COURSE OVERVIEW DE0815-4D
Water Injection Technology
Water Flooding A-Z

Course Title
Water Injection Technology: *Water Flooding A-Z*

Course Reference
DE0815-4D

Course Duration/Credits
Four days/2.4 CEUs/24 PDHs

Course Date/Venue

Session(s)	Date	Venue
1	March 04-07, 2024	Club B Meeting Room, Ramada Plaza by Wyndham Istanbul City Center, Istanbul, Turkey
2	June 24-27, 2024	Jubail Hall, Signature Al Khobar Hotel, Al Khobar, KSA
3	September 16-19, 2024	Boardroom 1, Elite Byblos Hotel Al Barsha, Sheikh Zayed Road, Dubai, UAE
4	December 16-19, 2024	Ajman Meeting Room, Grand Millennium Al Wahda Hotel, Abu Dhabi, UAE

Course Description

This practical and highly-interactive course includes real-life case studies where participants will be engaged in a series of interactive small groups and class workshops

The objective of oil producing companies is to maximize oil recovery from any given reservoir. To achieve the stated objective, the reservoir engineers do not rely only on primary (natural) energy, but also on artificial energy which gives rise to what we call secondary and tertiary methods of oil recovery.

Water flooding is one of the secondary methods of oil recovery. It involves injecting clean, non-corrosive water into the reservoir to displace the remaining oil. This course is primarily on the mechanics of oil recovery by water flooding.

The aim of this course is to provide the participants with a complete and up-to-date overview of the area of Water Flooding. Upon the successful completion of this course, the participant should have a solid grounding in the understanding of the purpose, operation and inspection of water injection systems for enhanced oil recovery. The course will illustrate potential problems and their resolution.

Course Objectives

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

- Apply and gain an in-depth knowledge on water injection technology and determine the water flooding process from "A" to "Z" as a major method of enhanced oil recovery (EOR)
- Recognize the various elements of reservoir drive mechanisms and producing characteristics
- Employ the methods pertaining to water flood performance efficiencies and discuss the design aspects of water injection system
- Distinguish the influence of the reservoir and fluid characteristics on injection process and determine the relation between reservoir engineering data and injected water
- Evaluate the different effects of the recovery factor and reserves as well as explain the aspects of water injection systems according to water source by identifying the various matching reservoir requirements
- Explain the functions of water injection systems through filters and deaeration and identify the various types of filters
- Detail the different qualities of seawater corrosion and distinguish the relationship of microbiological growth and corrosion in line with the structure and growth of diatoms, bacteria and algae
- Apply the several tests used to evaluate water quality including process of collecting samples, transport of samples and test frequencies for particle counts
- Use the different types of water treatment chemicals including chlorine, bentonite and polyelectrolyte
- Discuss the thermal methods of EOR including hot water and steam injection and get important tips of the polymer injection process
- Implement the process of pigging and cleaning of pipelines as well as list the various types of pigs

Who Should Attend

This course provides an overview of all significant aspects and considerations of water injection technology and water flooding for reservoir and production engineers, technical staff and geoscientists with interest in improved oil recovery by water flooding. Basic knowledge of reservoir engineering concepts is recommended. Further, the course is recommended for all engineers and technical staff (superintendents, supervisors & foremen) whose responsibilities include the safe and cost-effective operation of water injection systems. Management will also benefit by increasing their awareness of the cost-effective use of treatment chemicals and by developing their skills in analysis of water quality data. Furthermore, this course is suitable for corrosion personnel, W.I. personnel, lab personnel, chemists and chemical engineers.

Accommodation

Accommodation is not included in the course fees. However, any accommodation required can be arranged at the time of booking.

Course Certificate(s)

Internationally recognized certificates will be issued to all participants of the course who completed a minimum of 80% of the total tuition hours.

Certificate Accreditations

Certificates are accredited by the following international accreditation organizations: -

- The International Accreditors for Continuing Education and Training (IACET - USA)

  Haward Technology is an Authorized Training Provider by the International Accreditors 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 2018-1 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 2018-1 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 Accreditors 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 **2.4 CEUs** (Continuing Education Units) or **24 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 Instructor(s)

This course will be conducted by the following instructor(s). However, we have the right to change the course instructor(s) prior to the course date and inform participants accordingly:

Dr. Mahmoud Aly, PhD, MSc, BSc, is a **Senior Process & Petroleum Engineer** with over **15 years** of extensive experience in **Process** and **Petroleum Engineering** within **Offshore** & **Onshore Oil/Gas** industry. His international experience covers **Australia**, **Europe**, **Africa** and the **Middle East**.

Dr. Mahmoud's extensive experience covers **Oil/Gas Surface** and **Sub-surface Production Facilities** within **upstream Offshore** & **Onshore** Fields. He is an expert in **Artificial Lifts**, **Water Injection Treatment**, **Water Treatment Technology**, **Production Operations** (**Oil & Gas**), **Petroleum Processing**, **Hydrocarbon Phase Behaviour**, **Enhanced Oil Recovery** (**EOR**), **Process Troubleshooting**, **Gas Processing & Conditioning**, **Gas Plant Safety**, **Well Drilling**, **Well Completion & Testing**, **Well Control & Workover** and **Environmental Risk Assessment** related to **Oil/Gas Production**.

