RESERVOIR PERFORMANCE OF HORIZONTAL WELLS

Instructor: Dr. Djebbar Tiab
Professor, Mewbourne School of Petroleum and Geological Engineering,
Mewbourne College of Earth and Energy, University of Oklahoma

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Jakarta

COURSE DESCRIPTION
This course stresses practical reservoir engineering concepts essential to predicting the performance of horizontal and slanted wells, with a special emphasis on:

• Role of geology in selecting optimum site for drilling a horizontal well
• Assessing Productivity of HW
• Evaluation of Slanted Well Performance
• Interpretation of HW pressure transient tests in oil and gas reservoirs
• Performance of Stimulated horizontal wells
• Determine Horizontal Well Productivity
• Placement of Horizontal Wells to avoid Water and Gas Coning
• Performance of horizontal wells in Naturally fractured reservoirs
• Illustrate interpretation techniques by solving a large number of exercises

BENEFITS OF THE COURSE:
At the end of this course, the participants will be able to do the following:

• Select optimum geological setting for horizontal well placement
• Interpret pilot-hole tests
• Understand the fundamental theory and applications of well test analysis to horizontal wells;
• Use modern techniques for analyzing drawdown and buildup test in Horizontal and slanted wells;
• Evaluate and forecast horizontal well production performance with and without hydraulic fractures
• Assess the productivity of Horizontal Wells
• Decide on whether to fracture a vertical well or drill a horizontal well
• Apply the knowledge and skills in their job assignments upon course completion.

This a companion course to the very popular course “Advanced Well Test analysis”. Videos and Daily Excel-based class exercises will reinforce the concepts covered in class. Participants are required to bring a personal computer to work exercises.

WHO SHOULD ATTEND?
Petroleum Engineers who want to (a) know how to use geologic information to select the optimum site to drill a horizontal well; (b) understand well testing principles unique to horizontal wells; (c) apply advanced modern interpretation techniques to analyze complex problems related to the pressure behavior of horizontal wells in hydraulically and/or naturally fractured oil and gas reservoirs; (d) know how to stimulate horizontal wells and assess post-fracturing performance and (e) use
modern interpretation methods for calculating productivity of horizontal wells. Previous experience in basic reservoir engineering and basic understanding of fluid flow equations is helpful.

COURSE CONTENT:

1 – OVERVIEW OF HORIZONTAL WELL TECHNOLOGY
   1. Overview of Horizontal Well Drilling & Completions (VIDEO)
   2. Role of Geologist
   3. Horizontal well applications
   4. Formation Evaluation for Optimum HW Completion
   5. Unconventional Applications of HW
   6. Multi-HW Systems
   7. Types of HW and Completions
   8. Workshop: Exercises

2 – IMPACT OF VERTICAL PERMEABILITY ON HORIZONTAL WELLS PERFORMANCE
   1. Impact of Directional Permeability on HW Productivity (+VIDEO)
   2. Kv from Core Analysis
   3. Kv from Resistivity Logs
   4. Kv from Pilot-Hole Test: Conventional Techniques
   5. Workshop: Exercises

3 – PERFORMANCE OF SLANTED WELLS
   1. Effect of Slant on Pressure-Transient Responses
   2. Flow Regimes
   3. Models Used in Well-Test Analysis of Slanted Wells
   4. Skin and Pseudo-skin
   5. TDS Technique: Infinite System
   6. TDS Technique: Finite System & Reserves
   7. Calculation of Reservoir Properties
   8. Regression Analysis and Practical Considerations: Wellbore Storage
   9. Workshop: Exercises

4 - INTERPRETATION OF HORIZONTAL WELL TESTS
   1. Fundamentals of Well Test Analysis (VIDEO)
   2. Analysis of a Pilot-Hole (Vertical) Well Test
   3. Partially Penetrating Well
   4. Flow Regimes and Analytical Solutions
   5. Flow Time Equations and Solutions
   6. Pressure Drawdown and Buildup Testing in HW
   7. Application of Pressure Derivative (VIDEO)
   8. Analytical/TDS Technique for Horizontal Wells
   9. Determining Average Reservoir Pressure in HW
   10. Workshop: Exercises

