

Single-phase pressure diffusion @model

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

(1) $\phi \cdot c_t \cdot \partial_t p + \nabla \mathbf{u} + c \cdot (\mathbf{u} \nabla p) = \sum_k q_k(t) \cdot \delta(\mathbf{r} - \mathbf{r}_k)$	(2) $\mathbf{u} = -M \cdot (\nabla p - \rho \mathbf{g})$	(3) $F_\Gamma(p, \mathbf{u}) = 0$
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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
$M = k/\mu$	phase mobility	∇	gradient operator
k	formation permeability to a given fluid	$\mathbf{g}$	gravity vector
μ	dynamic viscosity of a given fluid	$\mathbf{u}$	fluid velocity under Darcy flow
$q_k(t)$	sandface flowrates of the k -th well	Γ	reservoir boundary
$F_\Gamma(p, \mathbf{u})$	reservoir boundary flow condition through the reservoir boundary Γ , which is usually the aquifer or gas cap		

Derivation of Single-phase 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](#):

(4) $\phi \cdot c_t \cdot \partial_t p + \nabla \mathbf{u} + c \cdot (\mathbf{u} \nabla p) = 0$	(5) $\mathbf{u} = -M \cdot (\nabla p - \rho \mathbf{g})$
(6) $\int_{\Sigma_k} \mathbf{u} d\mathbf{\Sigma} = q_k(t)$	(7) $F_\Gamma(p, \mathbf{u}) = 0$

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
$q_k(t)$	sandface flowrates at the k -th well (could be injecting to or producing from the reservoir)

Physical models of pressure diffusion can be split into two categories: [Newtonian](#) and [Rheological \(non-Newtonian\)](#) based on the fluid stress model.

Mathematical models of [pressure diffusion](#) can be split into three categories: [Linear](#), [Pseudo-Linear](#) and [Non-linear](#).

These models are built using [Numerical](#), Analytical or Hybrid [pressure diffusion solvers](#).

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 \(LSS\)](#).

See also

[Physics](#) / [Mechanics](#) / [Continuum mechanics](#) / [Fluid Mechanics](#) / [Fluid Dynamics](#) / [Pressure Diffusion](#) / [Pressure Diffusion @model](#)

[[Aquifer Drive Models](#)] [[Gas Cap Drive Models](#)]

[[Linear single-phase pressure diffusion @model](#)]