

Linear pressure diffusion @model

The general form of linear [single-phase pressure diffusion @model](#) with the finite number of sources/sinks is given by:

$(1) \quad \phi \cdot c_t \cdot \partial_t p + \nabla \mathbf{u} = \sum_k q_k(t) \cdot \delta(\mathbf{r} - \mathbf{r}_k)$	$(2) \quad \mathbf{u} = -M \cdot (\nabla p - \rho \mathbf{g})$
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where

$p(t, \mathbf{r})$	reservoir pressure	t	time
$\rho(\mathbf{r}, p)$	fluid density	$\mathbf{r}$	position vector
$\phi(\mathbf{r}, p)$	effective porosity	$\mathbf{r}_k$	position vector of the k -th source
$c_t(\mathbf{r}, p)$	total compressibility	$\delta(\mathbf{r})$	Dirac delta function
$q_k(t)$	sandface flowrates of the k -th source	∇	gradient operator
$M = k/\mu$	phase mobility	$\mathbf{g}$	gravity vector
k	formation permeability to a given fluid	$\mathbf{u}$	fluid velocity under Darcy flow
μ	dynamic viscosity of a given fluid		

Derivation of Linear pressure diffusion @model

The alternative form is to write down equations (1) and (2) in reservoir volume outside wellbore and match the solution to the fluid flux through the [well-reservoir contact](#):

$(3) \quad \phi \cdot c_t \cdot \partial_t p + \nabla \mathbf{u} = 0$	$(4) \quad \int_{\Sigma_k} \mathbf{u} d\mathbf{\Sigma} = q_k(t)$	$(5) \quad \mathbf{u} = -M \cdot (\nabla p - \rho \mathbf{g})$
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where

Σ_k	well-reservoir contact of the k -th well
$d\mathbf{\Sigma}$	normal vector of differential area on the well-reservoir contact , pointing inside wellbore

Many popular [1DR](#) solutions can be approximated by [Radial Flow Pressure Diffusion @model](#) which has a big methodological value.

The simplest analytical solutions for pressure diffusion are given by [1DL Linear-Drive Solution \(LDS\)](#) and [1DR Line Source Solution \(LSS\)](#)

The table below shows a list of popular well and reservoir pressure diffusion models.

Wellbore storage model	Well model	Reservoir model	Boundary model
Constant	Skin-factor	Homogeneous	Infinite
Fair	Vertical well	Dual-porosity	Circle No Flow
Rate-dependant	Fractured vertical well	Dual-permeability	Circle Constant P_i
	Limited entry well	Anisotropic reservoir	Single fault
	Horizontal well	Multi-layer reservoir	Parallel faults
	Slanted well	Linear-composite	Intersecting Faults
	Multifrac horizontal well	Radial-composite	

See also

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