Dr. Mahmoud has **PhD**, **Master** and **Bachelor** degrees in **Petroleum** & **Process Engineering** from the **Curtin University of Technology** (**Australia**) and he has numerous papers, articles and seminars in Petroleum & Process engineering. Further, he is a **Certified Instructor/Trainer** and an active member of Society of Petroleum Engineers (**SPE**).

Training Methodology

All our Courses are including **Hands-on Practical Sessions** using equipment, State-of-the-Art Simulators, Drawings, Case Studies, Videos and Exercises. The courses include the following training methodologies as a percentage of the total tuition hours:-

30% Lectures
20% Practical Workshops & Work Presentations
30% Hands-on Practical Exercises & Case Studies
20% Simulators (Hardware & Software) & Videos

In an unlikely event, the course instructor may modify the above training methodology before or during the course for technical reasons.

Course Fee

Istanbul	**US$ 7,250** per Delegate + **VAT**. This rate includes Participants Pack (Folder, Manual, Hand-outs, etc.), buffet lunch, coffee/tea on arrival, morning & afternoon of each day.
Al Khobar	**US$ 6,750** per Delegate + **VAT**. This rate includes H-STK® (Haward Smart Training Kit), buffet lunch, coffee/tea on arrival, morning & afternoon of each day.
Dubai	**US$ 6,750** per Delegate + **VAT**. This rate includes H-STK® (Haward Smart Training Kit), buffet lunch, coffee/tea on arrival, morning & afternoon of each day.
Abu Dhabi	**US$ 6,750** per Delegate + **VAT**. This rate includes H-STK® (Haward Smart Training Kit), buffet lunch, coffee/tea on arrival, morning & afternoon of each day

Course Program

The following program is planned for this course. However, the course instructor(s) may modify this program before or during the course for technical reasons with no prior notice to participants. Nevertheless, the course objectives will always be met:

Day 1

0730 – 0800	*Registration & Coffee*
0800 – 0815	*Welcome & Introduction*
0815 – 0830	***PRE-TEST***
0830 – 0930	***Reservoir Drive Mechanisms & Producing Characteristics: Introduction***
0930 – 0945	*Break*
0945 – 1015	***Enhanced Oil Recovery - Preamble*** *Types of Reservoirs: Limestone and Sandstone ● Function of EOR: Pressure Maintenance and Displacement ● Options Available: Gas Injection and Re-Injection (Including Carbon Dioxide), Water, Polymer, Microbial*
1015 – 1045	***Enhanced Oil Recovery - Injectivity*** *Injectivity Requirements and Limitations ● Breakthrough ● Fracturing ● Loss of Injectivity ● Scale Formation ● Prevention of Scale Formation ● Recovering Injectivity By Acid Treatments*
1045 – 1115	***Describing Water Flooding*** *Definition. Objectives ● Candidates ● Patterns ● Factors Affecting Pattern Selection ● Well Spacing ● Oil, Water, and Gas Saturations ● Fractional Flow ● Performance Measures ● Practices and Problems ● Reservoir Monitoring*
1115 – 1215	***Waterflood Performance Efficiencies***
1215 – 1230	*Break*
1230 – 1300	***Design Aspects of Water Injection System***
1300 - 1330	***The Influence of the Reservoir Characteristics on Injection Process***
1330 – 1420	***The Influence of the Fluid Characteristics on the Injection Process***
1420 - 1430	***Recap*** *Using this Course Overview, the Instructor(s) will Brief Participants about the Topics that were Discussed Today & Advise Them of the Topics to be Discussed Tomorrow*
1430	*Lunch & End of Day One*

Day 2

0730 – 0800	***Relation Between Reservoir Engineering Data & Injected Water***
0800 – 0830	***Reservoir Management Concepts & Water Injection Projects***
0830 – 0930	***Waterflood Monitoring & Management***
0930 – 0945	*Break*
0945 – 1015	***Effects of Water Injection on the Recovery Factor& Reserves***
1015 – 1100	***Water Injection Systems – Water Source*** *Water Source: Produced Water, Aquifers & Seawater ● Nature & Composition of Waters & Seawater ● Matching Reservoir Requirements ● Water Compatibilities & Scale*
1100 – 1215	***Water Injection Systems – Basic Water Treatment*** *Basic Seawater Treatment: Filtration & Deaeration ● Water Depth Selection ● Prevention of Macrofouling ● Winning Pumps ● Chlorination*
1215 – 1230	*Break*

