Special Core Analysis

5 days **RCM/SCAL**

Overview

LEVEL

Skilled

PURPOSE

This course provides a comprehensive and practical understanding of methods, procedures and issues related to evaluation of special rock properties such as relative permeability and capillary pressure at laboratory and all considerations before their application in reservoir simulation.

LEARNING OBJECTIVES

Upon completion of the course, participants will be able to:

discuss the business impact of Special Core Analysis (SCAL) measurements using state-of-the-art laboratory and data interpretation techniques,

design a SCAL measurement program,

assess the quality of SCAL reports,

implement SCAL data into reservoir simulation studies.

WAYS AND MEANS

Highly interactive course alternating theory, exercises and field cases.

Use of the SCAL (Special Core Analysis) license free simulator SCORES.

LEARNING ASSESSMENT

Knowledge assessment with multiple choice questions and open explanatory questions.

Agenda

INTRODUCTION — 0.25 d

Business value of SCAL, remaining vs. residual oil saturation, wettability.
Best practice: need for interpretation-by-simulation.
General overview of laboratory measurement techniques.

STEADY-STATE TECHNIQUE — 0.75 d

Basics: experimental set-up in the lab, physics of the experiment, horizontal vs. vertical, automation of data gathering.
Analytical interpretation: data consistency, design of experiments, choices for fractional flow.
Best practice: interpretation-by-simulation, hands-on exercises using the SCORES/DuMux simulator.
Residual oil vs. remaining oil saturation, impact of imbibition capillary pressure, oil end-effect.
Impact of drainage capillary pressure, water end-effect.

CORE PLUG PREPARATION & UNSTEADY-STATE TECHNIQUE — 1 d

Core plug preparation:
Plug selection, using quantitative X-ray CT images, cleaning.
Establish initial water saturation:
Mercury injection (MICP) for reservoir saturation height functions and pore size distribution.

Recent developments in MICP showing important problems in MICP for low permeability rock when assessing transition zones.
Ageing.
Unsteady-State (Welge) technique:
Basics: experimental set-up in the lab, physics of the experiment, horizontal vs. vertical, automation of data gathering; analytical interpretation with exercises in Excel™.
Analytical calculation of shock front saturation, JBN method.
Corey parameter characterization.
Best practice: interpretation-by-simulation, hands-on through exercises with the SCORES/DuMux simulator: effect of viscosity ratio, impact of capillary forces, capillary number and desaturation.

CENTRIFUGE TECHNIQUE & SCAL DATA QUALITY ASSESSMENT

1 d

Centrifuge technique:
Basics: experimental set-up in the lab, physics of the experiment, drainage vs. imbibition hardware, automation of data gathering.
Analytical interpretation with exercises in Excel™. Bond number:
Hassler-Brunner analysis for multi-speed experiments.
Hagoort analysis for single-speed experiments.
Best practice: interpretation-by-simulation, hands-on through exercises with the SCORES/DuMux simulator:
Effect of oil viscosity, characteristic time.
Impact of water mobility in imbibition experiments.
Impact of capillary forces.
History matching multi- and single-speed experiments.
SCAL quality assessment:
How to recognize bad data?
Best practice: verifying data consistency.
Implement SCAL data into reservoir simulation studies:
Rock-typing.
Gridding for reservoir simulation.

POROUS PLATE TECHNIQUE, SCAL FOR GAS FLOODING EXPERIMENTS, STRENGTHS & WEAKNESSES OF EACH SCAL TECHNIQUE

1 d

Porous plate technique - Basics:
Experimental set-up in the lab, physics of the experiment, capillary continuity, multiple plugs vs. single plug equipment.
Automation of data gathering.
Analytical interpretation with exercises in Excel™: recognizing equilibrium, characteristic time.
Best practice: interpretation-by-simulation, hands-on through exercises with the SCORES/DuMux simulator.
How to set-up simulations in the absence of data?
Experimental design.
Interpretation-by-simulation of capillary pressure and resistivity measurements.
SCAL for gas flooding experiments:
Understand limitations of UnSteady-State and Steady-State techniques through exercises in Excel:
Impact of shock front in drainage and imbibition mode in UnSteady-State experiments.
Hagoort criterion for viscous fingering.
3-phase relative permeabilities, spreading condition, centrifuge experiments for GOGD.
Best practice: interpretation-by-simulation, hands-on through exercises with the SCORES/DuMux simulator: impact of capillary pressure in flooding experiments.
Plenary discussion of strength and weaknesses of each SCAL measurement technique.
Understanding main characteristics of each technique facilitates designing a lean and fit-for-purpose SCAL measurement program.

SCAL FOR EOR & SCAL MASTER MEASUREMENT PROGRAM

1 d

SCAL for EOR:
Introduction into EOR techniques in the field.
Understanding scope for EOR.
Issues and design of SCAL experiments for low salinity flooding, Microbial EOR, CO_2 EOR, Thermal EOR, Chemical EOR, EOR in fractured reservoirs.
Plenary discussion on the design of a best practice master measurement program:
At the end of this discussion, a comprehensive handout will be distributed that serves as a Master SCAL measurement program for future use in the office.