Steady State Linear Pressure Diffusion @model

Motivation

In many practical cases the reservoir flow created by well or group of wells is getting aligned with a specific linear direction away from well.

This happens when well is placed in a channel or a narrow compartment. It also happens around fracture planes and conductive faults.

This type of flow is called linear fluid flow and corresponding PTA type library models provides a reference for linear fluid flow diagnostics.

Inputs & Outputs

Inputs		Outputs	
q_t	total sandface rate	$p(x)$	reservoir pressure
p_i	initial formation pressure		
d	reservoir channel width		
σ	transmissibility, $\sigma = \frac{k\,h}{\mu}$		
L	reservoir channel length towards the pressure support boundary		

k	absolute permeability
h	effective thickness
μ	dynamic fluid viscosity

Physical Model

Linear fluid flow	**Homogenous reservoir**	**Finite reservoir flow boundary**	**Zero wellbore radius**	**Slightly compressible fluid flow**	**Constant rate production**
$p(t, \mathbf{r}) \rightarrow p(x)$ $\mathbf{r} \in \mathbb{R}^2 = \{x, y\}$	$M(x,p) = M = \mathrm{const}$ $\phi(x,p) = \phi = \mathrm{const}$ $h(x) = h = \mathrm{const}$	$0 \leq x \leq L_e$	$x_w = 0$	$c_t(p) = c_r + c = \mathrm{const}$	$q_t = \mathrm{const}$

Mathematical Model

(1) $\frac{\partial p}{\partial t} = 0 \Leftrightarrow \frac{d^2 p}{dx^2} = 0$	(2) $p(t, x \to L_e) = p_i$	(3) $\left. \frac{\partial p(t,x)}{\partial x} \right\|_{x \to 0} = \frac{q_t}{\sigma\, d}$
(4) $p(x) = p_i - \frac{q_t}{\sigma\, d}(x - L_e)$		

Applications

See also

Physics / Fluid Dynamics / Linear fluid flow

[Radial Flow Pressure Diffusion @model]