Phase Permeability

@wikipedia

A measure of ability of a porous formation to allow a certain fluid to pass through it.

Symbol	Dimension	SI units	Oil metric units	Oil field units
k	L^2	m^2	md	md

For the laminar flow:

(1) $$k = \mu \cdot \frac{|\mathbf{v}|}{|\nabla p|}$$

where

μ	fluid viscosity
$\|\mathbf{v}\|$	fluid velocity
∇p	pressure gradient

Permeability depends on fluid type, filling the porous media and the fluid type which is sweeping through it which leads to splitting its value into a product of two components:

(2) $$k = k_a \cdot k_r$$

where

k_a	absolute permeability to air which is defined by the reservoir pore structure only, also denoted as k_{abs} or k_{air}
k_r	relative permeability to a given fluid which is defined by the interaction between fluid and reservoir matrix

In general case, permeability is anisotropic both in vertical and lateral directions and quantified by symmetric tensor value:

(3) $$k = \begin{bmatrix} k_{11} & k_{12} & k_{13} \\ k_{12} & k_{22} & k_{23} \\ k_{13} & k_{23} & k_{33} \end{bmatrix}$$

which can be diagonalized for a proper selection of coordinate axis $(\mathbf{e_1}, \mathbf{e_2}, \mathbf{e_3}) \rightarrow (\mathbf{e_x}, \mathbf{e_y}, \mathbf{e_z})$:

(4) $$k = \begin{bmatrix} k_x & 0 & 0 \\ 0 & k_y & 0 \\ 0 & 0 & k_z \end{bmatrix}$$

and characterized by 3 principal tensor components $k = (k_x, k_y, k_z)$

If not mentioned otherwise the permeability usually means absolute horizontal permeability: $k = k_h = \sqrt{k_x^2 + k_y^2}$.

See also

Natural Science / Physics / Fluid Dynamics / Percolation

Petroleum Industry / Upstream / Subsurface E&P Disciplines / Field Study & Modelling

[Petrophysics] [Basic reservoir properties] [Wettability] [Permeability] [Absolute permeability] [Horizontal permeability] [Vertical permeability] [kv/kh]

[Relative permeability]