25.7.14

TPG4150 RESERVOIR RECOVERY TECHNIQUES

Fall Semester 2014

Lectures: Wednesday 14:15-16 (P1), Thursdays 8:15-10 (P1)
Assisted exercises: Fridays 13:15-14 (P1)

The course deals with physics of petroleum reservoirs and computational methods for planning of recovery of oil and gas from such reservoirs. Main subjects include analysis of microscopic and macroscopic displacement processes and of internal and external energy sources and the effects of such energies on the recovery of oil and gas from various types of petroleum reservoirs and fluid systems.

Lecturer

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Assistant

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Textbooks

1. Dake, L.: *Fundamentals of reservoir engineering,* Elsevier, New York (1978)
(not obligatory, but .pdf copy available on It'sLearning)

2. Handouts
(a number of handouts available on home page during the semester)

The following topics are covered

- Review of rock and fluid properties
- Oil, gas and gas-condensate systems
- Material balance equations
- Natural drive mechanisms
- Microscopic and macroscopic displacement efficiency
- Fluid flow equations
- Reservoir types
- Injection of gas and water
- Well patterns
- Planning of production
- Improved oil recovery methods

Exercises

Obligatory calculation exercises, partly by use of computer, will be assigned.
A group project will be based on Gullfaks or Norne data.
Exercises count 25% on the final course grade.

Web-address

http://www.petroleum.ntnu.no/~kleppe/TPG4150

Preliminary list of recommended reading material

Textbook 1: L.P. Dake: *Fundamentals of Reservoir Engineering*, Elsevier, Amsterdam, 1978

Chapter 1: Some Basic Concepts in Reservoir Engineering
- 1.1 Introduction
- 1.2 Calculation of Hydrocarbon Volumes
- 1.3 Fluid Pressure Regimes
- 1.4 Oil Recovery: Recovery Factor
- 1.6 Application of the Real Gas Equation of State
- 1.7 Gas Material Balance: Recovery Factor

Chapter 2: (Review material)

Chapter 3: Material Balance Applied to Oil Reservoirs
- 3.1 Introduction
- 3.2 General Form of the Material Balance Equation for a Hydrocarbon Reservoir
- 3.3 The Material Balance Expressed as a Linear Equation
- 3.4 Reservoir Drive Mechanisms
- 3.5 Solution Gas Drive
- 3.6 Gas Cap Drive
- 3.7 Natural Water Drive
- 3.8 Compaction Drive and Related Pore Compressibility Phenomena

Chapter 4: (Review material)

Chapter 5: The Basic Differential Equation for Radial Flow in a Porous Medium
- 5.1 Introduction
- 5.2 Derivation of the Basic Radial Differential Equation
- 5.3 Conditions of Solution
- 5.4 The Linearization of Equation 5.1 for Fluids of Small and Constant Compressibility

Chapter 9: Natural Water Influx (understand principles only)
- 9.1 Introduction
- 9.2 The Unsteady Water In flux Theory of Hurst and Van Everdingen
- 9.3 Application of the Hurst, Van Everdingen Water Influx Theory in History Matching
- 9.4 The Approximate Water Influx Theory of Fetcovitch for Finite Aquifers
- 9.5 Predicting the Amount of Water Influx

Chapter 10: Immiscible Displacement
- 10.1 Introduction
- 10.2 Physical Assumptions and Their Implications
- 10.3 The Fractional Flow Equation
- 10.4 Buckley-Leverett One Dimensional Displacement
- 10.5 Oil Recovery Calculations
- 10.6 Displacement Under Segregated Flow Conditions
- 10.7 The Allowance of the Effect of a Finite Capillary Transition Zone in Displacement Calculations
- 10.8 Displacement in Stratified Reservoirs
- 10.9 Displacement When There is a Total Lack of Vertical Equilibrium

Handout Notes (preliminary)

- Handout note 1: J. Kleppe: "Material Balance Equations"
- Handout note 2: J. Kleppe: "Fluid Flow Equations"
- Handout note 3: J. Kleppe: "Review of Relative Permeabilities and Capillary Pressures"
- Handout note 4: J. Kleppe "Dykstra-Parson´s Method For Simplified Analysis of Oil Displacement by Water in a Layered Reservoir"
- Handout note 5: Buckley-Leverett Analysis for diffuse flow conditions
- Handout note 6: Dietz Analysis for segregated flow conditions

A number of exercises will be required during the semester