Groundwater Cycle

V2.5: Porosity

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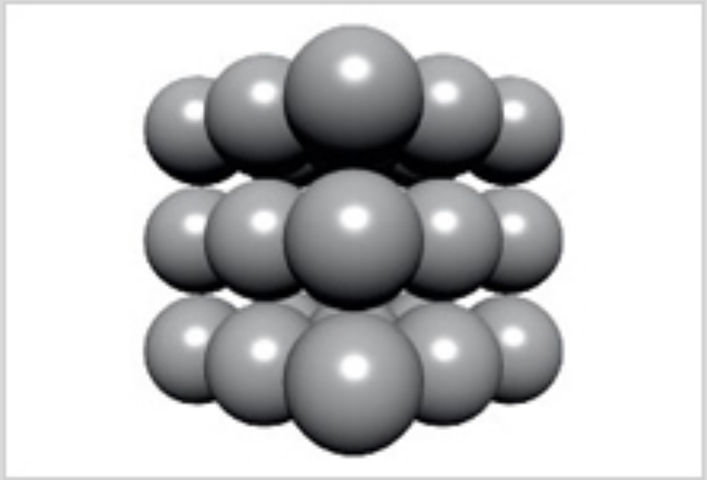
2.5 : Porosity

Porosity is the ratio of the volume of voids to the total volume, or the amount of void space that water can occupy in a porous media:

$$\eta = \frac{V_v}{V_T} * 100$$

Porosity is a percent volume!

2.5 : Porosity



Considering the simple case of cubic packing of spheres, one can calculate the maximum porosity as:

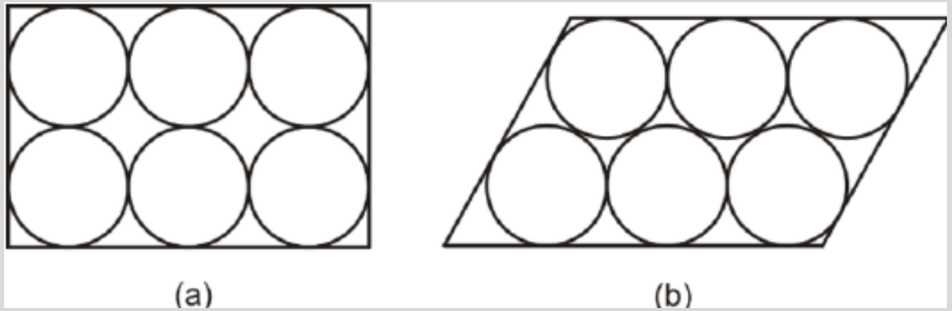
$$\eta = \frac{(2r)^3 - \frac{4}{3}\pi r^3}{(2r)^3}$$
$$= \frac{8 - \frac{4}{3}\pi}{8}$$
$$\approx 0.5$$

Real porosity is of course less, because smaller grains occupy the voids, grains are never perfect spheres, cubic packing is unstable.

2.5 : Porosity

Cubic packing:

Rhombohedral packing:



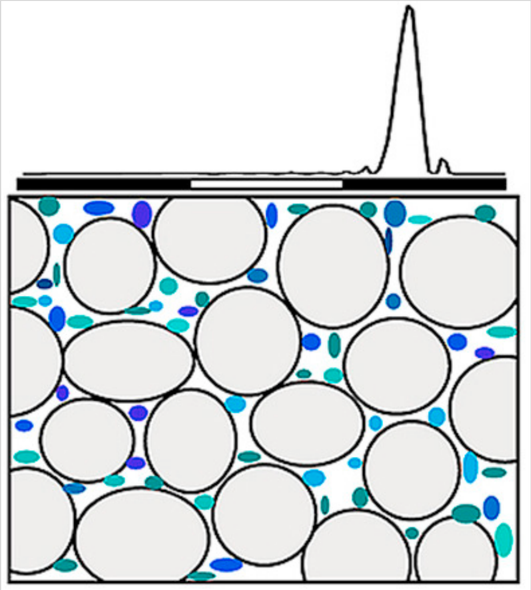
$$\eta = 0.5 = 50\,\%$$

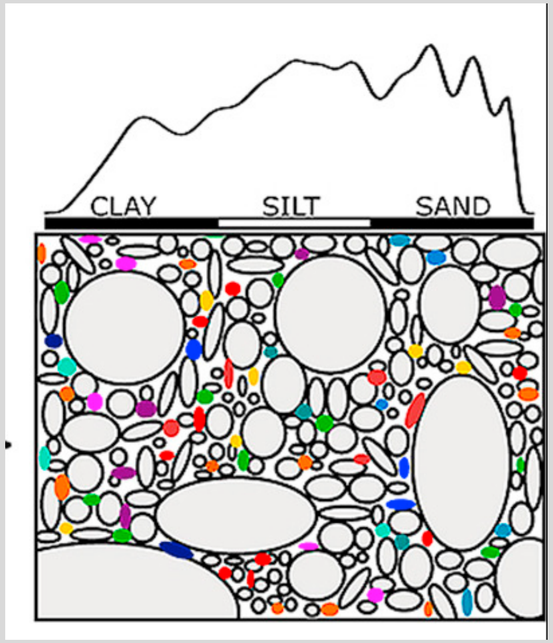
$$\eta = 0.26 = 26\,\%$$

Porosity does not depend on the diameter of the grain!

2.5 : Porosity

Real porosity is of course less, because smaller grains occupy the voids and grains are never perfect spheres.





Adapted from Seaton et al. "Soil textural heterogeneity impacts bacterial but not fungal diversity." *Soil Biology and Biochemistry* (2020).

2.5 : Porosity

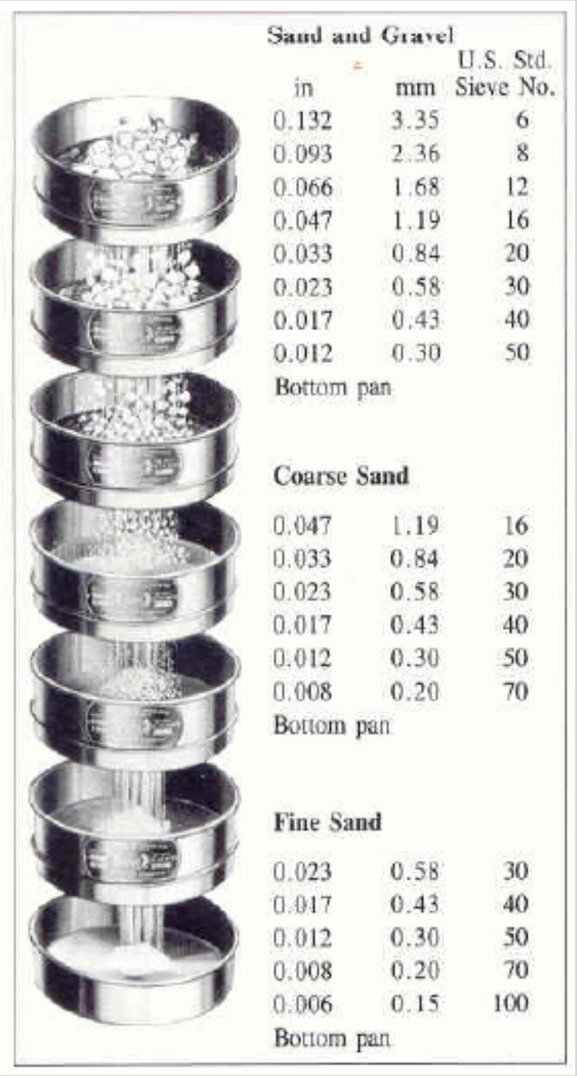
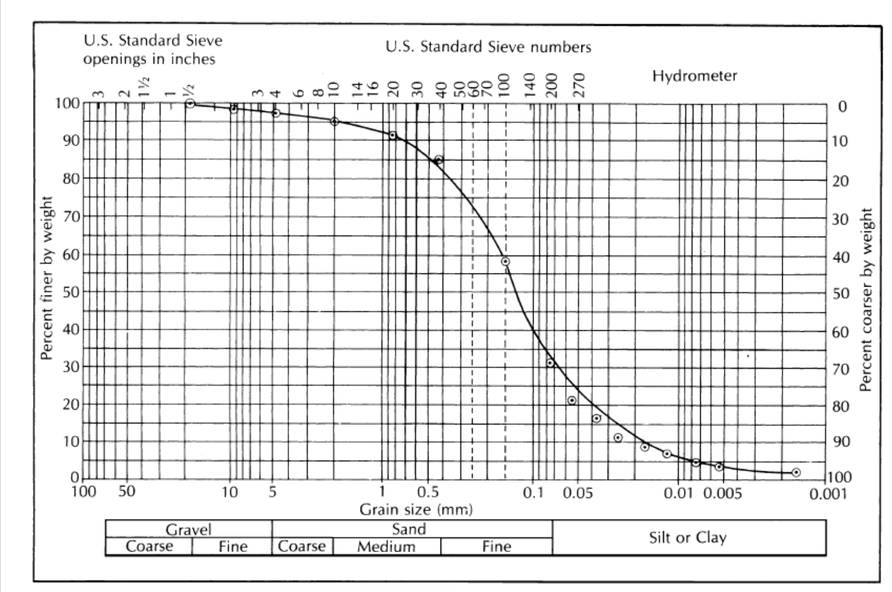


