

1.34 WASTE CONTAINMENT AND SITE REMEDIATION TECHNOLOGY HOMEWORK 2 – DUE FEBRUARY 27, 2004

Question 1

A cubic meter of unsaturated soil is contaminated by TCE at a residual saturation of 0.2. You can assume the soil porosity is 0.25. Rain water infiltrates at a rate of 500 mm/year (typical for sand and gravel aquifers in Massachusetts). How long will the soil remain contaminated assuming that dissolution into the infiltrating water is the only removal mechanism?

Question 2

- A pool of Tetrachloroethylene (PCE) has formed above a vertical fracture of circular cross section having an average diameter, D , of 2 μm . Water pressure conditions in the fracture and the overlying aquifer are hydrostatic. Estimate the height of the PCE pool, H_c that must form above the fracture entrance before DNAPL invasion of the fracture takes place.
- If the fracture were planar in shape, having an average opening of 2 μm , what would the new value of H_c be?

Question 3

An underground tank storing gasoline has been leaking into the subsurface for 10 years. Ground-water flow in the soil surrounding the tank is horizontal, under an average hydraulic gradient of 0.005. How far downstream of the tank would you extend an investigation program of ground-water contamination at the site if the surrounding soil is predominately made up of the following?

- Coarse sand
- Fine sand
- Silt
- Clay

You can presume the gasoline contains MTBE which is not retarded. How would your results change if you were only concerned about the benzene in the gasoline? (Give a quantitative answer.)

Question 4

The Union Chemical Superfund Site in South Hope, Maine is contaminated by numerous chemicals including tetrachloroethylene (PCE), trichloroethylene (TCE), and xylene. The site soils are clayey-silty glacial till. Slug tests on the site have measured the hydraulic conductivity to vary with a geometric mean hydraulic conductivity of 1.6×10^{-4} cm/sec. The water table slopes toward Quiggle Brook on the east with a gradient of about 0.035. Ground-water contamination is found as far as about 400 feet away from Quiggle Brook. The fraction organic carbon has not been measured in the site soils.

For the three compounds named above, estimate the retardation coefficient and time of travel from the furthest contamination to Quiggle Brook. (Hint: the reference information on chemicals in the course reader can help with estimating parameters.)

Comment on the likelihood of the chemicals actually reaching the brook.