TETRA TECH RPS ENERGY | TRAINING

N006: An Introduction to Reservoir Engineering for Geoscientists

Instructor(s): Mark Cook

Format and Duration

Classroom - 4 Days
Virtual - 5 Sessions

Summary

This course examines the standard reservoir engineering processes and techniques, particularly their interface with geoscience activities. This course illustrates, with examples, the use of subsurface data in the construction of a reservoir model. It covers three related main themes: static reservoir models; developing dynamic reservoir simulation models; and reservoir management during the producing life of a field. This course covers the fundamentals of fluid flow in porous media, from a rock and fluid perspective. Reference is made to the application of reservoir engineering principles in carbon capture and storage (CCS).

Business Impact: By building a greater awareness of **reservoir engineering principles**, participants will be able to **communicate more effectively** with their Reservoir Engineering colleagues, ensuring **better integration** between disciplines, thereby improving the efficiency, effectiveness, and quality of business activities.

Learning Outcomes

Participants will learn to:

1. Operate more effectively, and work more collaboratively, with their Reservoir Engineering colleagues.
2. Interpret original fluid contacts, through analysis of logs and pressure vs. depth profiles, prior to production start-up; define saturation vs height relationships and estimate original hydrocarbon in place volumes.
3. Employ fluid sampling techniques and differentiate the physical and chemical properties of hydrocarbons and their description through phase diagrams.
4. Examine the uses and importance of well tests and appraise how analysis is conducted.
5. Identify the controls on fluid flow in the reservoir, the balance of viscous, capillary, and gravity forces and the impact of reservoir drive mechanisms including depletion, water and gas drive.
6. Analyse production performance in the wellbore and debate artificial lift techniques and the potential benefits of horizontal wells. Compare production enhancement through stimulation, horizontal wells, and completion techniques.
7. Define the processes and interfaces of building both static and dynamic reservoir models, including the challenges of upscaling, and demonstrate knowledge of the principles of reservoir numerical simulation techniques, and its validation.
8. Evaluate the importance of continued reservoir management for forecasting future production profiles and maximising economic hydrocarbon recovery from a producing field over the complete life cycle.
9. Compare the Enhanced Oil Recovery (EOR) techniques: steam and fire flooding, miscible and immiscible gas displacement.
10. Apply key reservoir engineering principles to carbon capture and storage (CCS).

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Training Method

This is a classroom or virtual classroom course comprising a mixture of lectures, discussion, case studies, and practical exercises.

Who Should Attend

This course is aimed at Geoscientists and other subsurface professionals who interface with Reservoir Engineers in their regular work, or who wish to obtain a broad grounding in reservoir engineering principles. This course will also benefit new team leaders tasked with managing multi-disciplinary teams.

Course Content

The material covered in this course is built around the reservoir model, which can be constructed using analytical (calculator) or numerical (simulation) processes. The process is in three parts:

1. Building a static reservoir model
2. Developing a dynamic model – analytical and simulation
3. Reservoir management during the producing life of a field

The following topics will be covered:

Introduction

Basic reservoir rock and fluid description

Controls on fluid flow in the reservoir

- Rock permeability and relationship with porosity
- Reservoir zonation - Darcy's Law and impact of permeability contrasts
- Exercise: Reservoir Zonation

Defining fluid contacts and estimating volumetrics

- Defining fluid contacts - pressure vs depth relationships
- Capillary pressures and saturation-height relationships
- Exercise: Defining Fluid Contacts

Reservoir fluid properties

- Fluid sampling
- Analysis of fluid samples

- Chemical and physical properties of hydrocarbons
- Phase diagrams

- Making use of the PVT report
- Exercise: Defining Reservoir Fluid Properties

Well test analysis

- Uses of well testing
- Planning a well test
- Well testing operations
- Well test analysis – determining kh, skin, PI, boundary effects
  - Analysis techniques – semi-log and log-log analysis
  - Understanding the non-uniqueness of engineering analysis
- Exercise: Logs from Reservoir CHALK-1
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  Exercise: Integrated Oil Well Testing Analysis

Dynamic behaviour of reservoir fluids

Material balance and fluid displacement

- Drive mechanisms - depletion, gas cap drive, water drive
- Material balance for oil and gas reservoirs
- Fluid displacement on a macroscopic scale - sweep efficiency
- Fluid displacement on a microscopic scale - relative permeability
- Estimating recovery factors
- Diffuse and segregated flow regimes
- Exercise: Reservoir Drive Mechanism; Material Balance

Dynamic well performance

- The inflow performance relationship
- Tubing performance curves
- Artificial lift techniques
- Horizontal wells

Reservoir simulation

- Gridding and simulation principles

- Upscaling static and dynamic model properties

Measuring reservoir performance and reservoir management

Reservoir monitoring

- Overview of reservoir management
- Monitoring tools: pressure, PLT, TDT, RFT, MDT, XPT pressure data, production and injection data

Production

- Decline curve analysis
- Reservoir simulation and history matching
- Reserves reporting

Enhanced oil recovery techniques

- Mobility control (polymer)
- Miscible and immiscible techniques (surfactants, gas flooding)
- Thermal techniques (steam and fire flooding)

Carbon capture and storage (CCS)

- Selecting the container (saline aquifer, depleted gas fields)
- Displacement in the reservoir and residual gas
- Capillary trapping and risk management in CCS