TPG4150 Reservoir Recovery Techniques 2016
Professor Jon Kleppe
List of lectures, hand-out notes and exercises

References below are to Hand-out notes (H)

Wednesday 23.8
Introduction to oil recovery in hydrocarbon reservoirs; Simple recovery mechanisms (fluid and pore expansion); Role of fluid expansion and rock compression in recovery; Review of *Black Oil* fluid phase behavior; formation volume factors for oil and gas; solution gas-oil ratio; formation volume factor for water; saturated and undersaturated systems (H1);

- Handout note 1: J. Kleppe: "Material Balance Equations"
- Exercise 1: Review of PVT behavior and simple volumetric reservoir calculations

Thursday 24.8 (2 hrs)
Material Balance Equations (MBE), cont'd; One-dimensional analysis; Derivation of single phase fluid flow equations; continuity equation; Darcy´s equation; fluid and rock equations; initial and boundary conditions; analytical solutions

- Exercise 2: Material Balance Calculations
- Handout note 2: J. Kleppe: "Fluid Flow Equations"
- Exercise 3: Derivation and solution of single phase flow equations

Wednesday 30.8 (2 hrs)
Flow equations (cont'd); Non-horizontal flow; One-dimensional, horizontal, one-phase flow equation using Black Oil fluid description; Horizontal fluid flow equations for oil-water systems; multi-phase continuity equations; Darcy´s equations for multi-phase flow displacement of oil by water in a horizontal, linear system (H2);

Thursday 31.8 (2 hrs)
Oil-water flow (cont'd): Review of relative permeabilities and capillary pressures. Imbibition experiment in class room; Simplified solution methods: factors affecting flow conditions, diffuse and segregated flow conditions; Fractional flow equation; typical saturation profile in a linear system. The Buckley-Leverett problem; Fractional flow equation; typical saturation profile in a linear system; determination of front and average saturations at break-through; effects of mobility ratios and fractional flow curve on saturation profile; Frontal Advance Equation; computation of water saturation profile for displacement of oil by water; Capillary dispersion across water-oil interface. Gravity vs. viscous forces in reservoir flow, Vertical equilibrium conditions,

- Handout note 3: J. Kleppe: "Review of Relative Permeabilities and Capillary Pressures"
- Article: Oilfield Review, "Fundamentals of Wettability"
- Exercise 4: Buckley-Leverett Calculations

Wednesday 7.9 (2 hrs)
No lecture

Thursday 6.9 (2 hrs)
No lecture

Wednesday 13.9 (2 hrs)
Dietz stability analysis; derivation of equation for oil-water system. Stability of gas displacement vs. by water displacement; Stability of gas displacement vs. by water displacement

- Exercise 5: Dietz Analysis

Thursday 14.9 (2 hrs)
Summing up of Dietz Analysis Method; water-oil systems, gas-oil systems, North Sea conditions, The Oseberg Field case; Summing up of flow regimes; effects of dynamic forces, gravity and capillary pressure; layered reservoirs; vertical equilibrium conditions.
Dykstra-Parsons method for isolated layers (H4); Assumptions; Darcy velocity vs. frontal velocity; derivation of formulas.

- Handout note 6: J. Kleppe: "Dykstra-Parsons Method"
- Exercise 6: Dykstra-Parsons Calculations

Wednesday 20.9 (2 hrs)
Dykstra-Parsons method, cont'd; details of derivation of formulas, application procedure. Summing up. Use of drainage capillary pressures for computing initial equilibrium saturations in an oil-water reservoir;
Thursday 21.8 (2 hr)
Introduction to fractured reservoirs; concept of dual porosity system; Flow in fractured reservoirs; Warren-Root model; matrix properties and fracture properties; flow in fractured systems; Ekofisk properties; water flooding of fractured system; recovery by water flooding of a discontinuous, strongly water-wet system (H5); discussion of recovery of oil by spontaneous imbibition and forced imbibition for mixed-wet reservoirs; effect of capillary continuity between matrix blocks on recovery; gas-oil gravity drainage in fractured reservoirs; effect of capillary continuity on recovery.

- Handout note 7: Fractured reservoirs paper
- Exercise 7: Fractured Reservoir Calculations

Wednesday 27.9
Presentation of Group Project; definition of groups
Thursday 4.10
Group work - no lecture.
Wednesday 11.10
Discussion of Group Project in class, Q&A
Thursday 12.10
Group work - no lecture.
Wednesday 11.10
Q&A on the Group Project
Thursday 12.10
Group work - no lecture.
Wednesday 18.10
Q&A on the Group Project
Thursday 19.10
Group work - no lecture.
Tuesday 25.10
Q&A on the Group Project
Thursday 26.10
Group work - no lecture.

Wednesday 1.11
Q&A on the Group Project
Thursday 2.11
Group work - no lecture.
Wednesday 8.11
Q&A on the Group Project
Thursday 9.11
Group work - no lecture.
Wednesday 15.11
Q&A on the Group Project
Thursday 16.11
Final presentations of group work in P1