Problem 4-23

a. Use ROSETTA (Schaap et al., 1998) to calculate the hydraulic parameters for the van Genuchten (1980) hydraulic model of the following particle sizes and bulk densities:

Table 4-7: Particle sizes and bulk densities for 4 soils

Soil #	Sand (%)	Silt (%)	ρ_b (g cm^{-3})
1	20	70	1.2
2	40	50	1.3
3	60	20	1.4
4	80	5	1.5

The ROSETTA program can be downloaded free of charge from the US Salinity Laboratory's web site (http://www.ars.usda.gov/Services/docs.htm?docid=8953).

Answer:
The following table gives the van Genuchten model parameters for the four soils.

Table 4-8: van Genuchten parameters for 4 soils

Soil	α_{VG} (cm^{-1})	n (-)	θ_s (cm^3 cm^{-3})	θ_r (cm^3 cm^{-3})
1	0.004	1.7	0.44	0.06
2	0.007	1.6	0.39	0.05
3	0.02	1.4	0.42	0.06
4	0.03	1.6	0.40	0.06

b. What will be the corresponding parameters for the Brooks and Corey (1964) hydraulic model?

Answer:
The Brooks and Corey water retention model is:

$$\theta = (\theta_s - \theta_r)\left(\alpha_{BC}\left|h\right|\right)^{-\lambda} + \theta_r \qquad \text{for } \alpha_{BC}\left|h\right| > 1$$

To find the values of α_{BC} and λ for each soil listed in the table, use the van Genuchten parameters and the following van Genuchten water retention model to predict θ(h). Then use the predicted $\theta(h)$ in RETC to calculate the corresponding best-fit α_{BC} and λ values for each soil.
For the first soil listed in the table, α_{BC} = 0.007 cm^{-1} and λ = 0.462.
van Genuchten model:

where $m = 1 - \frac{1}{n}$

As visible in the following figure, the two models give nearly identical water retention curves using this approach except near saturation where the Brooks-Corey model reaches a plateau of saturation when the product of $\square_{BC}$ and absolute value of *h* exceeds one or when *h* exceeds the soil's air entry pressure head of -100 cm.

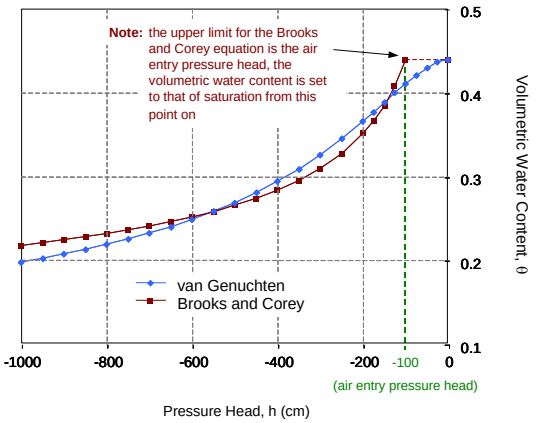

Fig. 4-19: Retention curves for two hydraulic models