of Hydrocarbon Pipeline Transportation Facilities
- Oil Receiving Systems
- Oil Processing
- Oil Processing Plant
- Crude Oil Refining Process
- How is Oil Processed?
- Oil Production Process
- Oil Processing Companies
- Oil Extraction Process
- Oil Drilling Process
- Export Systems
- Natural Gas, NGLs, Condensate
- Upstream Oil and Gas Emission Sources
- Production Sources
- Associated Gas Venting
- Dehydrators
- Fugitive Leaks
- Gas-Actuated Pneumatic Pumps
- Heaters
- Hydrocarbon Liquids Loading
- Produced Water Tanks
- Wellhead Compressor Engines
- Gas Export to Booster Stations
- Oil & Gas Industry
- Gas Dilemma
- Gas Problem

- Ideal Gas Equation
- Gas Value
- Gas Monetization
- Gas Transportation Technology
- Pipeline
- Gas Booster Station
- Compressed Natural Gas (CNG)
- CNG Transportation
- Liquified Natural Gas (LNG)
- LNG Process Diagram
- LNG Value Chain
- Gas to Liquid (GTL)
- GTL Definition & History
- GTL Process
- Simplified GTL Block Diagram
- Gas to Wire (GTW)
- Combined Cycle Gas Turbine
- Methane Hydrate
- Gas Sales Agreement (GSA)
- Design and Selection of Gas Oil Separation Plant and Surface Production Facilities
- Typical Oil Production Facility Flow Diagram
- Gas Oil Separation Plant
- Three-Phase Separation with Heating and Desalting
- Three-Phase Separation with Three Delivery Pressure Levels
- HP, High Pressure
- An Efficient Desalting System
- Separation and Sweetening by Cold Stripping with Associated Gas
- Three-phase Separation with Stabilization, Sweetening and Mercaptans Removal
- Heating Control System
- Heating Control Loop Block Diagram
- General Control Loop Block Diagram
- Oil and Gas Separation
- Horizontal Separator (Two-phase)

- Vertical Separator
- Spherical Separator
- Two Barrels Two-phase Separator
- Separator's Internals
- Inlet Diverter
- Separator's Internals – Wave Beaker Plates
- Wire Mesh Mist Eliminator
- Typical Mist Extractor
- Centrifugal Mist Eliminator
- A Coalescing Pack Mist Extractor
- Design & Selection of a Two-phase Horizontal Separator
- Gas Capacity
- Liquid Capacity
- Seam-to-Seam Length & Slenderness Ratio
- Procedure for Sizing Horizontal Separators
- Selection of Horizontal Separator
- Model of a Vertical Separator
- Approximate Shell Length from Liquid Level Height
- Vertical Separator
- Determination of Oil Pad Height
- Vortex Breaker
- Three-phase Oil & Gas Separation
- Quiz 2
- Three-phase Horizontal Separation
- Bucket & Weir Design
- Retention Time
- Settling Equation
- Procedures for Sizing Horizontal Three-phase Separator
- Mist Extractor
- Radial Gas Scrubber
- Vertical Gas Scrubber
- Case Study-1: Sand Separation in Surface Facilities for Heavy and Extra Heavy Oil
- Case Study-1: Selection of a De-sander

- Quiz 3
- Crude Oil Desalting and Treatment
- Crude Oil Desalting
- Quiz 4
- Crude Oil Treatment
- Factors to be Studied Prior Selection of oil Treatment Method
- Vertical Treater
- Heat Exchangers
- Flow Arrangement
- Types of Heat Exchangers
- Double Pipe Heat Exchangers
- Double Pipe Heat Exchanger Applications
- Shell & Tube Heat Exchanger
- Types of Shell & Tube Heat Exchangers
- Shell & Tube Heat Exchanger Applications
- Plate Heat Exchanger
- Plate Heat Exchanger Applications
- Spiral Heat Exchanger
- Spiral Heat Exchanger Applications
- Selection
- Maintenance
- Case Study-3: Shell & Tube Heat Exchanger Steady-State
- Quiz 5
- Produced- Water Treating Systems
- Case Study-4: Waste Water Treatment Plant Case Study
- Produced-Water Treating Equipment
- Typical Produced-Water Treating System
- Treating Equipment
- Settling Tanks and Skimmer Vessels
- Vertical Skimmer Schematic
- Horizontal Skimmer Schematic
- Skimmer Sizing Equations
- Horizontal Cylindrical Vessel One Half Full

