Waxman-Smits-Thomas Model (WST) @model

One of the saturation from resistivity models:

(1) $$\frac{1}{R_t} = \phi_t^m s_{wt}^n \left[\frac{1}{R_w} + \frac{1}{s_{wt}}\frac{1}{R_{sh}}\right]$$

and saturation is given by

(2) $$s_w = \frac{s_{wt} - s_{wb}}{1 - s_{wb}}$$

(3) $$s_{wb} = \frac{V_{wb}}{V_t}$$

(4) $$\frac{1}{R_{sh}} = s_{wb}\left(\frac{1}{R_{wb}} - \frac{1}{R_w}\right)$$

where

s_w	formation water saturation	
s_{wb}	bound water saturation	
ϕ_e	effective porosity	
V_{sh}	shaliness	
R_t	total measured resistivity from OH logs	
R_w	formation water resistivity	
R_{sh}	wet clay resistivity	
A	dimensionless constant, characterising the rock matrix contribution to the total electrical resistivity	0.5 ÷ 1, default value is 1 for sandstones and 0.9 for limestones
m	formation matrix cementation exponent	1.5 ÷ 2.5, default value is 2
n	formation matrix water-saturation exponent	1.5 ÷ 2.5, default value is 2

In some practical cases, the clay resisitvity R_{sh} can be expressed as:

(5) $$\frac{1}{R_{sh}} = B \cdot Q_V$$

where

B	conductance per cat-ion (mho · cm^2/meq)
Q_V	Cation Exchange Capacity (meq/ml)

and both can be measured in laboratory.

The other model parameters still need calibration on core data.

See Also

Petroleum Industry / Upstream / Subsurface E&P Disciplines / Petrophysics

Well & Reservoir Surveillance / Well logging / Reservoir Data Logs (RDL) / Formation Resistivity Log @model