1230 – 1330	***Water Injection Systems - Filters & Deaeration*** *Types of Filters: Cartridge, Gravity, Upflow, Mixed Media, Rotating Drum ● Filter Aids: Ferric Salts, Bentonite, Polyelectrolytes ● Chlorination & Upfilter Biocide Treatments ● Deaeration: Gas Stripping & Mechanical Vacuum Deaeration ● Chemical Scavengers & Catalysts ● Effect of Temperature ● Interaction of Chlorine & Scavenger ● Bacterial Growth Through Plant Chlorination ● Biocide Treatment ● Types of Biocide ● Variations in Biocide Use ● Interaction of Scavenger & Biocide*
1330 - 1420	***Seawater Corrosion*** *Corrosiveness of Seawater ● Typical Corrosion Rates ● Oxygen Corrosion ● Effect of Flow ● Effect of Temperature When Seawater Used as Primary Coolant ● Winning Pumps ● Annular Restrictions Around Winning Pumps ● Flow Tubing: Mortar Lined Carbon Steel, Duplex Stainless Steels, Titanium, Copper Nickel Alloys, Non-Metallic Materials ● Filter Containers & Coatings ● Deaeration Towers & Coatings ● Downstream Flowline Systems. Injection Tubing*
1420 - 1430	***Recap*** *Using this Course Overview, the Instructor(s) will Brief Participants about the Topics that were Discussed Today & Advise Them of the Topics to be Discussed Tomorrow*
1430	*Lunch & End of Day Two*

Day 3

0730 – 0800	***Buried & Subsea Pipelines*** *Soil Corrosiveness ● Enhanced Corrosion Around Water Pipelines ● Seawater Corrosiveness ● Seabed Sediment Corrosiveness ● External Coatings & Cathodic Protection to Prevent Corrosion ● Coating & CP Interactions ● External Damage to Pipelines ● Internal Coating of Pipelines ● Refurbishment of Pipelines ● Repair of Pipelines ● Replacement of Pipelines*
0800 – 0830	***Microbiological Growth & Corrosion*** *Structure & Growth of Diatoms, Bacteria & Algae ● Growth Requirements ● Interactions Between Organisms ● Microbiological Corrosion ● Sessile & Planktonic Bacteria ● Biofouling inFilers, Deaerators, Flowlines ● Injectivity Loss ● Reservoir Souring*
0830 – 0930	***Water Quality*** *Quality Issues & Associated Risk ● Intake Water ● Measuring Particle Counts ● Millipore Filtration ● Post-Filtration Water Quality ● Residual Chlorine After Filtration ● Residual Oxygen After Deaeration ● Residual Scavenger ● Water Quality At Receiving Wells ● Effect of Injection Water Quality On Injectivity ● Total Iron & Corrosion ● Millipore Filtration At The Injection Wells ● Calculating Volumes & Quantities*
0930 – 0945	*Break*
0945 – 1015	***Steam & Hot Water Injection***
1015 – 1100	***Hot Water & Thermal EOR***
1100 – 1215	***Characteristics of Steam Injection***

1215 – 1230	Break
1230 – 1420	***Tests Used to Evaluate Water Quality*** *Lab Tests and Field Tests ● Test Point ● Collecting Samples ● Transport of Samples Test Frequencies for Particle Counts, Filtration Efficiency, Millipore Filtration Tests, Chlorine, Oxygen, Residual Oxygen Scavenger, Total Iron ● Treatment Issues: Residual Biocide, Hydrogen Sulphide, Sulphate-Reducing Bacteria (SRB), General Aerobic Bacteria (GAB), pH*
1420 - 1430	***Recap*** *Using this Course Overview, the Instructor(s) will Brief Participants about the Topics that were Discussed Today and Advise Them of the Topics to be Discussed Tomorrow*
1430	Lunch & End of Day Three

Day 4

0730 – 0800	***Water Treatment Chemicals Used in Water Injection Systems*** *Chlorine ● Bentonite ● Polyelectrolyte ● Filter Aids ● Scavenger ● Biocides ● Selection of Biocides: Time to Kill, Field Tests*
0800 – 0830	***Using Surfactant Solutions to Improve Water Characteristics (Improve Oil Recovery)***
0830 – 0930	***Why Polymers are Added to Water?***
0930 – 0945	Break
0945 – 1100	***Effects of Salinity on the Surfactants & Polymers Behavior***
1100 – 1130	***Inspection of Facilities*** *Using Iron Counts to Evaluate Corrosion ● Effects of Flow ● Areas of Corrosion ● Typical Corrosion Patterns ● Weld Decay ● Ultrasonic Testing ● X-Radiography ● Internally Coated Vessels and Lines ● Endoscopes ● Visual Inspection ● Inspection Frequency*
1130 – 1230	***Pigging & Cleaning of Pipelines*** *Identifying the Need to Pig ● Types of Pigs ● Risks Involved ● Pig Alerts ● Frequency of Pigging and Effectiveness ● Cleaning of Pipelines ● Measuring Effectiveness ● Intelligent Pigging ● Evaluation of Data*
1230 – 1245	Break
1245 - 1315	***Economics of Water Flooding***
1315 – 1345	***Case Studies***
1345 - 1400	***Course Conclusion*** *Using this Course Overview, the Instructor(s) will Brief Participants about the Course Topics that were Covered During the Course*
1400 – 1415	***POST-TEST***
1415 – 1430	Presentation of Course Certificates
1430	Lunch & End of Course

Practical Sessions

This practical and highly-interactive course includes the real-life case studies and exercises:-

Course Coordinator

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