- Horizontal Rectangular Cross Section Tank
- Vertical Cylindrical Tank
- Plate Coalescers
- Parallel Plate Interceptor (PPI)
- Corrugated Plate Interceptor (CPI)
- A Typical CPI Pack
- Cross-Flow Devices
- Free-Flow Turbulent Coalescers (SP Packs)
- Skim Tank with SP Packs Installed
- Heavy Oil Treatment Facilities
- Heavy and Extra-Heavy Crude Oils
- Special Treatment Unit
- Quiz 6
- Process Equipment Troubleshooting
- Types of Troubles
- Categories of Troubles
- Five Key Elements Common to the TS Process
- Some of Troubleshooting of Process Equipment
- Separators Troubleshooting
- Effects
- Causes
- Diagnostic Chart for Centrifugal Pump Troubles
- List of Possible Causes
- Case Study – 5: Case Studies of Centrifugal Pumps
- Case Study – 6: Head in Storage Tank
- Process Control
- Variables: The Quantity can be Changed: Classification of the Variables in a Chemical Process Control
- Three General Types of Control Configuration
- Feedback System for Flow Control
- Combination of Feedback & Feedforward Control Configuration
- Feedback System for Pressure Control
- Feedback System for Temperature Control
- Case Study – 7: Level Control Selection

- Maintenance Execution & Shutdowns Best Practice
- The Importance of Maintenance Execution
- Maintenance Execution
- Job Screening
- Scoping
- Planning
- Scheduling
- Execution
- Close-Out
- Workflow
- Maintenance Work-flow
- Maintenance Events – PMs
- Breakdowns
- Corrective Work
- Four Phases of Shutdown Maintenance
- Initiation
- Shutdown Steering Group
- Planning & Preparation
- Shutdown Criteria
- Job List Review
- Gantt Chart Development
- Risk Analysis
- Execution
- Meeting Structure
- Earned Value
- Shutdown Communication
- Close-out
- Post Shutdown Review
- Previously Worked Example
- Crude Treatment Facility Operational Process to Ensure Smooth and Efficient Operations
- Example of an Incident Command Structure
- Biosecurity Control Zones
- Cleaning and Disinfecting Respirators

- Disinfecting Slurry Pits
- Identify and Implement Requirements for Equipment and Systems to Carry out Handover
- Roles and Responsibilities
- Safety Critical Handover Procedure
- Operations Handover Forms & Checklist
- Guidance on Completing Forms & Checklists
- Flare Operation
- Typical Flows to Flare Systems
- Typical Flare System
- Typical Flare Header System
- Hydraulic Design
- Hydraulic Issues
- Knock-Out Drum
- Typical Knock-Out Drum
- Case Study – 8: Repair of a Vertical Knock-Out Drum
- Liquid Seal
- CRU
- Flare System
- Flare System Purge Requirements
- Purge Requirements
- Purge Reduction Devices (Stack Seal)
- Flare Types
- Flare Tip Design
- Single Point Flare
- Air Flare
- Multi-Point Flare
- Enclosed Ground Flare
- Integrated Pilot System
- Pilot Assembly
- Flare System Operational Controls
- Flare System Monitoring Instrumentation
- Flare System Operation Monitoring
- Typical Flare Recovery System

- Flare Recovery System
- Other Flaring Reduction Best Practices
- Flare Operation
- Operation - Weather Effects
- Operational Flow Control
- Factors that can Affect Flame Stability
- Operating Hazards and Limitations
- Flare Maintenance
- Quiz 7
- Review and Verify the Requirements of Crude Treatment Facilities
- What is SOP?
- Who Needs SOP's?
- When do You Use SOP's?
- Where do You Use SOP's?
- Why are SOP's Important?
- How to Write SOP's?
- Flowchart
- Process Description
- SOP Preparation
- SOP's Standard Format for Writing is Divided into Eight Parts
- The Key Factor
- Writing Requirements
- Effective Writing for SOP
- What to Include SOP?
- Facilities Troubleshooting
- Review
- Initial Questions of Troubleshooting
- Laboratory Analysis
- Frequency of Failures based on Type of Equipment
- Important Note: Problem Solving is a Social Process
- 7 Steps Strategy of Troubleshooting
- Engage Yourself or Hook Up
- Advantages of Systematic Approach

- Case Study
- Fault Tree Analysis
- 5 Why's
- What If
- What are Centrifugal Pumps?
- Important Terms
- Minimum Flow
- Capacity
- Centrifugal Pumps TS Rules of Thumb
- Capacity Curve
- Distillation
- Instruments Sensors Faults
- Control Valve Faults
- Rules of Thumb for Furnace Operation
- Furnaces
- Reciprocating Compressor
- 10 Important Troubleshooting Guidelines
- Gas Compression
- Introduction
- Objectives
- Classifications
- Definitions Related to a Compressor
- Types of Compressors
- Reciprocating Compressors
- Two Stages Compressor
- Advantages of Multi-staging
- Intercooling
- Efficiencies for Compressor
- Volumetric Efficiency
- Mechanical Efficiency
- Centrifugal Compressor
- Basic Components
- Understanding natural Gas Compressor Stations