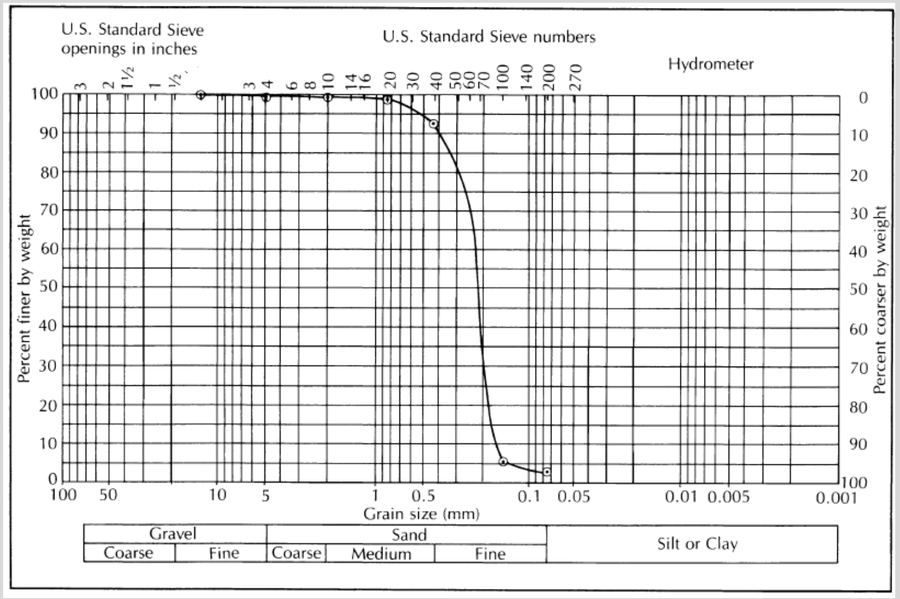
Table 3.2 Engineering Grain-Size Classification

Name	Size range (mm)	Example
Boulder	>305	Basketball
Cobbles	76–305	Grapefruit
Coarse gravel	19–76	Lemon
Fine gravel	4.75–19	Pea
Coarse sand	2–4.75	Water softener salt
Medium sand	0.42–2	Table salt
Fine sand	0.075–0.42	Powdered sugar
Fines	<0.075	Talcum powder

2.5 : Porosity



Cu=8.3



Cu=1.4

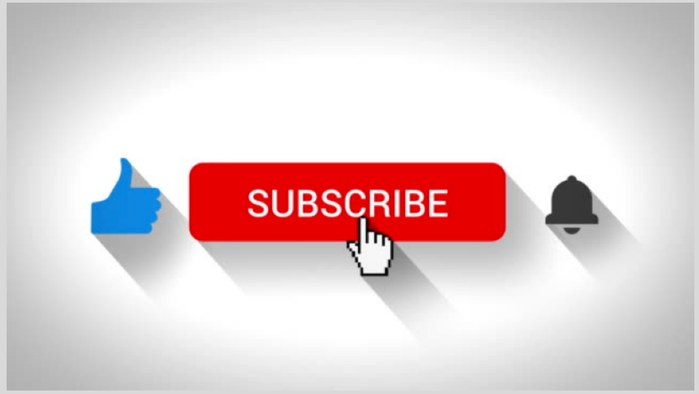
Grain Size Distribution

Uniformity Coefficient: $C_u = d_{60}/d_{10}$

Effective porosity= d_{10}

2.5 : Porosity

Groundwater Cycle



Porosity

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