COURSE OVERVIEW DE0767
Drilling Fluids and the Circulating System (E-Learning Module)

Course Title
Drilling Fluids and the Circulating System (E-Learning Module)

Course Reference
DE0767

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 up-to-date overview of drilling fluids and the circulating system. It covers the drilling fluid cycle, well schematic, formation damage, corrosion reduction and electrochemical corrosion cell; the types of lost circulation zones, stuck pipe reduction, and differential pressure sticking, pressure losses in a circulating mud system and penetration rates; the characteristics of a drilling fluid and the principal components of drilling fluids; the water base mud, gas drilling fluid, oil-based mud and viscosity; and the behavior and flow performance of drilling fluid including the fundamental properties of drilling fluids.

Further, the course will also discuss the drilling fluids classification and additives, clear fluid systems, density and comparative densities of clear-fluid completion systems; the laboratory compatibility tests, brine formulations, metallurgical factors, packer-fluid treatments and corrosion test; the displacement procedure, applications of DIF systems, filtration tests and applications for air, foam, and aerated mud; the various types aerated fluids and recommended applications; the recommended operating procedures for aerated mud; the corrective procedures and formulations; and the rheological models and hydraulics calculation terms.

During this course, participants will learn the laminar calculation and turbulent flow; the mud handling equipment; the pump configurations, particle size classification, well control, shut-in procedures, kill methods, concurrent method and drill cuttings evaluation; and the sample contamination, percentage composition, limestone classification and porosity descriptions.

Course Objectives

Upon the successful completion of this course, participants will be able to:-

- Apply and gain an in-depth knowledge on drilling fluids and the circulating system
- Recognize drilling fluid cycle, well schematic, formation damage, corrosion reduction and electrochemical corrosion cell
- Identify the types of lost circulation zones, reduce stuck pipe and discuss differential pressure sticking, pressure losses in a circulating mud system and penetration rates
- Describe the characteristics of a drilling fluid and the principal components of drilling fluids
- Discuss water base mud, gas drilling fluid, oil-based mud and viscosity
- Explain the behavior and flow performance of drilling fluid including the fundamental properties of drilling fluids
- Classify drilling fluids and additives, clear fluid systems, density and comparative densities of clear-fluid completion systems
- Apply laboratory compatibility tests, brine formulations, metallurgical factors, packer-fluid treatments and corrosion test
- Carryout displacement procedure, applications of DIF systems, filtration tests and applications for air, foam, and aerated muds
- Recognize the various types aerated fluids and recommended applications
- Employ the recommended operating procedures for aerated mud as well as corrective procedures and formulations
- Illustrate rheological models and define hydraulics calculation terms
- Calculate laminar and turbulent flow and identify mud handling equipment
- Apply pump configurations, particle size classification, well control, shut-in procedures, kill methods, concurrent method and drill cuttings evaluation
- Review sample contamination, percentage composition, limestone classification and porosity descriptions

Who Should Attend

This course covers systematic techniques on drilling fluids and the circulating system for drilling engineers, drilling representatives, drilling fluid engineers, contractor personnel, drilling supervisors, mud engineers, cementing engineers, tool pushers, managers and technical support involved with drilling operations and responsible for the development, planning and application of the drilling fluids program.

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

- Drilling Fluid Overview
- Drilling Fluid Cycle
- Well Schematic
- Additional Benefits
- (Quiz – 1)
- Minimize Formation Damage
- Reduce Corrosion
- Electrochemical Corrosion Cell (Development In A Fatigue Stress Crack)
- Electrochemical Corrosion Cell
- Oxygen Corrosion Cell
- (Quiz – 2)
- (Quiz – 3)
- Minimize Lost Circulation
- Types Of Lost Circulation Zones Found In Soft And Hard Rock Formations
- Reduce Stuck Pipe
- Differential Pressure Sticking
- Pressure Losses In A Circulating Mud System
- Improve Penetration Rates
- (Quiz – 4)

- Reduce Environmental Impact
- Improve Safety
- Characteristics Of A Drilling Fluid
- (Quiz – 5)
- (Quiz – 6)
- Drilling Fluid Composition
- Principal Components Of Drilling Fluids
- Water Base Mud
- Water As A Drilling Fluid (Water Base Mud)
- Water Phase
- Solids Phase
- Active Solids Phase
- Inert Solids
- Oil Base Mud (Obm)
- Gas Drilling Fluid
- Drilling Fluid Selection
- Water Base Mud
- Water Base Mud Consist Of Four Components:
- Type Of Geologic Formation
- The Common Type Of Water Base Mud Used In Drilling
- Spud Mud
- Low Solids Polymer
- Lignosulfonate Muds
- Lime Mud & Gypsum Mud
- Polymer Mud
- Potassium Chloride / Polymer Muds (Kcl)
- Salt Saturated Mud System
- (Quiz – 7)
- (Quiz – 8)
- Oil Based Mud
- Crude Oil
- Diesel Oil
- Low Aromatic Mineral Oil

