Summary
This course addresses topics that are specific to exploitation of unconventional reservoirs – identification and characterization, economics, efficient completion technologies, well testing and development strategies. Tight gas and shale gas reservoirs, and coal bed methane engineering are addressed.

Learning Outcomes
Participants will learn to:

1. Assess, characterize and classify unconventional resources.
2. Understand the impact of organic matter maturation and hydrocarbon generation on unconventional resource assessment
3. Assess oil and gas storage mechanisms for unconventional reservoirs
4. Assess flow mechanisms for unconventional reservoirs
5. Design pressure transient (fall off) analysis for wells in unconventional reservoirs
6. Develop a shale gas/oil apparent permeability model for simulation using petrophysical data
7. Perform rate transient analysis for unconventional well to predict total fracture surface area contributing to production
8. Evaluate the relative accuracies of unconventional reserve estimates
9. Evaluate production rate decline characteristics of unconventional wells
10. Formulate a field development plan for an unconventional resource
11. Categorize similarities and differences between tight gas, shale gas and CBM
12. Propose integrated use of geoscience, engineering and advanced technology in exploitation of unconventional reserves.

Duration and Training Method
This is a four-day classroom course, consisting of lectures with worked examples, hands-on computer- and paper-based exercises, and discussion. Presentations by participants are encouraged. The ratio of lecture to computer time is approximately 80/20.

Who Should Attend
The course is designed for mid to senior level engineers and engineering managers that have some familiarity with unconventional reservoirs.

Prerequisites and Linking Courses
Familiarity with reservoir engineering principles and terminology is assumed, as presented in Basic Application level class N422 (Reservoir Engineering for Non-Engineers) and Skilled level class N997 (Applied Reservoir Engineering).

Engineering aspects of unconventional reservoirs are also explored at a Basic level in N313 (Evaluating Resource Plays: The Geology and Engineering of Low Permeability Oil and Gas Reservoirs), as well as at Skilled level in N986 (Reservoir Production Engineering of Resource Plays) and N989 (Rate and Pressure Transient Analysis for Unconventional Reservoirs). Related course include N250 (Evaluation Methods for...
Shale Reservoirs) and N409 (Improved Hydraulic Fracture Design Using Microseismic Imaging).

Course Content

Unconventional resources are a unique part of the more general topics of reservoir engineering and gas reservoir engineering. The uniqueness stems from special completion methods required to efficiently exploit the resource, rapid production declines followed by long periods of relatively low production rates and the accompanying economic performance. Production mechanisms of certain classes of tight reservoirs differ from traditional Darcy mechanisms and require different models for reserve evaluation and production estimation.

- Introduction
  - Unconventional Gas Reservoirs (UGR)
  - Tight gas and oil, CBM and shale gas definitions
  - Characteristics and play locations
  - Featured unconventional gas plays
- Fundamentals
  - Storage and flow characteristics
  - Pore structure and gas storage mechanisms (gas-in-place, volumetrics, material balance)
  - Flow mechanisms: matrix and fracture flow
  - Completion/stimulation methods
  - Vertical, hydraulically fractured wells
  - Vertical, cavity-completed wells (CBM)
  - Horizontal wells, naturally completed, and multilaterals
  - Multi-fractured horizontal wells
  - Surveillance methods: microseismic, production logging
- Introduction to Tight Gas Case Study
- Reservoir sample analysis (core, cuttings, or other)
  - Special Core Analysis: relative permeability, other methods for pore size analysis, electrical properties, rock mechanical properties
  - Organic matter characterization (CBM and shale)
  - Gas content and adsorption isotherm determination (CBM and shale)
  - Inorganic matter characterization integration of logs with core
  - Tight Gas Case Study: routine and special core analysis
- Rate-Transient (production data) Analysis
  - Introduction to concept
  - Example signatures
    - vertical wells in low-K, single porosity reservoirs
    - horizontal wells in low-K, single-porosity reservoirs
    - multi-fractured hz wells in low-K, single porosity reservoirs
    - multi-fractured hz wells in low-K, double-porosity reservoirs
  - Analytical methods for RTA
overview of techniques
- type-curve methods
- straight-line methods
- simulation
  - Empirical methods for RTA
    - Arps decline curves with Fetkovich type-curves
    - new methods such as power-law exponential
  - Tight Gas Case Study: application of RTA techniques
    - integration with surveillance data such as microseismic
    - hydraulically-fractured vertical wells
    - multi-fractured horizontal wells: commingled stage analysis
    - multi-fractured horizontal wells: individual stage analysis
  - Additional example applications
    - tight gas, shale gas, single- and multi-phase CBM
- Pressure Transient Analysis (well-testing)
  - Conventional PTA concepts: buildup test
  - Methods for tight gas/shale gas
    - issues with testing tight gas/shale gas
    - alternative methods for testing tight gas/shale gas
  - Methods for CBM
    - PTA behavior
    - CBM properties that prevent direct application of conventional PTA
    - commonly applied single-porosity models
    - multi-layer reservoirs
    - double-porosity reservoirs
    - what is the ideal test?
- Exploration
  - Subsurface considerations
  - Applicability of conventional play/prospect analysis
  - Monte Carlo simulation
  - Introduction to new unconventional prospect analysis techniques
- Development
  - Reserves evaluation workflow for tight gas/shale gas
  - Analyzing field production
  - Well optimization (compression and completion optimization)
  - Optimal development considerations
  - Field simulation examples
Courses Taught for RPS

N274: Unconventional Resource Engineering for Geoscientists

N279: Geological Characterization and Engineering of Unconventional Oil and Gas Shales: Classroom and Field Seminar (Oklahoma, USA)


N973: Reservoir Engineering for Unconventional Gas and Tight Oil Reservoirs

Background

Yucel Akkutlu is professor of petroleum engineering at Texas A&M University, College Station. He is the holder of Flotek Industries, Inc. Career Development Professorship. He is a chemical engineer and received a Ph.D. in petroleum engineering from the University of Southern California, Los Angeles. His main research interest is fluid flow, transport and reactions in porous media. This interest finds many applications in reservoir engineering, in particular the areas of enhanced oil/gas recovery and the oil/gas recovery from source rocks such as coal, shale and hydrates.

Akkutlu was the executive editor of the SPE Journal. He was the 2014-15 SPE Distinguished Lecturer. He has received 2018 TAMU-Association of Former Students College-Level Teaching Award, 2016 TAMU-Association of Former Students Distinguished Achievement Award, 2015 AIME Rossiter W. Raymond Memorial Award, and received 2015 TAMU College of Engineering William Keeler Faculty Fellow Award, 2015 AIME Rossiter W. Raymond Memorial Award. Dr Akkutlu also received several departmental-level awards. He has served in several committees, including SPE Annual Technical Conference and Exhibition (ATCE) Recovery Mechanisms and Flow in Porous Media (RMFPM) committee, 2007-2010, the Natural Sciences and Engineering Research Council of Canada (NSERC) as a member of the materials and chemical engineering committee, 2011-2014.

Affiliations & Accreditation

PhD University of Southern California - Petroleum Engineering
MSc University of Southern California - Petroleum Engineering
BSc Hacettepe University - Chemical Engineering