Waterflooding: From Conventional to Low Salinity Water Injection.

Course Description

Waterflooding is the most implemented and lowest cost method of secondary recovery. The majority of secondary recovery come from water injection processes. Average recovery factor (RF) by waterflooding is around 30%. Nonetheless, to reach a reasonable RF in any particular case needs a good understanding of the reservoir heterogeneities distribution and fluid properties variations as well as a thoughtfully implementation.

Waterflooding (WF) is a continuous optimization process that includes not only the vertical and areal sweep efficiency improvements, but also production cost reduction and net present value maximization. This training intends to covers key elements of a waterflooding process from source water selection to produced water disposal.

The theoretical aspects of the low salinity waterflooding will also be covered to signify its importance to improve the conventional waterflooding. Participants will also gain knowledge and skills which help them to identify typical waterflooding production problems and propose mitigation action for WF performance improvement.

Several case studies will be reviewed and discussed to understand the best practices and lesson learned related to waterflooding operations. The classroom discussions and case studies analysis will be implemented using the integrated asset management approach which is key for scenario optimization and ranking. The course covers conventional reservoirs.

The course will be supplemented by practical example problems, group exercises and interactive group discussion designed to consolidate and reinforce learning and identify and offer solutions to specific problems associated with waterflooding of oil fields.

Who Should Attend?

This course is designed for professionals with background in reservoir engineering, geology, production operations, reservoir management, field development, and related disciplines.

1. Attendants should be familiar with Waterflooding and Enhanced Oil Recovery Processes

2. Preferably, attendants should have some basic knowledge of reservoir simulation, and reservoir characterization.

What You Will Gain:

1. Learning the mechanisms related to waterflooding processes
2. Understanding the screening criteria for waterflooding and low salinity water flooding
3. Understanding how the microscopic and macroscopic sweep efficiency affect the overall waterflooding efficiency
4. Understanding how injection patterns can affect the areal sweep efficiency
5. Estimating injection water requirement, water sources, water treatment before and after injection, water quality specification, pH, and corrosion considerations.
6. forecasting incremental oil recovery and developing production and injection scenarios
7. Understanding the low salinity waterflood mechanisms, and expected recovery factor
8. Learning about surveillance and monitoring of waterflooding
9. Learning WF best practices from case studies, and lessons learned
10 Using commercial to show the benefits of different injection strategies

Training Methodology

The training course will combine lectures (30%) with workshop/work presentations (30%), interactive practical exercises and case studies (20%), supported by video material, software and general discussions (20%)

Course Content

Introduction of Waterflooding and Waterflooding Process

- Physics of water displacing oil
- Screening criteria for waterflooding
- Factors affecting waterflooding processes
- Reserve estimation of waterflooding processes
- Types of waterflooding

Waterflooding Process

- Waterflooding Process
    - Relative permeability, imbibition, drainage
    - Wettability
    - Capillary Pressure
    - Effect of reservoir heterogeneity on sweep efficiency
    - Injection patterns, mobility control
    - Waterflooding simulation considerations
    - Streamlines simulation
- Overview of WAG processes

Vertical, Areal and Volumetric Sweep Efficiency

- Vertical, Areal and Volumetric Sweep Efficiency
- Effect of Reservoir Heterogeneities on waterflooding
- Volumetric sweep efficiency, recovery factor
- Effect of crossflow, segregated flow
- Analytical forecast
    - Fractional flow
    - Buckley and Leverett Theory
    - Welge Method
    - Recovery Factor Estimation
    - Polymer effect on waterflooding
    - Heterogeneity versus recovery factor in waterflooding
- Introduction to Capacitance Resistance Model (CRM) for waterflooding methods
- Fundamentals of Streamline simulation, use and limitations

Low salinity Waterflooding. Surveillance and Monitoring of Water Injection Processes

- Physics of low salinity water injection
- Lab tests, typical LSW recovery Factor
- Pilot tests
- Water disposal
- Surveillance and Monitoring of Water Injection Processes

Waterflooding planning and Field Development Plan

- Waterflooding planning
- Water management in waterflooding processes, water treatment and quality control
- Well architecture, well spacing, and well pattern selection
- Intelligent well completion for water control, ICD, ICV, downhole water separation
- Risk Analysis
- Economic and environmental considerations
- Water injection process optimization
- Case studies discussion