- Synthetic Oils
- Mud Characteristics
- A–Velocity:
- Fluid Velocity Inside The Pipe:
- Exercise -1
- (Quiz – 9)
- Fluid Velocity Inside The Annulus
- (Quiz – 10)
- B-Density:
- C–Viscosity:
- Viscosity: The Resistance To Flow.
- Low Viscosity:
- High Viscosity:
- Behavior & Flow Performance Of Drilling Fluid
- Fluid Rheology
- Flow Characteristics
- Laminar Flow
- Turbulent Flow
- Fluid Classification
- Newtonian Fluid Is: T= M (Γ)
- Non- Newtonian Fluid:
- A Review Of Rheological Models
- Bingham Plastic Model
- Plastic Viscosity
- Yield Point
- Apparent/ Effective Viscosity
- Gel Strength
- Power Law Model:
- Consistency Index (K)
- Power Index (N)
- Herschel-Bulkley Model (Modified Power Law)
- Fundamental Properties Of Drilling Fluids
- Density

- 2 Filtration Properties
- Solids Content
- Ph Value
- Water Base Mud
- Spud Mud
- Mixing Procedure:
- Formulation
- Salt Water Spud Mud
- Low Solids Polymer Mud
- Formulation
- Example
- Build Up 1000 Bbl
- Lignosulfonate Muds
- Lignosulphonate Formulation
- Fresh Water Lignosulphonate Polymer Mud:
- Chrome Lignite Chrome Lignosulfonate:
- Kcl Polymer Mud
- Characteristics Of The Kcl Mud
- Mixing Procedures
- Maintenance Of Kcl Polymer
- Basic Formulation For Kcl Polymer Mud
- Calculations
- Example
- Salt Saturated Polymer Mud
- Characteristics
- Maintenance
- Treatment
- Un-Weighted Salt Saturated Muds
- Weighted Salt Saturated Muds
- Lime Mud & Gypsum Mud
- Theory Of Calcium Treated Mud
- Effect Of Chemical Upon Pre Hydrate Clay
- Viscosity Effect Of Calcium Muds

- Viscosity Effect Of Treating Different Mud
- Lime Treated Mud
- Method Of Converting To Lime Mud
- Gypsum Treated Mud
- Preparation Of Gypsum Mud
- Low Solids Polymer
- Functions
- Low Solids Non-Dispersed Mud
- Low Solids Polymer
- Product Application Of Drilling Fluids
- Attapulgite
- Barite (Barium Sulfate Used As A Primary Weighing Agent.
- Bentonite Sodium Montmorillonite
- Cal. Carbonate(Ca Co3)
- Hematite (Iron Oxide)
- Guar Gum
- Application
- Drillstab (Asphlat)
- Biopolymer
- Calcipolate
- Pac-R
- Pac-Slv
- Cmc-Hv
- Cmc-Lv
- Xcdpolymer
- Benex
- Polymer
- Starch
- Phpa
- Phpa (Powder)
- Application
- Disperse (Cls)
- Disperse Fcl

- S.A.P.P
- T.S.P.P.
- Caco3 (Fine)
- Caco3 (Medium)
- Nutshell (F.M.C.)
- Nlmica (F.M.C.)
- Fibwood
- Aluminium Stearate
- Calcium Chloride
- Castic Soda
- Lime
- Potassium Chloride
- Potassium Hydroxide
- Soda Ash
- Sodium Bicarbonate
- Sodium Chloride
- Starch Preservative
- Nlhydsulphelem
- Zinc Chloride
- Dd (Drilling Detergent)
- (Carrbo Tec)
- (Carrbo Mul)
- (Carrbo Trol)
- (Carrbo Gel)
- Oilyield
- Oilthin
- Wettagent
- Rheomode
- Pipefree Breaker
- Torque Reducer
- Drilling Fluids
- 1.0 Drilling Fluid Functions
- 2.0 Drilling Fluid Selection

