

Multi-layer IPR

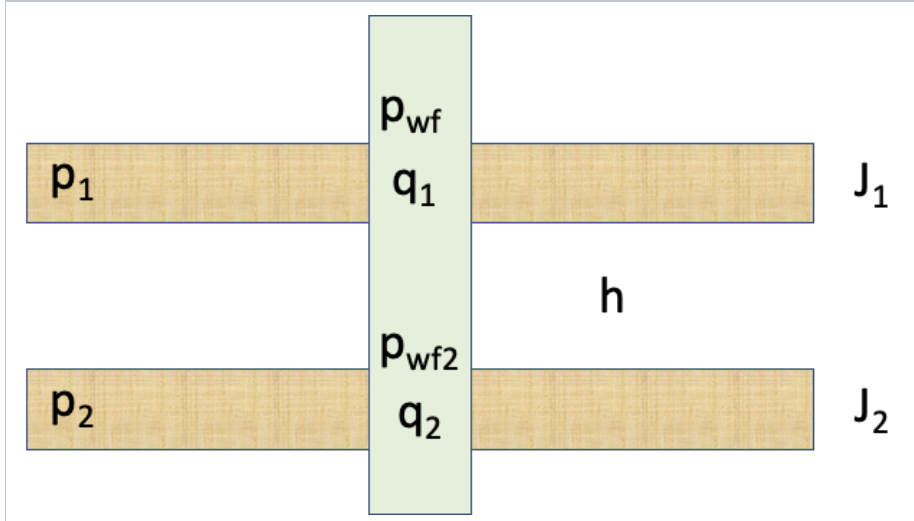


Fig. 1. Multi-layer well schematic

(1)	$q = \sum_{k=1}^N q_k$	(2)	$p_{wf} = p_e - q/J$	(3)	$J = \sum_{k=1}^N J_k$
(4)	$p_e = J^{-1} \cdot \sum_{k=1}^N J_k (p_k - \delta p_k)$				

where

q	total subsurface flowrate of the well
J	total well productivity Index
p_e	apparent formation pressure of dual-layer formation
$p_{wf} = p_{wf, k_{ref}}$	bottom-hole pressure at the top of the reference layer k_{ref}
$p_{wf, k} = p_{wf} + \delta p_k$	bottom-hole pressure at the top of the k -th layer
δp_k	wellbore pressure loss between k -th layer and reference layer k_{ref}
q_k	total subsurface flowrate of the k -th layer
p_k	formation pressure of the k -th layer
J_k	productivity Index of the k -th layer

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

In many practical cases:

(5) $\delta p_k = \rho \, g \, h_k$

where

ρ	wellbore fluid density
g	gravity constant
$h_k = TVDSS_k - TVDSS_{k_{ref}}$	true vertical height between k -th layer and reference layer k_{ref}

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