Watercut Fractional Flow @model

A proxy model of watercut $\mathrm{Y_W}$ in producing well with reservoir saturation $s = \{s_w, s_o, s_g\}$ and reservoir pressure p_e:

(1) $\mathrm{Y_{Wm}} = \dfrac{1-\epsilon_g}{1 + \frac{M_{ro}}{M_{rw}} \cdot \frac{B_w}{B_o}}$	(2) $\epsilon_g = \dfrac{A}{q_t} \cdot M_{ro} \cdot \left[\dfrac{\partial P_c}{\partial r} + (\rho_w - \rho_o) \cdot g \cdot \sin\alpha \right]$

where

$B_w(p_e)$	Water formation volume factor	$B_o(p_e)$	Oil formation volume factor	s	Reservoir saturation $\{s_w, s_o, s_g\}$
$M_{rw}(s)$	Relative water mobility	$M_{ro}(s)$	Relative oil mobility	p_e	Current formation pressure
ρ_w	Water density	ρ_o	Oil density	g	Standard gravity constant
q_t	Total sandface flowrate	A	Cross-sectional flow area	α	Deviation of flow from horizontal plane
$P_c(s)$	capillary pressure				

If capillary effects are not high $P_c \to 0$ or saturation does not vary along the streamline substantially $\dfrac{\partial s_w}{\partial r} \to 0$, then $\dfrac{\partial P_c}{\partial r} = \dot{P}_c \cdot \dfrac{\partial s_w}{\partial r} \approx 0$.

If flow is close to horizontal $\sin\alpha \to 0$ then gravity effects are vanishing too: $(\rho_w - \rho_o) \cdot g \cdot \sin\alpha \approx 0$.

In these cases (1) simplifies to:

(3) $$\mathrm{Y_{Wm}} = \frac{1}{1 + \frac{M_{ro}}{M_{rw}} \cdot \frac{B_w}{B_o}} = \frac{1}{1 + \frac{k_{ro}}{k_{rw}} \cdot \frac{\mu_w}{\mu_o} \cdot \frac{B_w}{B_o}}$$

The models (1) and (3) can also be used in production analysis assuming homogeneous reservoir water saturation s_w:

(4) $$s_w(t) = s_{wi} + (1 - s_{wi}) \cdot \mathrm{E_{Dow}(t)} = \mathrm{s_{wi}} + (1 - \mathrm{s_{wi}}) \cdot \mathrm{RFO(t)/E_S}$$

where

$\mathrm{RFO} = \dfrac{Q_O^{\uparrow}}{V_{\mathrm{STOIIP}}}$	current oil recover factor
$Q_O^{\uparrow}$	cumulative oil production
V_{STOIIP}	STOIIP
E_S	sweep efficiency
s_{wi}	initial water saturation
s_{orw}	residual oil saturation to water sweep

See Also

Petroleum Industry / Upstream / Subsurface E&P Disciplines / Well Testing (WT) / Flowrate Testing / Flowrate / Production Water cut (Yw)

[Watercut Diagnostics / Watercut Fractional Flow plot] [Watercut Correlation @model]

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