- 3.0 Drilling Fluid Additives
- 3.1 Weighting Materials
- Table 7.1: Materials Used As Densifiers, After Reference
- Barite
- (Quiz – 11)
- 2. Iron Minerals
- Iron Carbonate
- Iron Titanate
- 3. Calcium Carbonates
- 4. Lead Sulphides
- 5. Soluble Salts
- Table 7.2 Maximum Densities Of Single Salt Brines, After Baroid
- 3.2 Viscosifiers
- Table 7.3 Materials Used As Viscosifiers, After Reference 1
- 3.2.1 Clays
- Bentonite
- Attapulgite
- Organophillic Clays 1
- Exercise - 2
- (Quiz – 12)
- 3.2.2 Polymers
- Figure 7.1 Structure Of Polymers
- Types Of Reactive Groups
- Table 7.4 Relation Of A Polymer In A Drilling Fluid And Its Structure
- 3.0 Drilling Fluid Additives
- Starches
- Guar Gum
- Cellulose Derivatives
- Carboxymethylcellulose (Cmc)
- Polyanionic Cellulose 1
- Hydroxyethyl Cellulose
- 3.3 Filtration Control Materials
- 3.4 Rheology Control Materials 1

- 3.5 Alkalinity And Ph Control Materials
- 3.6 Lost Circulation Control Material
- 3.7 Lubricating Material
- 3.8 Shale Stabilizing Materials
- 4.0 Drilling Fluid Types
- 4.1 Water Based Mud
- Inhibited
- Non-Inhibited
- Non-Inhibited - Non-Dispersed
- 4.1.1 Non-Dispersed, Non-Inhibited Mud Systems
- 4.1.2 Dispersed, Non-Inhibited Systems
- 4.1.3 Dispersed Inhibited Systems
- 4.1.4 Non-Dispersed, Inhibited Systems.
- Salt Saturated Mud
- Kc1 Polymer Mud
- Phpa Muds
- 4.2 Completion And Workover Fluids
- 4.0 Drilling Fluid Types
- 4.3 Oil Based Muds
- 4.3.1 Invert Emulsion Oil Mud
- Water
- Wetting Agent
- Organophillic Clay
- Lime
- 4.3.2 Pseudo Oil Based Mud
- Table 7.5 Typical Physical Properties Of Some Base Fluids
- Table 7.6 Guidelines For Logging In Oil Muds
- 4.4 Gas Based Fluids
- 5.0 Drilling Mud Properties
- 5.1 Mud Weight Or Mud Density Unity
- Exercise-3
- Apparatus
- Application

- Additives
- 5.2 Funnel Viscosity
- 5.3 Plastic Viscosity (Pv)
- 5.5 Gel Strengths
- 5.6 Fluid Loss And Filter Cake
- Example Of Filtration Reducers:
- 5.7 Other Basic Mud Tests
- Methyl Blue Test (Mbt)
- Chlorides And Hardness
- Emulsion Test
- Hast
- 6.0 Drilling Fluid Problems
- 6.1 Contaminations
- 6.2 Calcium / Magnesium Contamination
- Treatments
- Anhydrite / Gypsum Contamination
- 6.3 Cement / Lime Contamination
- Excess Lime Can Be Calculated From The Formula:
- Treatment
- 6.4 Sodium Chloride Contamination
- 6.5 Carbonate / Bicarbonate Contamination
- 6.6 Hydrogen Sulphide (H_2S) Contamination
- 6.7 Co_2 Intrusions
- 6.8 Water Flows
- 7.0 Solids Control
- 7.1.2 Particle Classification
- Particle Size
- 7.2 Solids Control Equipment
- 7.2.1 Screen Separation Devices
- 7.2.2 Settling Separation In Non-Stirred Compartments
- 7.2.3 Removal Of Gaseous Contaminants
- 7.2.4 Forced Settling By Centrifugal Devices
- Hydrocyclone

- Desanders
- Desalters
- Mud Cleaners
- Centrifuges
- Classification Of Drilling Fluids And Additives
- Basic System Classifications Functions Of Additives Additional Detailed Information
- Basic System Classifications
- Water-Based Muds (WBM)
- Oil-Based Muds (OBM)
- Completion Fluids
- Hpht Specialty Fluids
- Drill-In Fluids (DiF)
- Synthetic Based Muds (SBM)
- Wellbore Clean-Up Additives
- Air, Mist, Foam And Gas
- Foam
- Aerated Fluids
- Functions Of Additives
- Additional Detailed Information
- Completion Fluids- Overview Clear-Fluid Systems Solids-Enhanced Fluids Contaminants Handling And Transporting Fluids
- Clear Fluid Systems
- Monovalent And Divalent Solutions
- Monovalent Solution
- Divalent Solution
- Selection Criteria For Clear Fluid
- Density
- Comparative Densities Of Clear-Fluid Completion Systems
- Crystallization Point
- Eutectic Point
- Brine/Formation Water Incompatibility
- Laboratory Compatibility Tests
- Corrosion

