Dual-layer IPR

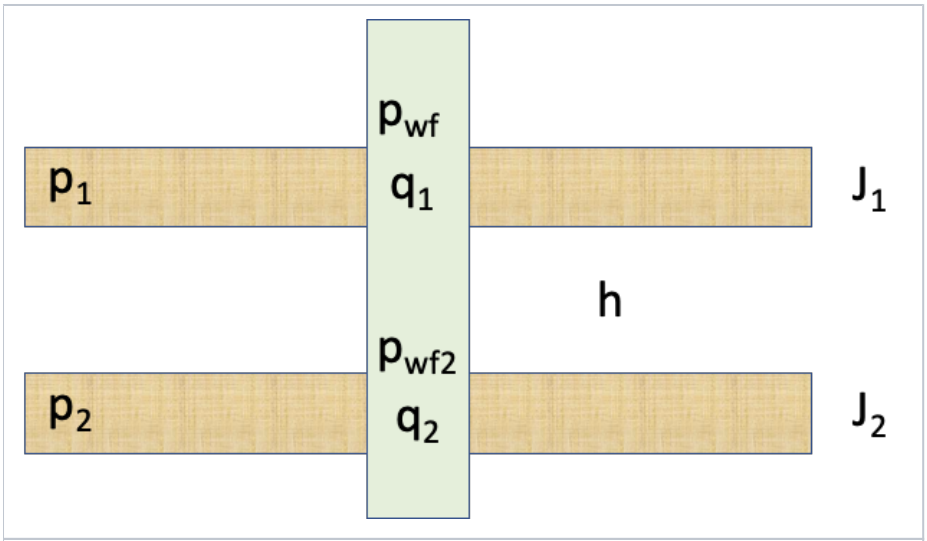

Fig. 1. Dual-layer well schematic

(1)	$q = q_1 + q_2$	(2)	$p_{wf} = p_e - q/J$	(3)	$J = J_1 + J_2$
(4)	$p_e = \frac{J_1 \cdot p_1 + J_2 \cdot (p_2 - \delta p_2)}{J_1 + J_2}$				

where

Well		
	q	total subsurface flowrate of the well
	J	total well productivity Index
	p_e	apparent formation pressure of dual-layer formation
Layer #1		
	$p_{wf} = p_{wf,1}$	bottom-hole pressure at Layer #1 top
	q_1	total subsurface flowrate of the Layer #1
	p_1	formation pressure of the Layer #1
	J_1	productivity Index of the Layer #1
Layer #2		
	$p_{wf2} = p_{wf} + \delta p_2$	bottom-hole pr4essure at Layer #2 top

	δp_2	wellbore pressure loss between the tips of two layers
	q_2	total subsurface flowrate of the Layer #2
	p_2	formation pressure of the Layer #2
	J_2	productivity Index of the Layer #2

In many practical cases one can safely assume:

(5) $$\delta p_2 = \rho\, g\, h$$

where

ρ	wellbore fuid density
g	gravity constant
$h = TVDSS_1 - TVDSS_2$	true vertical height between k-th layer and reference layer k_{reff}

The above equations are valid for both producers $q > 0$ and injectors $q < 0$.

(6) $$p_{wf,1} = p_{wf} = p_1 - q_1/J_1$$
(7) $$p_{wf,2} = p_{wf} + \delta p_2 = p_2 - q_2/J_2$$

This leads to

(8) $$q_1 = J_1 \cdot (p_1 - p_{wf})$$
(9) $$q_2 = J_2 \cdot (p_2 - p_{wf,2}) = J_2 \cdot ((p_2 - \delta p_2) - p_{wf})$$

and

(10) $$q = q_1 + q_2 = q_1 = J_1 \cdot (p_1 - p_{wf}) + J_2 \cdot ((p_2 - \delta p_2) - p_{wf})$$
(11) $$q = -(J_1 + J_2) \cdot p_{wf} + J_1 \cdot p_1 + J_2 \cdot (p_2 - \delta p_2)$$

or

(12) $$q = J \cdot (p_e - p_{wf}),\ \text{where } J = J_1 + J_2 \text{ and } p_e = J^{-1} \cdot (J_1 \cdot p_1 + J_2 \cdot (p_2 - \delta p_2))$$

See Also

Petroleum Industry / Upstream / Production / Subsurface Production / Subsurface E&P Disciplines / Field Study & Modelling / Production Analysis / Productivity Diagnostics

[Production Technology / Well Flow Performance]

[Formation pressure (Pe)] [Multi-layer IPR]