Slightly compressible Material Balance Pressure @model

Approximation of Material Balance Pressure @model for slightly compressibility flow:

(1)	$$p(t) = p_i + \frac{\Delta Q(t)}{V_\phi \cdot c_t}$$
(2)	$$\Delta Q = -\frac{B_o - R_s\, B_g}{1 - R_s\, R_v} \cdot Q_O^{\uparrow} + \frac{B_g - R_v\, B_o}{1 - R_s\, R_v} \cdot \left(Q_G^{\downarrow} - Q_G^{\uparrow} + Q_{GCAP}^{\downarrow} \right) + B_w \left(Q_W^{\downarrow} - Q_W^{\uparrow} + Q_{WAQ}^{\downarrow} \right)$$

where

$\Delta Q(t)$	Cumulative Voidage Replacement Balance (CVRB) over time t
$V_\phi = V \cdot \phi_i$	initial drainage volume of the main pay (excluding the aquifer and gas cap)
$\phi_i = \phi(p_i)$	initial porosity
$c_t = c_\phi + c_o\, s_{oi} + c_g\, s_{gi} + c_w\, s_{wi}$	total compressibility
c_ϕ	pore compressibility
s_{wi}	initial water saturation
s_{gi}	initial gas saturation
s_{oi}	initial oil saturation: $s_{oi} = 1 - s_{wi} - s_{gi}$
$c_o,\, c_g,\, c_w$	fluid compressibility of water phase, oil phase and gas phase

The equations (1) and (2) are often used in express assessment of thief water production share $\Omega_W^{\uparrow} = Q_{W,\rm true}^{\uparrow} / Q_W^{\uparrow}$ and thief water injection share $\Omega_W^{\downarrow} = Q_{W,\rm true}^{\downarrow} / Q_W^{\downarrow}$:

(3) $\quad p_i - p(t) = \alpha \cdot Q_O^{\uparrow}(t) + \beta \cdot Q_W^{\uparrow}(t) - \gamma \cdot Q_W^{\downarrow}(t)$		(4) $\quad \alpha > 0, \quad \beta > 0, \quad \gamma > 0$
(5) $\quad V_\phi = \frac{1}{\alpha \cdot c_t} \cdot \frac{B_o - R_s\, B_g}{1 - R_s\, R_v}$	(6) $\quad \Omega_W^{\uparrow} = \frac{Q_{W,\rm true}^{\uparrow}}{Q_W^{\uparrow}} = \frac{\beta}{\alpha} \cdot \frac{1}{B_w} \cdot \frac{B_o - R_s\, B_g}{1 - R_s\, R_v}$	(7) $\quad \Omega_W^{\downarrow} = \frac{Q_{W,\rm true}^{\downarrow}}{Q_W^{\downarrow}} = \frac{\gamma}{\alpha} \cdot \frac{1}{B_w} \cdot \frac{B_o - R_s\, B_g}{1 - R_s\, R_v}$

See Also

Petroleum Industry / Upstream / Production / Subsurface Production / Field Study & Modelling / Production Analysis / Material Balance Analysis (MatBal) / Material Balance Pressure @model

[Derivation of Slightly compressible Material Balance Pressure @model]

[Capacitance-Resistivity Model (CRM) @model]