Pores / air filled pores / Permeability

Prof. Dr.-Ing. habil W. Bidlingmaier & Dr.-Ing. Christian Springer

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Total proportion of voids

$$n = \frac{\rho}{1 + \frac{w}{100} * \rho_s} \; [\%]$$

ρ	apparent density	[g/cm^3]
w	content of water TS	[%]
ρ_s	particle density	[g/cm^3]

Air filled porosity

$$n_a = \left(1 - \left(\frac{w}{100} * \rho_d\right) - \frac{\rho_d}{\rho_s}\right) * 100$$

n_a	air filled porosity	[%]
w	water content TS	[%]
ρ_d	dry density	[g/cm^3]
ρ_s	particle density	[g/cm^3]

Water-filled voids

$n_w = n - n_a$ [%]

n_w	water-filled voids	[%]
n	total proportion of voids	[%]
n_a	air filled porosity	[%]

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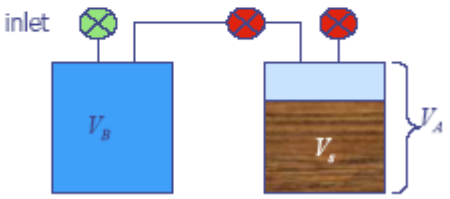
By Tom Richards

Air-filled Porosity (free air space) : ε_a

Experimental analysis:

$$\varepsilon_a = \frac{\left(\frac{P_i V_B}{P_f}\right) - V_A - V_B + V_S}{V_S}$$

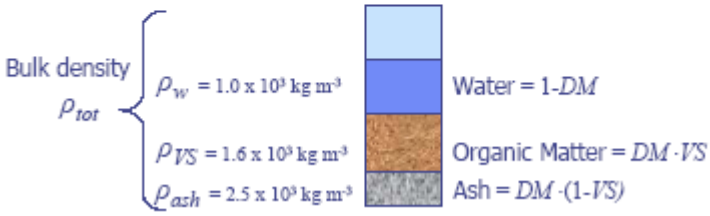
Air pycnometer:

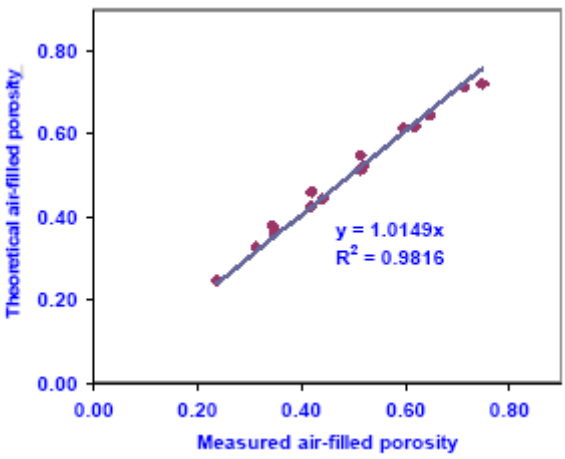


Air-filled Porosity (free air space) : ε_a

Theoretical equation:

$$\varepsilon_a = 1 - \rho_{tot} \cdot \left(\frac{(1 - DM)}{\rho_w} + \frac{DM \cdot VS}{\rho_{VS}} + \frac{DM \cdot (1 - VS)}{\rho_{ash}} \right)$$





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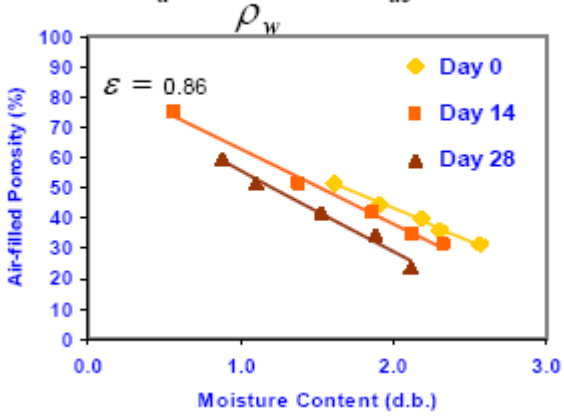
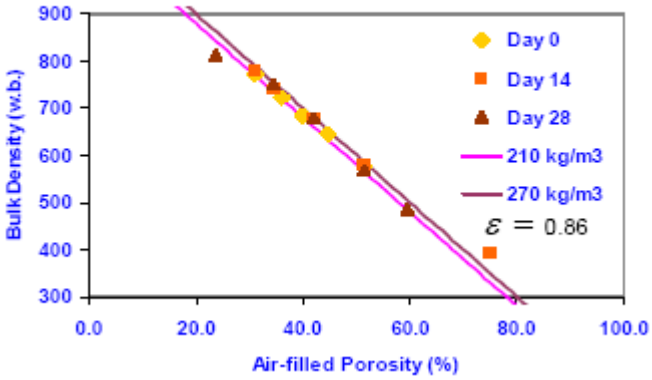
$$\varepsilon_a = \frac{\rho_{db}}{\rho_w} \cdot MC_{db} + \varepsilon$$



$$\rho_{tot} = -\rho_w \cdot \varepsilon_a + \left(\rho_{db} + \varepsilon \cdot \rho_w\right)$$



Effect of porosity on permeability

$$-\frac{dP}{dx} = \frac{\mu}{\kappa} v + \frac{\rho_a}{\eta} v^2$$

$$\kappa = \frac{d_p^{\,2}}{A} \frac{\varepsilon_a^{\,3}}{(1-\varepsilon_a)^2}$$