- Brine Formulations
- Solids-Enhanced Fluids
- Typical Solids-Enhanced Fluid
- Contaminants
- Corrosion
- Corrosion Overview
- Temperature
- Velocity
- Solids
- Metallurgical Factors
- Corrosive Agents
- Corrosion Categories
- Drilling Fluid Corrosive Agents
- Packer-Fluid Treatments
- Corrosivity Of Completion W/O Fluids
- Corrosion Test
- Displacement- Displacement Overview, Displacement Procedure, Spacer Recommendations And Formulations
- Displacement
- Displacement Procedure
- Drill-In Fluids (Dif)- Overview Drill-In Fluid Systems Available Dif Systems
- Overview Drill-In Fluid Systems
- Applications Of Dif Systems
- Bridging-Off Is The Key
- Correct Particle Size Is Important
- Filtration Tests
- Available Dif Systems
- Field Tests- Overview Field Testing Listing Of Field Tests
- Overview Field Testing
- Listing Of Field Tests
- Foam And Aerated Fluids
- Applications For Air, Foam, And Aerated Muds
- Types Aerated Fluids And Recommended Applications
- Air Drilling

- Foam Drilling
- Determining Air And Fluid Volumes
- Exercise - 4
- Controlling The Foam Drilling Fluid
- Conditions For Effective Drilling
- Aerated Mud
- Equipment Required For Aerated Mud Drilling
- Recommended Operating Procedures For Aerated Mud
- When Using Aerated Mud Systems:
- Recommended Operating Procedures For Aerated Mud
- Determining Hydrostatic Loss Caused By Gas-Cut Mud
- Corrosion
- Lost Circulation
- Overview Lost Circulation
- Formations In Which Circulation May Be Lost
- Corrective Procedures And Formulations
- Locating The Loss Zone
- Cavernous / Vugular Formation
- Permeable Or Fractured Formations
- Gunk Mixture For Wb Muds
- Crosslinkable Lcm Pill
- High-Filtration Squeeze For Wb Mud
- Diaseal M
- Locating The Loss Zone
- Oil-Based Muds
- Overview
- Oil-Based Mud (Obm) Systems
- Baroid Ob Drilling Fluids
- Mi Ob Drilling Fluids
- Inteq Ob Drilling Fluids
- Mud Management
- Logging In Obm
- Guidelines For Logging In Obm

- Special Applications
- Packer Fluids And Casing Packs
- Arctic Casing Packs
- Product Usage Information
- Rheology And Hydraulics
- Rheological Terms
- Flow Regimes
- Fluid Types
- Newtonian
- Non-Newtonian
- Rheological Models
- Hydraulics Calculation Terms
- Fluid Hydraulics Equations
- Pump And Circulating Information
- Bit Hydraulics
- Calculations For Laminar And Turbulent Flow
- Equivalent Circulating Density Hole Cleaning Calculations
- Mud Pumps
- Duplex Pdp & Triplex Pdp
- Solids Removal
- Solid Control Equipment
- Shale Shakers
- Degasser
- Mud Cleaners
- Treatment And Mixing Equipment
- Drilling Fluid Roles
- Drilling Fluid Circulation
- Swivel
- Drilling Fluid In Wellbore
- Drilling Fluid At Surface
- At Surface
- Process Of Mud Circulation
- The Tanks

- Mixing And Suction Tanks
- Mud Handling Equipment
- Reciprocating Positive Displacement Pumps Vs. Centrifugal Pumps
- Positive Displacement Pumps Compartments
- Pump Configurations
- Affecting Parameters On Flow Rate
- Types Of The Positive Displacement Pumps
-
- Double Acting (Duplex) Design
- Example 1.3
- Solution
- Recall
- Single-Acting (Triplex) Design
- Example: Pump Factor For Triplex Pump
- Example: Pump Rate
- Exercise – 5:
- Centrifugal Pumps
- Duplex Vs. Triplex Pumps
- Duplex Pumps
- Triplex Pumps
- Pump Liners
- The Pump Factor
- Volumetric Efficiency
- Pump Flow Rate
- Pump Operating Pressure
- Pump Power
- Pump Factor & Hydraulic Power
- Surge Dampeners
- Schematic Of A Typical Surge Dampener
- Aim Of The Solids Removal System
- Solids In Drilling Fluids Classification: Based On Specific Gravity,)Or Density)
- Solids In Drilling Fluids Classification: Based On Particle Size
- Particle Size Classification

