

## Waterflooding: Performance Predictions and Surveillance

**Course Duration** : 5 days

**Date** : 08-Sep-2025 to 12-Sep-2025

**Location** : Amsterdam

**Type of Participant** : This course is intended for reservoir, production, and petroleum engineers, as well as geoscientists, asset managers, and technical staff involved in the planning, execution, and optimization of waterflooding projects, particularly those working on mature fields or secondary recovery operations.

### Summary:

This course provides a comprehensive understanding of the technical principles and practical methods used in waterflooding, with a focus on performance prediction and surveillance. Participants will explore the factors that control recovery efficiency, including reservoir properties, flood patterns, and injection strategies. Through detailed discussions on fluid displacement mechanisms, sweep efficiency, and reservoir heterogeneity, attendees will learn how to design, evaluate, and optimize waterflood operations. The course also covers key surveillance techniques and diagnostic tools to monitor flood performance and identify underperforming patterns.

### Objective:

By the end of this course, participants will be able to:

- Understand the key factors influencing waterflood recovery efficiency
- Review and apply core reservoir rock and fluid flow properties to waterflood design
- Accurately estimate oil in place and its role in waterflood planning
- Explain the mechanism of immiscible fluid displacement and its impact on



sweep

- Evaluate various flood patterns and their effect on areal sweep efficiency
- Determine appropriate injection rates and pressures for effective pressure maintenance
- Assess the impact of reservoir heterogeneity on waterflood performance
- Predict waterflood outcomes using analytical and empirical techniques
- Apply surveillance tools such as Hall plots, VRR analysis, and water cut monitoring
- Diagnose waterflood performance issues and recommend optimization actions
- Interpret real field data and case studies to apply best practices in ongoing projects

## Contents:

### 1. Introduction to Waterflooding

- Overview and objectives of waterflooding
- Role of waterflooding in secondary oil recovery
- Benefits and limitations

### 2. Factors Controlling Waterflood Recovery

- Key drivers of waterflood effectiveness
- Impact of reservoir conditions on recovery efficiency
- Interaction of fluid and rock properties

### 3. Review of Rock Properties and Fluid Flow

- Porosity, permeability, and heterogeneity
- Relative permeability and capillary pressure



- Fluid properties affecting water injection and oil displacement

#### 4. Determination of Oil in Place (OOIP)

- Volumetric method
- Material balance method
- Importance of accurate OOIP estimation in flood design and prediction

#### 5. Mechanism of Immiscible Fluid Displacement

- Buckley-Leverett theory
- Displacement and sweep efficiency
- Mobility ratio and front stability

#### 6. Flood Patterns and Areal Sweep Efficiency

- Regular vs. irregular waterflood patterns (five-spot, nine-spot, line drive, etc.)
- Pattern selection and optimization
- Impact on areal and vertical sweep

#### 7. Injection Rates and Pressures

- Injection design and well injectivity
- Pressure maintenance vs. over-injection risks
- Voidage replacement ratio (VRR) considerations



## 8. Effect of Reservoir Heterogeneity

- Layering, permeability contrast, and thief zones
- Impact on sweep efficiency and breakthrough timing
- Approaches to improve conformance

## 9. Waterflood Performance Prediction

- Analytical methods: Dykstra-Parsons, fractional flow analysis
- Empirical decline curve methods
- Overview of reservoir simulation for forecasting
- Recovery factor estimation

## 10. Waterflood Surveillance and Diagnostics

- Key performance indicators (KPIs): WOR, BHP, VRR
- Tools and techniques: Hall plots, injectivity index, water cut analysis
- Pattern balancing and flood conformance monitoring
- Early detection of underperformance

