Reservoir Engineering for Geoscientists (G024)

Tutor(s)

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Overview

The course examines reservoir engineering processes, techniques and terminology, particularly those that interface with geoscience activities. The material is structured around the three-part process of building a reservoir model: (1) building a static model to identify the main flow units, (2) developing a dynamic model to predict fluid flow in the reservoir, and (3) implementing a life-of-field reservoir management plan to maximize economic recovery. Numerous examples illustrate the use of subsurface data and the techniques employed during the construction of a reservoir model. The focus is on the principles rather than the detailed work of the reservoir engineer; the use of complex mathematics is avoided.

Duration and Logistics

Classroom version: 5 days; a mix of classroom lectures (60%), case studies (20%) and exercises (20%). The manual will be provided in digital format and participants will be required to bring a laptop or tablet computer to follow the lectures and exercises.

Virtual version: Five 4-hour interactive online sessions presented over 5 days, including a mix of lectures (60%), case studies (20%) and exercises (20%). A digital manual and hard-copy exercise materials will be distributed to participants before the course.

Level and Audience

Fundamental. The course is aimed at geoscientists, petrophysicists and others who interface with reservoir engineers on a regular basis, as well as anyone who wishes to obtain an understanding of reservoir engineering techniques.

Objectives

You will learn to:

1. Effectively interact with reservoir engineering colleagues.
2. Interpret original fluid contacts, understand saturation vs height relationships and estimate original hydrocarbon in-place volumes for oil and gas reservoirs.
3. Differentiate the physical and chemical properties of hydrocarbons and their description through phase diagrams.
4. Recognize the strengths and weaknesses of well tests and their analysis.
5. Analyze production performance and describe production enhancement techniques.
6. Contrast static and dynamic reservoir models and assess the merits of reservoir numerical simulation.
7. Assess the value of reservoir management for forecasting production profiles and maximizing

economic hydrocarbon recovery from a producing field over the complete life cycle.

8. Examine the controls on fluid flow in the reservoir and reservoir drive mechanisms.

Course Content

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
- Defining fluid contacts and estimating volumetrics
    - Basic reservoir volumetrics
    - Defining fluid contacts – RFT pressure measurements and pressure vs depth relationships, Capillary pressures and saturation–height relationships
- Reservoir fluid properties
    - Fluid sampling
    - Analysis of fluid samples – chemical properties of hydrocarbons, physical properties of hydrocarbons and phase diagrams
    - Making use of the PVT report
- Well test analysis
    - Uses of well testing
    - Planning a well test
    - Well testing operations
    - Well test analysis – determining kh, skin, PI, boundary effects. Analysis principles, analysis techniques (semi-log and log-log analysis), the components of total skin and special test types

Dynamic Behaviour of Reservoir Fluids

- Material balance and fluid displacement
    - Drive mechanisms – depletion, gas cap drive and water drive
    - Material balance for oil reservoirs
    - Material balance for 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
    - Buckley-Leverett displacement theory
- Dynamic well performance
    - The inflow performance relationship
    - Tubing performance curves
    - Artificial lift
    - Coning and cusping
    - Well completions
    - Horizontal wells
    - Well stimulation – fracturing and acidization
- Reservoir simulation
    - Gridding
    - Simulation principles
    - Input, output and visualisation
    - 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
    - Well interventions and workovers
- Production
    - Field analogues
    - Decline curve analysis
    - Analytical models
    - Reservoir simulation and history matching
    - Probabilistic production forecasting for reserves reporting
- Enhanced oil recovery techniques
    - Defining the target oil
    - EOR techniques
    - Steam and fire flooding
    - Miscible gas displacement
    - Immiscible gas displacement
    - Novel techniques