Productivity Index @model

The most accurate prediction of Productivity Index is based on numerical reservoir flow simulations.

Apart from this there are numerous proxy models covering popular categories of reservoir flow regimes, dynamic reservoir properties and well-reservoir contacts.

One of the most popular proxy model is Dupuit PI @model which covers a very wide range of stabilised reservoir flow.

A proxy model of Productivity Index for stabilised reservoir flow.

$$J = \frac{q}{p_{\rm frm} - p_{wf}} = \frac{2\pi\sigma}{\ln \frac{r_e}{r_w} - \epsilon + S} = \frac{2\pi \cdot \frac{k\,h}{\mu}}{\ln \frac{r_e}{r_w} - \epsilon + S}$$

where

q	depending on application may mean a total sandface flowrate (q_t) or a product of surface flowrate and FVF ($q = q_{\rm srf}\,B$)
p_{wf}	bottomhole pressure
$p_{\rm frm}$	depending on application may mean a drain-boundary formation pressure (p_e) or drain-area formation pressure (p_r)
σ	formation transmissibility
r_w	wellbore radius
r_e	distance to a drainarea boundary
S	total skin
ϵ	a model parameter depending on Productivity Index definition and boundary type ($\epsilon = \{0,\, 0.5,\, 0.75\}$, see **Table 1** below)

In case of homogeneous reservoir with only one vertical well producing the Dupuit PI @model is the exact analytical solution of Reservoir Flow Model (RFM).

Table 1. Variations to Dupuit PI @model depending on the reservoir flow regime and the definition/application of Productivity Index.

	Drain-area Productivity Index, $J_r = \frac{q}{p_r - p_{wf}}$	**Drain-boundary Productivity Index** $J_e = \frac{q}{p_e - p_{wf}}$
Steady State flow regime (SS)	$J_r = \frac{2\pi\sigma}{\ln \frac{r_e}{r_w} - 0.5 + S}$	$J_e = \frac{2\pi\sigma}{\ln \frac{r_e}{r_w} + S}$
Pseudo-Steady State flow regime (PSS)	$J_r = \frac{2\pi\sigma}{\ln \frac{r_e}{r_w} - 0.75 + S}$	$J_e = \frac{2\pi\sigma}{\ln \frac{r_e}{r_w} - 0.5 + S}$

For the fractured vertical well the geometrical skin-factor S_G is related to Fracture half-length X_f as:

(1) $$S_G = -\ln \left(\frac{X_f}{2\, r_w} \right)$$

$$J = \frac{q}{p_{\rm frm} - p_{wf}} = \frac{2 \pi \sigma}{\ln \frac{r_e}{r_w} - \epsilon + S} = \frac{2 \pi M \cdot h}{\ln \frac{r_e}{r_w} - \epsilon + S} = \frac{2 \pi k_{abs} \cdot h}{\ln \frac{r_e}{r_w} - \epsilon + S} \cdot M_r = T \cdot M_r(s_w, s_g)$$

See Also

Petroleum Industry / Upstream / Production / Subsurface Production / Subsurface E&P Disciplines / Production Technology / Productivity Index

[Dupuit PI @model]