- Solids Control Equipment
- Complete Mud Removal System With Mud Cleaner And Centrifuge
- A Typical Solids Control System
- Linear Shale Shaker
- Shale Shaker Mechanism
- The Procedure
- Types Of Shaker Operation
- Sample Of Shale Shakers
- Settling Separation In Non-Stirred Compartments
- Degassers
- Removal Of Gaseous Contaminants
- Vacuum Degasser
- A Typical Degasser Diagram A Vacuum Chamber Degasser)
- Forced Settling By Centrifugal Devices
- The Process Of The Hydrocyclones (Desanders And Desilters) Desanders
- The Desander
- Desilters
- Solid Control Equipment
- Particle Size Classification
- Decanting Centrifuge
- Internal View Of A Centrifuge
- Mud Cleaners
- Mud Cleaner Schematic
- Hydrocyclones
- Principle Of The Mud Cleaner
- Drilling Fluid Components
- Mixing Equipment
- Drilling Fluids Physical Properties Blenders
- Mud Agitator
- Sample Of Mud Agitator
- Mud Guns
- Mixing Hopper
- Specialized Tests

- Overview
- List Of Specialized Tests
- Test Equipment, Procedures, And Results
- Stuck Pipe
- Overview
- Differential Sticking
- Determining Depth To Stuck Zone
- Packing Off
- Undergauge Hole
- Keyseating
- Freeing Stuck Pipe
- Synthetic Based Muds (Sbm)
- Classification Of Sbm Systems
- Sbm Systems Overview
- Commercial Sbm Systems
- Baroid Sbm Systems
- Mi Sbm Systems
- Inteq Sbm Systems
- Logging Through Sbm
- Logging Through Sbm (Ester-Based)
- Tables-Charts-Calculations
- Overview
- Formulas For Adjusting Drilling Fluid Properties
- Formulas For Calculating Area And Volume
- Dimensions
- Chemical Properties
- Physical Properties
- Specific Materials
- Metric And Standard Conversion Factors
- Troubleshooting
- Completion/Workover Fluids
- Foam/Aerated Drilling Fluids
- Oil-Based Muds

- Synthetic-Based Muds
- Water-Based Muds
- Water-Based Drilling Fluids
- Water –Based Mud (Wbm)Systems
- High Performance Water –Based Muds (Hpwm)
- Design Criteria For Hpwbm
- Weaknesses Of No-Solids, Non-Dispersed Polymer Fluids
- Ideal Properties Of Hpwbm
- Composition Of Baroid Hpwbm
- Attributes of Flocculant-Encapsulator
- Effect of Solids On Rop
- Particle Size Distribution
- Solids Content Comparison
- Filtercake Quality
- HPHT Cake Quality Comparison
- Comparison HPWBM Vs Invert OBM
- Polymers for Specific Clay Inhibition
- Testing of Clay-Sync® Inhibitor For The Hydro-Guard® System
- Inhibition of the Hydro-Guard® System
- Polymer Bonding Creates Water Barrier
- Linear Swellmeter Testing (LST)
- HPWBM Technical Applications
- Summary
- HPWBM are Non-Damaging
- New Inhibitive Polymers
- Low Colloidal Content Through Flocculation
- Well Control
- Overview
- Kicks
- Shut-In Procedures
- Kill Methods
- Kick Control Problems
- Concurrent Method

- Drill Cuttings Evaluation
- Overview Drill Cuttings Evaluation
- Cuttings Description Format
- Clastic Rocks
- Carbonate Rocks
- Chemical Rocks
- Carbonaceous Rocks
- Igneous Rocks
- Metamorphic Rocks
- Sample Contamination
- Particle Shape
- Percentage Composition
- Limestone Classification
- Porosity Descriptions
- Clastic Rocks
- Carbonate Rocks
- Chemical Rocks
- Carbonaceous Rocks
- Igneous Rocks
- Igneous Rock Descriptions
- Metamorphic Rocks
- Metamorphic Rock Descriptions
- Sample Contamination