Gas Density (at Real Gas Condition)

Gas density at real condition is computed thus:

$$\boldsymbol{\rho = \frac{2.70 P \gamma_g}{zT}}$$

Note that density ρ is in lb_m/ft^3, T is in degree Rankine and P is in psi.

Bubble Point Pressure, P_b

Frequently, it is desired to determine bubble point pressure for an undersaturated reservoir, i.e. at what point will the undersaturated reservoir begin to liberate gas. The correlation below is applicable.

$$P_b = (18 \times 10^{y_g}) \left(\frac{R_{sb}}{\gamma_g}\right)^{0.83} \quad ----------2.32$$

Where $y_g = 0.00091 T_F - 0.0125\ ^oAPI$ ----------2.33

$$^oAPI = \frac{141.5}{\gamma_o} - 131.5$$

R_{sb} *is the solution gas oil ratio at or above bubble point pressure.*

Note: T_F is temperature in degree Fahrenheit.

Solution Gas-Oil Ratio, R_s

The correlation to calculate R_s at pressures below or equal to the bubble point is presented below. There is no need for a correlation to calculate R_s at pressures above bubble point because Rs is constant at pressures above bubble point down to bubble point pressure.

$$R_s = \gamma_g \left(\frac{P}{18 \times 10^{y_g}}\right)^{1.204} \quad ----------2.34$$

y_g *is still as defined by equation* 2.33

Oil Formation Volume Factor, B_o

Recall that the variation of Bo with pressure is divided into two regimes. See Figure 1

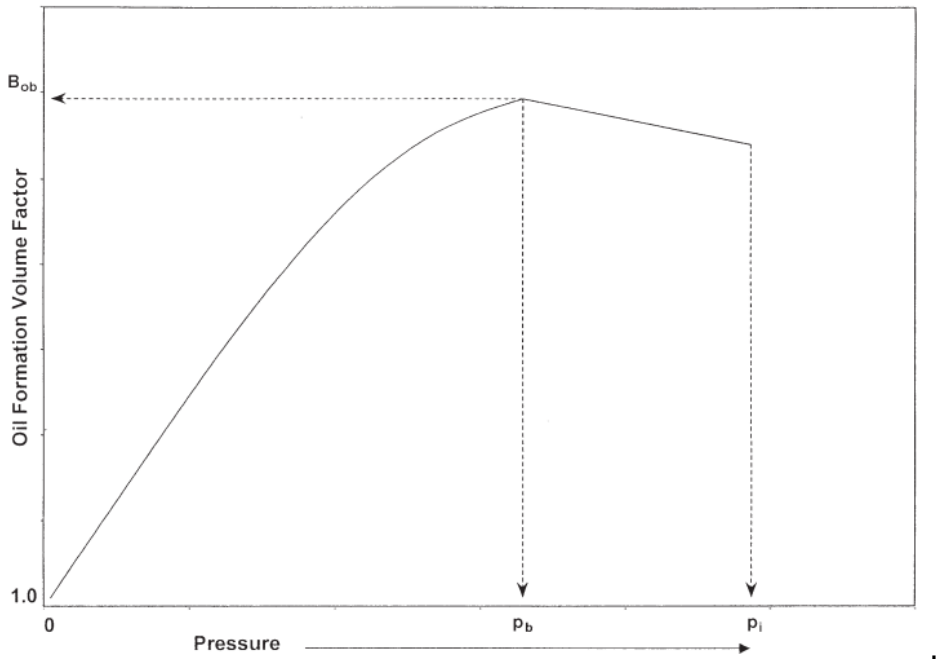

Figure 1: Variation of B_o with Reservoir Pressure

For pressures below or equal to bubble point, Standing's correlation for calculating Bo is herein presented:

$$B_o = 0.9759 + 0.00012F^{1.2} \quad ---------- 2.35$$

$$Where\ F = R_s\left(\frac{\gamma_g}{\gamma_o}\right)^{0.5} + 1.25T_F \quad ---------- 2.36$$

Note: T_F is temperature in degree Fahrenheit.

For pressure above bubble point, the analytical equation applicable is given as:

$$B_o = B_{ob}\exp[c_o(P_b - P)] \quad ---------- 2.37$$

B_{ob} *is the* B_o *at bubble point and can be calculated using equation* 2.35 *and* 2.36

Stock Tank Oil Initially In-Place (STOIIP)

The Stock Tank Oil Initially In-Place (STOIIP) is computed thus:

$$N = \frac{7758Ah\phi(1 - S_{wi})}{B_{oi}} \quad ----------4.5$$

Where:

STOIIP, N = Stock Tank Oil Initially in Place, STB

Area A = Drainage Area of the Reservoir, in Acres

Thickness h = productive oil zone thickness, in ft

Porosity ϕ = formation porosity, in fraction – the fraction of the bulk reservoir made up of pore spaces.

Saturation S_{wi} = initial water saturation, in fraction

B_{oi} = Oil Formation Volume Factor at initial reservoir pressure, RB/STB.

7758 = conversion factor