PIONEERS
Integrated Solutions
WHERE SCIENCE MEETS INNOVATION
CONSULTING - TRAINING - INSPECTION

Production Forecasting and Reserves Estimation Techniques for Gas-Condensate Field Development

Course Description:

- Field cases of retrograde gas condensates are presented and reviewed with emphasis in the gravity drainage effects in condensate banking, practical applications of fluid flow numerical simulation models and construction of integrated asset modelling from the reservoir to the wells and production facilities. This course utilizes proven learning techniques to ensure maximum understanding, comprehension and retention of the information presented.it is designed as a blended environment of presentation, class exercises, field application, analysis and several industry videos.

The Training Course will highlight:

- This course is designed to enable the participants to develop skills analyzing and understanding the behavior of gas condensate reservoirs, with the objective to optimize the production and the final recovery factor. It addresses the concepts and definition applicable to gas reservoirs, its classification criteria, the composition of the different types of gases, the use of phase diagrams and equations of state; rock fluid saturation functions relative permeability's modelling, velocity, and interfacial tension effects; well productivity and pseudo-pressure calculations for different completion strategies; material balance equations and numerical simulation applications.

Course Objective:

- **By attending, you will be able to:**
- Learn the concepts and principles of natural gas reservoirs and gas condensate reservoirs.
- Learn to identify a gas reservoir from the compositions and representation in a phase diagram.
- Understand the criteria applicable for gas reservoir classification, dry gas, wet gas, condensate and retrograde condensate.
- Understand the condensate banking phenomenon in retrograde gas condensates.
- Learn how to model a gas condensate reservoir and how to create an integrated asset model.
- Review the potential simplification of the project design cycle time using the Integrated Asset Model concept.
- Calculate the gas reserves by volumetric and MBE methods.
- Prediction natural gas reservoir performance
- Design and analyze gas well testing.
- Conduct and analyze the deliverability tests such as flow after flow and isochronal tests.
- Know the details of decline curve analysis.

Course outline

- Pre-evaluation test
- Introduction
- Properties of Natural Gas

Gas Reservoirs

- Retrograde Gas Reservoirs
- Near-Critical Gas-Condensate Reservoirs
- Wet Gas Reservoirs
- Dry Gas Reservoirs

Gas Reservoir Drive Mechanisms

- Volumetric Gas Reservoirs
- Water Drive in Gas Reservoirs

Estimation of Gas Reserves

- Introduction
- Gas in Place by Volumetric Method
- Material Balance Equation
- Assumption
- Derivation
- Application

Course outline

Reserves and Reservoir Performance Predictions

- Volumetric Estimates
- MBE Estimates
- Pressure Decline Curve P/Z Method
- Effect of Water drive on P/Z Vs. Gp
- Water-Drive Gas Reservoirs
- Methods for Estimating Water Influx
- MBE Straight-line Method
- Reservoir Size
- Recovery Factor

General Material – Balance Gas Reservoirs

- Gas Reservoirs
- Graphical Techniques for Abnormally Pressured Gas Reservoirs

Course outline

Gas Condensate Reservoirs

- Introduction
- Vapor-Liquid Equilibriums
- Gas-Condensate testing and Sampling
- Condensate System Behavior in the Single - Phase Region
- Condensate System Behavior in the Two - Phase Region
- Reservoir Performance Prediction

Decline Curve Analysis

- Introduction
- Economic Limit
- Fundamentals and Application of Decline Curves
- Production Decline Analysis
- Classification of Decline Curves
- Nominal and Effective Decline
- Arps' Decline Curve
- Mathematical Expressions for the Various Types of Decline Curves

1. ***Exponential (Constant Percent) Decline***

- Relationship Between Nominal and Effective Decline Rate
- Cumulative Production for Exponential Decline
- Steps for Exponential Decline Curve Analysis

2. ***Harmonic Decline Rate***

- Cumulative Production for Harmonic Decline

3. ***Hyperbolic Decline***

- Cumulative Production for Hyperbolic Decline
- Fetkovich's type curve
- Decline Type Curves

Course outline

Vertical Gas Well Performance

- Introduction
- Pressure - Range of Application
- Region III. High Pressure Region: Pressure Approximation Method
- Region II. Intermediate-Pressure Region
- Region I. Low-Pressure Region: Pressure Squared Approximation Method
- First Form: Pressure-Squared Approximation Form
- Second Form: Pressure-Approximation Form
- Third Form: Real Gas Potential (Pseudo pressure) Form

Well Deliverability Testing

- Flow-After-Flow Test

1. ***Flow-After-Flow Tests***
2. ***Isochronal Tests***
3. ***Modified Isochronal Tests***

Types and Purposes of Pressure Transient Tests

- Analysis of Constant-Rate Flow Tests
- Horner Plot (Semi log Plot)
- Analysis of Pressure-Buildup Tests
- Complications in Actual Tests

Course outline

Fundamentals of Pressure Transient Testing in Gas Wells

- Introduction

1. **Pseudo pressure and Pseudo time Variables**
2. **Pressure and Time Variables**
3. **Pressure-Squared and Time Variables**

- Summary of Working Equations for Gas-Well Test Analysis
- Non-Darcy Flow and Dimensionless Form

Analysis of Gas-Well Flow Tests

1. **Constant-Rate Gas Flow Tests**
2. **Gas Flow Tests with Discrete Rate Changes**
3. **Variable-Rate Gas Flow Tests with Smoothly Changing Rates**
4. **Gas Flow Tests with Non-Darcy Flow**

- **Analysis of Gas-Well Buildup Tests**

1. **Buildup Tests with Constant-Rate Production Before Shut-in**
2. **Buildup Tests with Discrete Changes in Rate Before Shut-in**
3. **Buildup Tests with Constant-Pressure Production Before Shut-in**
4. **Determining Average Drainage Area Pressure for Gas Wells**

- MBH Square Drainage Area

Final Evaluation Exam