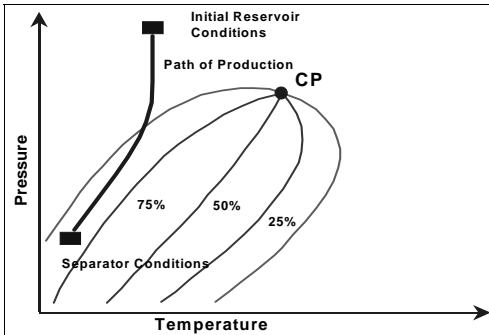


PETE 310

Lecture # 15
Properties of Black Oils
Definitions
(pages 224-240)

Phase Diagram of a Black Oil Reservoir



Properties of Black Oils Needed for Reservoir Engineering Calculations:

- Formation Volume Factor of oil B_o
- Total Formation Volume Factor of oil B_t
- Solution Gas oil Ratio R_s
- Coefficient of Isothermal Compressibility C_o

Properties of Black Oils Needed for Reservoir Engineering Calculations:

- Coefficient of isobaric thermal expansion β_o
- Oil Viscosity μ_o
- Interfacial Tension

Learning Goals

- Understand the behavior of those PVT properties (B_o, R_s, \dots) vs P and type of fluid (now)
- Evaluate PVT properties from (later)
 - Field data
 - Laboratory studies
 - Correlations

Definitions

- Specific gravity of a liquid

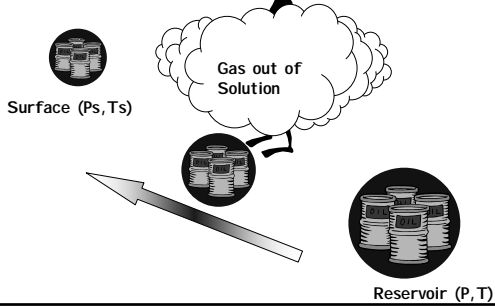
$$\gamma_o = \frac{\rho_o(P_1, T_1)}{\rho_w(P_1, T_1)}$$

- API gravity

$$^{\circ}API = \frac{141.5}{\gamma_o} - 135$$

Definitions

● Formation Volume Factor of Oil

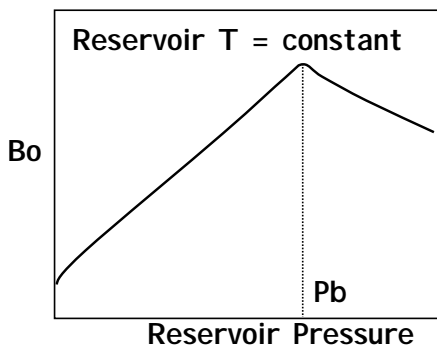


Definitions

Volume of Oil + Dissolved gas
 $B_o = \frac{\text{at Reservoir Pressure \& Temp.}}{\text{Volume of Oil entering Stock tank at } T_{sc}, P_{sc}}$

Units = Reservoir barrels (bb) / Stock tank barrels (STB)

General Shape of B_o



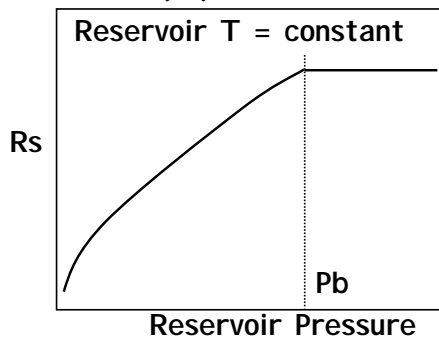
Solution Gas Oil Ratio (R_s)

- How much gas is dissolved in the oil volume per volume basis
- R_s depends upon pressure

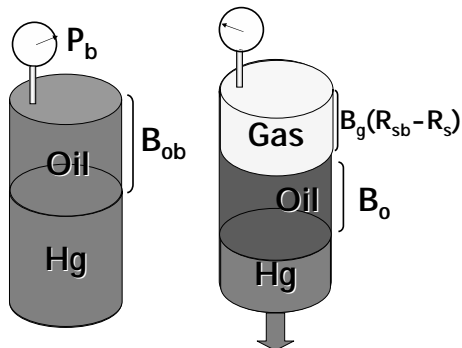
Units [=] SCF gas /STB oil



General Shape of Solution Gas Oil Ratio (R_s)



Total Formation Volume Factor B_t



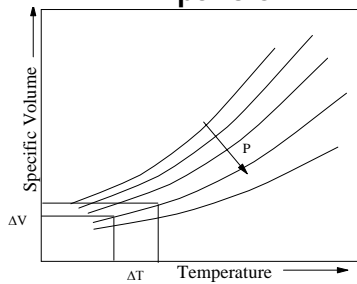
The Coefficient of Isothermal Compressibility of Oil

- Provides Instantaneous change of volume with P at constant T

$$C_o(P_A, T_A) = -\frac{1}{V} \left[\frac{\partial V}{\partial P} \right]_{T_A}$$

Also with molar volume
and specific volume

Coefficient of Thermal Expansion



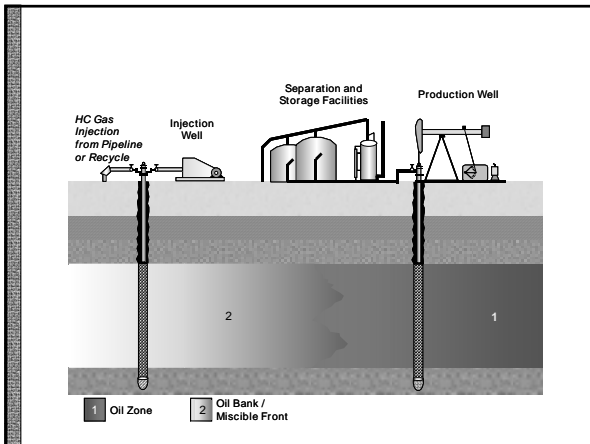
(Use in Steam Injection Processes)

Oil Viscosity

- Viscosity is a measure of the resistance to flow exerted by a fluid
- This is called dynamic viscosity and has units of
centipoise = g mass / 100 sec cm
- Kinematic viscosity is viscosity / density, units are in
centistokes = centipoise / g/cc

Needs of Crude Oil Viscosity

- Calculation of two-phase flow
- Gas-lift and pipeline design
- Calculate oil recovery either from natural depletion or from recovery techniques such as waterflooding and gas-injection processes



Variation of Oil Viscosity

