

Problem 14-04 Capillary elevation

The wall of your cattle shed became wet up to the height of 1.5 m. Assuming the complete wetting, estimate an effective diameter of the pore in the wall. For the surface tension take the value of 71 mN m^{-1} , for density 1 g cm^{-3} . What pressure you should apply to prevent water from entering the wall?

$$[d = 19.3 \text{ } \mu\text{m}; \Delta p = 14.715 \text{ kPa}]$$

Solution:

$$h = 1.5 \text{ m}$$

$$\gamma = 71 \text{ mN m}^{-1} = 0.071 \text{ N m}^{-1}$$

$$\rho = 1 \text{ g cm}^{-3} = 1000 \text{ g cm}^{-3}$$

$$\theta = 0^\circ, \quad \cos \theta = 1$$

$$h \rho g = \frac{2\gamma}{r} \cos \theta$$

$$r = \frac{2\gamma}{h \rho g} = \frac{2 \cdot 0.071}{1.5 \cdot 1000 \cdot 9.81} = 9.65 \cdot 10^{-6} \text{ m} = 9.65 \text{ } \mu\text{m}$$

$$d = 2 \cdot 9.65 = 19.3 \text{ } \mu\text{m}$$

Laplaceova-Youngova rovnice

$$\Delta p = \frac{2\gamma}{r} = \frac{2 \cdot 0.071}{9.65 \cdot 10^{-6}} = 14715 \text{ Pa} = 14.715 \text{ kPa}$$

