Absolute Permeability

Permeability is the ability of the rock to transmit fluids. When the rock is saturated by a single phase fluid this property is called absolute permeability κ .
It is defined through Darcy's Law:

$$\frac{Q}{A} = -\frac{\kappa}{\mu}\frac{\partial p}{\partial x} \qquad (1)$$

where Q is the flow rate, A is the cross sectional area, μ is the fluid viscosity and p is the fluid pressure.

Effective Permeabilities

Reservoirs contain up to three phases: oil, water and gas and each phase interferes with the flow of the others.
The permeability of a reservoir rock to any one fluid j in the presence of others is its effective permeability κ_j.
It is defined through a generalization of Darcy's Law:

$$\frac{Q_j}{A} = -\frac{\kappa_j}{\mu_j}\frac{\partial p_j}{\partial x} \quad , j = o, g, w \tag{2}$$

κ_j depends on the values of fluid saturations.

Relative Permeabilities

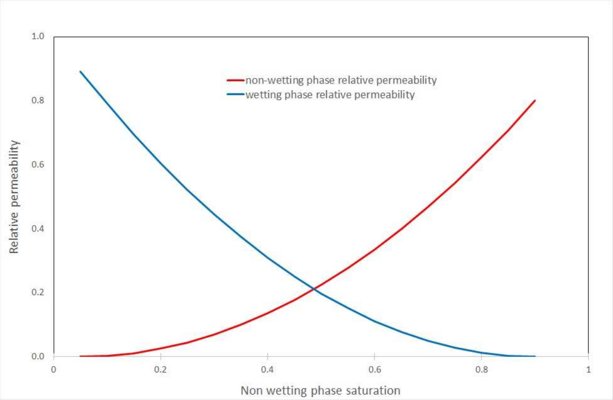
Relative permeability κ_{rj} to any one fluid j is the ratio of effective permeability κ_j to absolute permeability κ. Therefore, Darcy's Law becomes:

$$\frac{Q_j}{A} = -\frac{\kappa\kappa_{rj}}{\mu_j}\frac{\partial p_j}{\partial x} \tag{3}$$

Relative permeability can be expressed as a number between 0 and 1.0 or as a percent. Pore type and formation wettability affect relative permeability.

Relative Permeabilities for two-phase fluid flow

When a rock is saturated by two phases, one of them is considered the wetting phase (w) and the other one the non–wetting phase (nw).
A typical behavior of relative permeabilitiy curves is:



Capillary Pressure for two-phase fluid flow

Capillary pressure (P_c) is the pressure difference across the interface between two immiscible fluids arising from the capillary forces: surface tension and interfacial tension.
In porous media, the capillary pressure is the difference between the pressure in the non-wetting phase and the pressure in the wetting phase:

$$P_c = p_{nw} - p_w \tag{4}$$

P_c depends on the values of fluid saturation.

Capillary Pressure for two-phase fluid flow

A typical behavior of the Capillary Pressure curve is: