# Slightly compressible Material Balance Pressure @model

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

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|---|---|
| (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

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|---|---|
| $\Delta Q(t)$ | 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 |
| $c_\phi$ | 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 $\Omega_W^{\uparrow} = Q_{W,\text{true}}^{\uparrow} / Q_W^{\uparrow}$ and thief water injection share $\Omega_W^{\downarrow} = Q_{W,\text{true}}^{\downarrow} / Q_W^{\downarrow}$:

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

## 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 ]