Cozeny-Karman permeability @model

@wikipedia

One of the Absolute permeability models based on simulating the flow through the multi-pipe conduits or multi-grain pack:

(1) $k = 1014.24 \cdot \mathrm{FZI}^2 \cdot \frac{(\phi - \phi_0)^3}{(1 - \phi + \phi_0)^2}$	(2) $\mathrm{FZI} = \frac{1}{\sqrt{F_S}\, S_{gV}\, \tau}$

where

FZI	Flow Zone Indicator	$S_{gV} = \Sigma_e / V_\phi$	surface pore area per unit pore volume	Σ_e	pore surface area
ϕ	effective porosity	F_S	pore shape factor	V_ϕ	pore volume
ϕ_0	porosity cut-off	τ	pore channel tortuosity		

The alternative form is derived from the correlation which is valid in some practical cases:

(3) $$\frac{1}{\sqrt{F_S}\, S_{gV}} \approx 0.0037 \cdot d$$

where

d	average grain size

so that Absolute permeability is going to be:

(4) $$k = \frac{d^2}{72 \cdot \tau^2} \cdot \frac{(\phi - \phi_0)^3}{(1 - \phi + \phi_0)^2}$$

where

k	absolute permeability
ϕ	effective formation porosity
ϕ_0	porosity cut-off
d	grain size
τ	pore channel tortuosity

This correlation was historical the first physical permeability model, based on the fluid flow in porous media with simplified structure consisted of a bunch of independent capillaries with various diameters.

Later on it's been upgraded to percolation through inter-grain porous space which specifies the Flow Zone Indicator FZI as a function of grains size distribution, grain shape and packing.

The most popular correlation with a mean grain size D_g is given as:

(5) $$FZI = a \cdot D_g$$

where coefficient a is a function of grain shape, packing, inter-grain clay and, as a consequence, of inter-grain effective porosity ϕ.

See also

Petroleum Industry / Upstream / Subsurface E&P Disciplines / Petrophysics / Absolute permeability / Absolute permeability @model

References

J. Kozeny, "Ueber kapillare Leitung des Wassers im Boden." Sitzungsber Akad. Wiss., Wien, 136(2a): 271-306, 1927.