5 – PERFORMANCE OF STIMULATED HORIZONTAL WELLS
   1. Fundamentals of Stimulation: Fracturing, Acidizing (VIDEO)
   2. Limitations of Hydraulic Fracturing in Vertical Wells
   3. Matrix Stimulation/Hydraulic Fracturing
   4. Performance of Hydraulically Fractured Horizontal Wells
5. Influence of Isolators on Pressure Behavior & HW Performance
6. Objectives and Practical Considerations Prior to Fracturing
7. Post-Frac Conventional Pressure Testing
8. Application of Modern WTA Techniques in Fractured Wells
9. Finite Conductivity Fracture
10. Workshop: Exercises

6 – HORIZONTAL WELLS WITH ISOLATORS AND MULTIPLE HYDRAULIC FRACTURES
1. Candidates for zonal Isolations
2. Theoretical Models
3. Interpretation of HW Tests with Isolators
4. Locating Damaged Isolators
5. Post-Frac Pressure Test in HW With Multiple Hydraulic Fractures
6. Workshop: Exercises

7 - HORIZONTAL WELLS IN NATURALLY FRACTURED RESERVOIRS
1. Properties of Naturally Fractured Reservoirs (VIDEO)
2. Objectives of HW in Naturally Fractured Reservoirs
3. Types and Evaluation of Naturally Fractured Reservoirs
4. Petrophysical Evaluation of fissured carbonate reservoirs
5. Analysis of a Pilot-Hole Well Test
6. Pseudo-steady state and matrix flow in Horizontal wells
7. Anisotropic Reservoirs
8. Elliptical Flow
9. Average Reservoir Pressure of NFR
10. Workshop: Exercises

8 - PRODUCTIVITY OF HORIZONTAL WELLS IN COMPLEX RESERVOIRS
1. Horizontal well versus hydraulically fractured vertical well
2. Formation damage for horizontal wells
3. Matrix stimulation
4. Steady-State Flow Equations of horizontal wells
5. Unsteady-State Flow Equations
6. Effective Wellbore Radius for Horizontal Oil Wells
7. Effect of Formation Damage on HW Productivity
8. Pseudo-steady state flow Equations and Solutions
9. Pseudo-steady State Productivity Calculation Methods
10. Productivity of Multi-Fractured Horizontal Well
11. Workshop: Exercises

9 – WATER & GAS CONING IN HORIZONTAL WELLS
1. Coning In Vertical Wells (Brief Review
2. Meyer-Garder Correlation
3. Placement of Perforated Section
4. Water-coning in Anisotropic Systems
5. Breakthrough Time
6. Well Performance after Breakthrough
7. Long HW and Coning
8. HW Critical Rate
9. Horizontal Well Breakthrough Time In A Bottom Water Drive Reservoir
10. Breakthrough Time in Reservoirs with both Gas Cap & Water Drive
11. **Workshop:** Exercises

**10 - HORIZONTAL WELLS IN GAS RESERVOIRS**

1. Gas Reserves: Volumetric Methods, Material Balance Methods
2. Unsteady State Flow Equations
3. Real-Gas Pseudo Pressure, Non-Darcy Flow Equations
4. Pressure and Pressure Squared
5. Converting Pressure to Pseudo-pressure
6. Analysis of a Pilot-Hole Gas Well Test
7. Hydraulically Fractured Pilot Hole Test
8. Productivity of Horizontal Gas Wells
10. Steady State Gas Flow Equations for HW
11. **Workshop:** Exercises

**ABOUT THE INSTRUCTOR**

**Prof. Djebbar TIAB:**

- 1977-2014, Professor of Petroleum Engineering at the University of Oklahoma (OU);
- 2014 - ...: Emeritus Professor, University of Oklahoma,
- 2008 - : Visiting Professor of Petroleum Engineering at AUST. He retired from the University of Oklahoma in June 2014 to concentrate on consulting and training with his company UPTEC (United Petroleum Technology LLC), based in Norman, Oklahoma.

He received his B.Sc. (May 1974) and M.Sc. (May 1975) degrees from the New Mexico Institute of Mining and Technology, and Ph.D. degree (July 1976) from the University of Oklahoma - all in Petroleum Engineering. He served as the Director of the OU – Sonatrach “The University of Oklahoma Graduate Program in Petroleum Engineering in Algeria” from 1996 to 2004.

Before joining the University of Oklahoma in 1977, he worked as a research associate and as an assistant professor at the New Mexico Institute of Mining and Technology, where he taught drilling & well completion, production engineering, well logging and natural gas engineering. At the University of Oklahoma, Dr. Tiab taught various petroleum and general engineering courses including: well test analysis, advances in pressure transient analysis, petrophysics/reservoir rock properties, Core Analysis-lab, advanced petrophysics, oil reservoir engineering, natural gas engineering, reservoir mechanics lab, natural gas engineering lab, fluid mechanics, Production, Properties of reservoir fluids, Introduction to engineering, Advanced reservoir engineering, Fluid Flow Through Porous Media, Advanced natural gas engineering, Water flooding, Naturally Fractured Reservoirs, and Petroleum Geology for Non-Geologists.
He teaches Petroleum Engineering courses (MS and PhD level), as a visiting professor at the African University of Science and Technology (AUST) in Abuja, Nigeria, since 2008. He also supervises theses of several graduate students. In 2010, he taught at ESPRIT (Ecole Supérieure Privée d’Ingénierie et de Technologies) in Tunis, Tunisia.

Dr. Tiab has consulted for a number of oil companies and offered training programs in petroleum engineering in the U.S.A. and overseas. He worked for over two years in the oil fields of Algeria for Alcore, S.A., an association of Sonatrach and Core Laboratories. He has also worked and consulted for Core Laboratories and Western Atlas in Houston, Texas, for four years (1990-1993) as a Senior Reservoir Engineer Advisor. He is the manager of his consulting company, registered in Oklahoma, United Petroleum Technology, LLC (UPTEC).

He teaches several short courses for various organizations: Sonatrach (Algeria), OilProduction Inc. (Argentina), MAT (Iran), NExT (Schlumberger), PetroGroup (Colombia), Elite (Colombia), UPTEC (U.S.A.), HSG Consulting (Colombia), PetroSync (Singapore), BlackGold (India), GeoServices (Indonesia), Energetx (Libya), Energy Institute of the Americas (USA), … Provided training & consulting in several countries, including Algeria, Argentina, Colombia, Venezuela, India, Indonesia, Iran, Nigeria, Saudi Arabia, Tunisia, Turkey, UAE and USA. He typically teaches the following courses:

**Basic Courses:**
1. Properties of Reservoir Rocks (5 days)
2. Properties of Reservoir Fluids (5 days)
3. Oil Reservoir Engineering (5 days)
4. Gas Reservoir Engineering (5 days)

**Advanced courses:**
1. Advanced Well Test Analysis (5 or 10 days)
2. Advanced Petrophysics: Reservoir Characterization (5 days)
3. Advanced Reservoir Engineering (5 days)
4. Evaluation of Naturally Fractured Reservoirs & Carbonates (5 days)
5. Reservoir Performance of Horizontal Wells (5 days)
6. Basic & Advanced Reservoir Engineering (10 days)

As a researcher at the University of Oklahoma, Dr. Tiab received several research grants and contracts from the National Science Foundation (NSF), United States Department of Energy, U.S. Department of HEW, Sonatrach, KOC, Oklahoma Mining and Mineral Resources Institute, EPSCoR and the Energy Resources Institute. He is a member of the U.S. Research Council, Society of Petroleum Engineers (SPE), Core Analysis Society, Pi Epsilon Tau, Who is who and American Men and Women of Science. He served as a technical editor of various SPE, Egyptian, Kuwaiti and U.A.E. journals. He was member of the SPE Pressure Analysis Transaction. He also served as a member of the University of Oklahoma Senate. He has served as a member of the College of Engineering Dean’s Advisory and as Chairman of the Ad hoc PGE Graduate Program Committee. In 2001 he was elected to the SPE Twenty-Five Year Club. He currently serves on the SPE Awards Committee.

