Carter Leak-off Equation @model

The fluid velocity u_L across fracture area:

(1) $$u_L = \frac{C_L}{\sqrt{t - t_0}}$$

where

C_L	Carter leak-off coefficient
t	time
t_0	exposure time (also called fill-in time) which require for fracture area to get exposed to a fluid flow

The Carter leak-off coefficient C_L can be simulated numerically.

There are various analytical approximations, with the most popular being as:

(2) $$C_L = \Delta P \sqrt{\frac{k \phi c_t}{\pi \mu}}$$

where

$\Delta P = P_{wf} - P_e$	drawdown pressure across fracture face area
P_{wf}	bottom-hole pressure across fracture face area
P_e	formation pressure around fracture
k	reservoir phase permeability to fracture fluid
ϕ	reservoir porosity
μ	fracture fluid viscosity
$c_t = c_r + c_f$	total reservoir compressibility

Volumetric leak-off rate q_L is given by:

(3) $$q_L = 2 h_f X_f u_L = \frac{2 h_f X_f C_L}{\sqrt{t - t_0}}$$

where

h_L	leak-off fracture height (usually $h_L = h$, where h is net reservoir thickness)
X_f	fracture half-length

The Carter's leak-off productivity index is given by:

(4) $$J_L = \frac{q_L}{\Delta P} = 2 h_f X_f \sqrt{\frac{k \phi c_t}{\pi \mu (t - t_0)}}$$

See Also

Petroleum Industry / Upstream / Well / Well-Reservoir Contact (WRC) / Hydraulic fracture / Hydraulic Fracture @model