Water Shut-Off and Conformance Improvement Technologies

Course Price

£3050

Course Description

Approximately 20 billion barrels of water are reinjected in the US every year. Any technology that minimizes the amount of water or gas produced in conjunction with the produced oil would have a significant impact on the energy consumption and on the cost of oil production. There are many factors, such as the presence of thief zones or high permeability zones, fractures and water coning which lead to an increase in water production. In an attempt to block out the undesired water production and increase the volumetric sweep efficiency of on-going waterfloods, the industry has used crosslinked polymer gels. The process involves strategically injecting a Gelling fluid into water coning well or into a high permeability watered out zone, restricting flow in that zone and redirecting water flow into the lower permeability unswept oil zones. Thus water shut off and conformance-control treatments can be used to generate relatively large volumes of incremental oil production with low costs and selectively, targeted small volume treatments, which extends the economic lives of marginal and mature wells.

Course Objectives

• Review and study of the RESERVOIR ROCK AND FLUID PROPERTIES

• Review and study of OIL DISPLACEMENT BY WATERFLOODING

• Review and Analysis of the KEY FACTORS IN THE WATERFLOODING PROCESS

• The Gelling System as a predominant method of blocking permeability and redistributing water drive
  o Field Applications of Polymer Gel Systems,
  o Polymer gel selection
• Study of proper identification of the water-production mechanism,
• Study and analysis of appropriate selection of wells.
• Selection of the water control agent,
• Methods of water control agent placement and treatment design
• A diagnostic and Solutions of water production problem based on qualitative analysis of reservoir characteristics, production data and well test results.
• Moreover, the usual technique to optimize single well treatments.
• What experience has taught us?
• What are the latest advance and what is coming and needed.
Who Should Attend

Reservoir and Production Engineers, Chemical Engineers, Mechanical Engineers, Geologists, Field operations Technical personnel.

Course Content

Reservoir Rock And Fluid Properties

- Oil Displacement By Waterflooding
- Flow Injection-well Patterns
- Vertical Efficiency
- Areal Efficiency
- Volumetric Efficiency
- Swept Efficiency
  - Key Factor Factors In The Waterflooding Process
  - Reservoir Deep
  - Wells Location
  - Rock and Fluid Properties
  - Mobility Ratio
  - Injection Rate
  - Dipping
  - Reservoir Heterogeneities
  - Spacing Effect in a waterflood design
  - When to start Injection

- Produced-Injection Water Treatment (Optional)

Reservoir Conformance and Profile Modification

- Definition of Conformance.
- Illustration of Conformance and Conformance Problems.
- Conformance and the Rate of Oil Recovery.
- Excessive Water Production as a Conformance Problem.
- Definition of Sweep Improvement and Profile Modification

The Water Cycle in the Oilfield Operations

- Oil Fields Water STATS
- Good and less-attractive Problems for WSO Jobs
- Near Well Treatment matrix problems with crossflow
- Love/Hate with Fractures Conformance Problems
- Practical and Cost Effective Conformance Problems Identification
- Cost of Handling Water for Surface Processing, Well Producers, Well Injectors
- Evaluation of the concept of ‘Good » water and ‘Bad' Water
- The detection and use of ‘Good Water'
• The detection of ‘Bad » water its diagnostics and Solutions
1. ‘Bad’ Water: Transition Zones in Reservoirs with Aquifer
2. ‘Bad’ Water: Transition Zones in Reservoirs with Aquifer
3. ‘Bad’ Water: Fractures and Faults – Horizontal Flow
4. ‘Bad’ Water: Coning and Cusping
5. ‘Bad’ Water: Poor Areal Sweep
6. ‘Bad’ Water: Gravity Segregated Layer
7. ‘Bad’ Water: Watered-out Layer with Crossflow
8. What attractive problems are attractive to treat with Polymer Gels

Introduction to Polymer Gels

• Polymer Gels
• CC/AP Gels
• Aqueous Gels
• CC/AP Shutoff Treatments en Carbonates and Sandstone
• CC/AP Gels Technologies
• Other Polymer Gels
• Illustrative Field Applications
• Marathon CC/AP Gel WSO Treatments
• Benefits of Polymer Gels
• Polymer Gel WSO Treatment Design Parameter and Considerations
• Successful WSO Treatment Requirements
• Diagnostic Testing Especially useful for WSO Gel Treatment
• Fracture vs Matrix Conformance Problems
• Types of high-permeability Anomalies
• Limits, Constraints and Pitfalls
• RISKS: Improperly Designed or Executed WSO Jobs
• Success Rate for Gel WSO Jobs
• Gel Complement Cement
• DPR/PRM and SPB
• Polymer Treatment for Disproportionate Permeability Reduction to water.
• Relative Permeability Modification
• Issues and potential concerns with DPR WSO Treatment
• Thermal Fracturing in Injection Wells
• Critical Oil Rate for Water Coning in a Vertical Well Calculation
• Diagnostic Methods
  a. Economic Recovery Plot: Water-Oil Ratio (WOR) vs Recovery
  b. Identification of ‘Bad’ Water: Production History Plot
  c. Identification of ‘Bad’ Water: Production Decline Plot
  d. WOR Diagnosis Plot: Water Breakthrough
• Types of Treatments in Water Control and its effectiveness:
  o Category A: “Conventional” Treatments Normally Are an Effective Choice
  o Category B: Treatments with Gelants Normally Are an Effective Choice
  o Category C: Treatments with Preformed Gels Are an Effective Choice
  o Category D: Difficult Problems Where Gel Treatments Should Not Be Used
• Strategy for Attacking Excess Water Production
• General Discussion on all types of Water Control Methods:
  o Physical, chemical & polymer gel applications
• Candidate well selection
  o Commonly Used and How to Select the More Suitable One for a Particular Application
• Basic Requirements of a Gel System
• How Gels are Formed and Rated for Strength, Stability and Durability,

**What Experience Has Taught Us**

  o Historical Trends
  o Good Production Well Candidates
  o Types of Problems that are attractive to treat with Polymer Gels
  o Type of Fluid Selection and the Volume are critical
  o Quality Control Influence success rate
  o Polymer Dissolution regarding field Preparation of WSO Polymer Gels
  o Limitation, Constraints and Pitfalls
  o Gel Complement Cement

Selected Field Applications Example of Conformance –Improvement Techniques
  o Daqing Oil Field Polymer Flood.
  o Gel Injection-Well Fracture-Problem Treatments for Improving Sweep

**Latest Advance and what is coming and needed**

• Strong Gels
• Solid Additions
• Better, More cost effective and more operationally friendly identification of conformance and excessive water Problems
• Effective Exploitation of the gel DPR
• Greener Gel Technologies

Overall Analytical Review Of The Material Covered In The Course, Discussion And Conclusions.

**CPD Unit**

**Continuing Professional Development**

**35 HOURS CPD**