

6.4.2 EVALUATE THE POTENTIAL THAT "FREE" PRODUCT NAPL IS PRESENT @ SI

Worksheet 7-2: Method for Assessing Residual NAPL Based on Organic Chemical Concentrations in Soil Samples (from Newell and Ross, 1992; after Feenstra et al., 1991)

To estimate if NAPLs are present, a partitioning calculation based on chemical and physical analyses of soil samples from the saturated zone (from cores, excavation, etc.) can be applied. This method tests the assumption that all the organics in the subsurface are either dissolved in groundwater or adsorbed to soil (assuming dissolved-phase sorption, not the presence of NAPL). By using the concentration of organics on the soil and the partitioning calculation, a theoretical pore-water concentration of organics in groundwater is determined. If the theoretical pore-water concentration is greater than the estimated solubility of the organic constituent of interest, then NAPL may be present at the site. A worksheet for performing this calculation is presented below; see Feenstra et al. (1991) for the complete methodology.

Step 1: Calculate S^* , the effective solubility of organic constituent of interest. See Worksheet 7-1.

Step 2: Determine K_{oc} , the organic carbon-water partition coefficient from one of the following:

- Appendix A and associated references or
- Empirical relationships based on K_{ow} , the octanol-water partition coefficient, which also is found in Appendix A. For example, K_{oc} can be estimated from K_{ow} using the following expression developed for polyaromatic hydrocarbons:

$$\log K_{oc} = 1.0 \cdot \log K_{ow} - 0.21$$

Step 3: Determine f_{oc} , the fraction of organic carbon on the soil, from a laboratory analysis of clean soils from the site. Values for f_{oc} typically range from 0.03 to 0.00017 mg/mg. Convert values reported in percent to mg/mg.

Step 4: Determine or estimate ρ_b , the dry bulk density of the soil, from a soils analysis. Typical values range from 1.8 to 2.1 g/ml(kg/l). Determine or estimate θ_w , the water-filled porosity.

Step 5: Determine K_d , the partition (or distribution) coefficient between the pore water (ground water) and the soil solids:

$$K_d = K_{oc} \cdot f_{oc}$$

Step 6: Using C_t , the measured concentration of the organic compound in saturated soil in mg/kg, calculate the theoretical pore water concentration assuming no DNAPL (i.e., C_w in mg/l):

$$C_w = \frac{(C_t \cdot \rho_b)}{(K_d \cdot \rho_b + \theta_w)}$$

C_t = total concentration in saturated soil

C_w = concentration in water only.

← Equilibrium concentration

Step 7: Compare C_w and S^* , (from Step 1):

$C_w > S^*$, suggests possible presence of DNAPL
 $C_w < S^*$, suggests possible absence of DNAPL

← Remaining source of DNAPL (in the sample)

* May measure C_w directly by pore-water extraction