- Inside a Compressor Building
- Compression Station Yard
- Emergency Shutdown Valve on Incoming Pipeline
- Compressor Station
- Case Study – 9: Compressor Station Optimization During Gas Injection into Underground Storage
- Quiz 8
- Induced Gas Flotation (IGF)
- Froth Flotation
- Flotation Chart
- Cyclonic Separation
- Factors Affecting Hydrocyclone Performance
- Corrugated Plate Interceptor
- Parallel Plate Interceptor
- Crude Oil Storage Tanks
- Vertical Fixed Roof Tank
- External Floating Roof Tank
- Contact Deck Internal Floating Roof Tank
- Pressure Tank
- Foundations for Aboveground Tanks
- Tank Design Data & Calculations
- Other Considerations
- Tank Shell Testing
- Tank Volume Calibration
- Tank Accessories – Valves, Instrumentation, Mixers & Appurtenances
- Valves, Instrumentation & Appurtenances Valve Types
- Tank Heaters
- Tank Overfilling Protection
- Sizing of Vertical Tanks
- Case Study – 10: Crude Oil Storage – Sludge Happens Litigation, Asia
- Quiz 9
- KOC Operational Facilities Colour Coding Standards for Different Flow Lines
- KOC Colour Coding Specification
- Scope

- Piping & Flanges Fundamentals
- Piping Fundamentals
- Piping
- Selection of Piping Materials
- Engineering Materials
- Most Commonly Used Materials in Refineries
- Stainless Steels
- Preparation of Standard PMS/VMS
- Flanges
- Types of Flanges
- Material
- Bolts & Gaskets
- Valves
- Piping Flexibility
- Piping Layout
- Insulation
- Materials Used for Insulation
- Case Study – 11: Piping and Distribution
- Quiz 10
- Different Types of Valves used in Piping – A Complete Guide of Pipe Valves
- What is Valve?
- Types of Valves
- Gate Valve
- Globe Valve
- Check Valve
- Plug Valve
- Ball Valve
- Butterfly Valve
- Needle Valve
- Pinch Valve
- Pressure Relief Valve
- Valves Types based on Functions
- Classification of Valves Based on Function

- Based on the End Connection, Valve Ends can be
- Classification of Valves Based on Types of Actuator it Used
- Case Study – 12: New Flow Control Valve Addresses Demanding Oil Well Injection Application
- Filters and Strainers
- Overall Pumps
- Pump
- Pump Classification
- Positive Displacement Pump
- Reciprocating Pump
- Piston Pump (Double Acting)
- Plunger Pump (Single Acting)
- Diaphragm Pump (Single Acting)
- Rotary Pump
- Gear Pump
- Screw Pump
- Lobe Pump
- Dynamic Pump
- Centrifugal Pumps: How do they Work?
- Positive Displacement Characteristics
- Centrifugal Pumps Characteristics
- Pump Head
- Suction Head
- Net Positive Suction Head
- Transfer Pumps and Piping System
- Flow versus Head of a Centrifugal Pump
- Calculations of Hydraulic Friction Loss Factor
- Quiz 11
- Pump Energy: Function in Head & Flow
- Quiz 12
- Correction Factors
- Affinity Laws
- Cavitation in a Centrifugal Pump
- Quiz 13

- NPSH
- Quiz 14
- Design of a Flow Line
- Affecting Factors
- Optimum Flowline Size
- Quiz 15
- Pump Head Requirements
- Effective Characteristic Curve, Two Identical Centrifugal Pumps Operating in Parallel
- Non-Identical Centrifugal Pumps in Parallel
- Non-Identical Centrifugal Pumps in Series
- Operating Point for Two Identical Centrifugal Pumps Operating in Parallel
- Centrifugal Pumps Operating in Series
- Effective Characteristic Curve for Identical Centrifugal Pumps in Series
- Operating Points for Two Identical Centrifugal Pumps in Series
- Non-Identical Positive Displacement Pumps in Parallel
- Positive Displacement Pump Characteristic Curve
- Effect of Doubling Positive Displacement Pump Speed On Pump System Operating Point
- Effect of Characteristic Curve, Two Identical Positive Displacement Pumps Operating in Parallel
- Effect of Bringing Positive Displacement Pump in Line in Parallel with Identical Operating Pump
- Maintenance and Reinstatement After Maintenance for the Entire Facility
- Performance Criteria
- Knowledge and Understanding
- Scope/Range Related to Performance Criteria