TPG 4145 overview

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Phase diagrams

◦ p-T and p-v diagrams for pure (single) component

- ◦ Types of phases
- ◦ Where do different phases lie on p-T and p-v diagram
- ◦ Definitions of critical point, normal boiling point and acentric factor
- ◦ Problem 1

◦ P-T and p-v diagrams for binary and multi component mixtures

- ◦ Difference between pure component and multi component phase diagrams
- ◦ Critical point, cricondentherm, cricondenbar, bubble point and dew point definitions
- ◦ Change in shape of phase envelope with change in composition of binary mixture

Reservoir fluid types and compositions

◦ Reservoir fluid classification
  ◦ Classification using field data (initial producing GOR, API, etc)
  ◦ Classification based on Phase diagrams
  ◦ How phase diagrams of different types differ
  ◦ Saturated and undersaturated reservoir fluids
◦ Compositions
  ◦ Types of components (paraffins, aromatics, etc.
  ◦ Types of sampling
  ◦ Lab procedures for measuring compositions and mathematical recombinations
  ◦ Reported compositions in mass, moles and volumes
  ◦ Conversions between mass and moles
  ◦ Compositions in terms of black oil PVT properties (Rs and rs)
  ◦ Difference between Rp, rs and Rs
  ◦ How to convert compositional data in Rs or rs (assuming zn+ ~ GOR)
  ◦ Ideal volume mixing for standard conditions

Phase Equilibria Calculations

◦ K-values

  ◦ Importance of K-values

  ◦ Behavior of K-values with respect to pressure and temperature

    ◦ Low pressure K-values

    ◦ High pressure K-values

    ◦ Convergence pressure

  ◦ Correlations for K-value estimation

    ◦ Wilson correlation

    ◦ Standing low pressure K-values

◦ Two phase equilibrium calculation

  ◦ Rachford Rice solution

  ◦ Effect of surface processing on oil/condensate recovery

  ◦ Simple parctical examples to illustrate the use of Rachford Rice equations

    ◦ Known measured y_i (x_i not known as company does not have oil chromatograph) and oil density. Asked to calculate z_i, x_i and producing GOR

    ◦ Known measured stock tank producing GOR and oil properties, asked to find x_i, y_i and z_i. Compare measured GOR with GOR calculated from z_i (assuming z_{n+} ~ GOR)

  ◦ Saturation pressure calculation using known z_i and p_k. How to find p_k for (z_i,T)?

Phase Equilibria Calculations – Phase Properties

◦ Types of PVT properties (density, viscosity, FVF, solution OGR/GOR)

◦ Why do we need them?

◦ Behavior of different properties with pressure and temperature for oil and gas

◦ Difference between wet and dry gas FVF

◦ Methods to calculate phase properties

  ◦ Correlations (chapter 03)

  ◦ Direct lab measurements (types of PVT tests)

  ◦ EOS

◦ Types of PVT experiments and which one is used on what type of reservoir fluid

◦ For each PVT experiment

  ◦ Procedure for conducting the experiment

  ◦ Raw data measured in the lab and how it is interpreted (e.g. for CCE how Vro, density, Zg, etc are calculated from Vo, Vt, m, zi, etc.)

  ◦ Types of reported data

Black oil PVT properties

◦ How are they calculated from PVT lab experiments (correction with separator test data)

◦ How to find the optimum separator conditions

◦ BO properties from known compositional data (how EOS calculates these)

   ◦ Known z_i of reservoir oil and gas,

   ◦ Known x_i and y_i from flash of each phase (from an EOS flash to standard conditions or assume $x_i=z_{n+}$ and $y_i=z_{n-}$)

   ◦ Calculate all six BO properties and denstites (reservoir oil density is not easy to calculate)

◦ BO tables for reservoir simulation

Fluid Flow

◦ Darcy law and its limitation

◦ Flow equation for steady state condition

◦ Steady state and pseudo steady state reservoir rate equation for gas wells

◦ Skin effect and classification of skin (total skin = S*+Dq)

◦ Forchimer equation and its components (A and B)

◦ What factors make A and B change over time

◦ How to determine A and B from different types of well tests

◦ Tubing rate equation

◦ How to merge reservoir rate and tubing rate equations for total pressure drop

◦ Applications of rate equations

  ◦ Tubing size selection

  ◦ Number of wells to sustain a certain plateau

  ◦ Etc.

Extra information

- ◦ Be careful in unit conversions
- ◦ Should have good idea of the text book (which chapters discuss what topics, relevant formulae, etc.)
- ◦ Sometimes you need to assume values for certain parameters that are used as input in calculations. Do not get confused!