Dr. Tiab is the author/co-author of over two hundred forty (240) conference and journal technical papers in the area of pressure transient analysis, dynamic flow analysis, Petrophysics, natural gas engineering, reservoir characterization, reservoir engineering and injection
processes. In 1975 (M.S. thesis) and 1976 (Ph.D. dissertation) Tiab introduced the pressure derivative technique, which revolutionized the interpretation of pressure transient tests. He developed patents for CORE LAB in the area of reservoir characterization (identification of flow units).


Dr. Tiab supervised one hundred forty research projects at the University of Oklahoma and several at Core Laboratories. These research projects formed the basis of 154 theses (M.Sc. and Ph.D.). The research projects covered all aspects of Petroleum Engineering including reservoir engineering, formation evaluation/well test analysis, reservoir characterization, enhanced oil recovery and production. Most of his Ph.D. students are now consultants and/or professors at universities in the U.S.A., South America, Africa, Asia and the Middle East.

He received the Outstanding Young Men of America Award (1983), the SUN Award for Education Achievement (1984), Kerr-McGee Distinguished Lecturer Award (1985), the College of Engineering Faculty Fellowship of Excellence (1986), the Halliburton Lectureship Award (1987-89), the UNOCAL Centennial Professorship (1995-98), and the P&GE Distinguished Professor (1999 – 2000). The UNOCAL Professorship was created to honor the one-hundredth anniversary of the University of Oklahoma. He received the 2007 USCO Recognition Award for Outstanding Technical Achievements.

He received the prestigious 1995 SPE Distinguished Achievement Award for Petroleum Engineering Faculty. The citation read, “He is recognized for his role in student development and his excellence in classroom instruction. He pioneered the pressure derivative technique of well testing and has contributed considerable understanding to petrophysics and reservoir engineering through his research and writing.”

Dr. Tiab has been elected in October 2002 to the Russian Academy of Natural Sciences as a member because of “His outstanding work in petroleum Engineering”, and was awarded the Kapista gold Medal of Honor for “His outstanding contributions to the field of engineering.”

He received the technical 2003 SPE Formation Evaluation Award for “Outstanding achievements in petrophysics and reservoir engineering.”

Dr. Tiab receives (November 2013) the Africa Education Leadership Best Professor in Petroleum Engineering Award. The AEL Awards are presented to “Individuals who have surpassed several levels of excellence and set an example of being a role model and Exemplary Leadership. Individuals behind the Institution who are building their Institutions through Leadership, Innovation, Academic and Industry Interface and a supreme objective of Building future leaders.”

ENROLLMENT
In order to allow sufficient time for arranging travel plans, early enrollment is recommended.
Registration will be closed on 21 July 2017. Late enrollment may result in course cancellation.

**CANCELLATION, SUBSTITUTION & REFUND**
The tuition fee will be refunded (less US$ 100 registration fee) only if notification of cancellation is received at least 10 days prior to the commencement.

Non payment of tuition fee does not constitute automatic cancellation of participation. Substitution may be made at any time for those enrolled.

**CERTIFICATE**
A certificate of participation will be awarded to each person completing the course.

**TUITION FEE**
Tuition fee at Rp. 39,500,000 + VAT per delegate (the tuition fee will be adjusted based on the prevailing rate) is due and payable upon confirmation of enrollment. The fee is excluded accommodation. Payment should be settled at the latest on 21 July 2017. Any bank charges connected with payment in Rupiah must be added to tuition fee payment. Tuition fee includes admittance to the course, course materials, daily refreshments and full lunch.

Payment can be made to PT. Geoservices
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