Linear single-phase pressure diffusion @model

The general form of the Linear single-phase pressure diffusion @model with the finite number of sources/sinks Σ_k is given by:

(1) $\phi \cdot c_t \cdot \partial_t p + \nabla \mathbf{u} = \sum_k q_k(t) \cdot \delta(\mathbf{r} - \mathbf{r}_k)$	(2) $\mathbf{u} = -M \cdot (\nabla p - \rho \mathbf{g})$	(3) $\int_\Gamma \mathbf{u}\, d\boldsymbol{\Sigma} = q_\Gamma(t)$	
or			
(4) $\phi \cdot c_t \cdot \partial_t p + \nabla \mathbf{u} = 0$	(5) $\mathbf{u} = -M \cdot (\nabla p - \rho \mathbf{g})$	(6) $\int_{\Sigma_k} \mathbf{u}\, d\boldsymbol{\Sigma} = q_k(t)$	(7) $\int_\Gamma \mathbf{u}\, d\boldsymbol{\Sigma} = q_\Gamma(t)$

where

$p(t, \mathbf{r})$	reservoir pressure	t	time
$\rho(\mathbf{r})$	fluid density	$\mathbf{r}$	position vector
$\phi(\mathbf{r})$	effective porosity	$\mathbf{r}_k$	position vector of the k-th source
$c_t(\mathbf{r})$	total compressibility	$\delta(\mathbf{r})$	Dirac delta function
$M(\mathbf{r})$	reservoir fluid mobility $M(\mathbf{r}) = \frac{k(\mathbf{r})}{\mu}$	∇	gradient operator
$k(\mathbf{r})$	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 source	Γ	reservoir boundary
$q_\Gamma(t)$	flow through the reservoir boundary Γ, which is aquifer or gas cap		

Derivation of linear single-phase pressure diffusion @model

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)

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

Physics / Mechanics / Continuum mechanics / Fluid Mechanics / Fluid Dynamics / Pressure Diffusion / Pressure Diffusion @model / Single-phase pressure diffusion @model