**TITLE:** **Use of Soil Partitioning Coefficient to Evaluate Leaching**

**DATE EFFECTIVE:** August 2005

**HISTORY:** Update of VA30007.09.031 - Revision was necessary to reflect changes in the rule citations that became effective in August 2014.

**KEYWORDS:** Leaching, soil partitioning coefficient, protection of ground water

**RULE/ AUTHORITY:** OAC 3745-300-07(F)(4)(a)(i); 3745-300-10(D) and (E)

**QUESTION:** Is there a simple method that can be used to demonstrate that leaching of contaminants from soil to an underlying ground water zone is not a concern at a property?

**BACKGROUND:** The evaluation of the leaching of contamination in soil to ground water is required by OAC 3745-300-07(F)(4)(a)(i) and 3745-300-10(D) when the underlying ground water zone meets unrestricted potable use standards (UPUS). In addition, an evaluation of leaching and migration to a compliance point may also be necessary in accordance with OAC 3745-300-10(E)(3), which details ground water response requirements depending on the classification of the ground water zone.

**ANSWER:** While a straightforward method exists, the leaching of contaminants is highly specific to each property, and no single approach may be suitable for all cases. Therefore, it is essential to consider property-specific factors such as contaminant conditions, geology, climate, and subsurface characteristics before selecting a method. Furthermore, various physical, chemical, and biological processes can influence the extent of contamination reaching a groundwater zone. Key contaminant loss mechanisms may include volatilization, sorption to soil particles, dissolution in soil water, and natural degradation of the chemical compound.

The method described below focuses solely on the sorption of contaminants onto soil particles, neglecting other mechanisms. As such, it is simple but conservative, best used as a tool for developing screening levels. For more comprehensive methods that account for additional loss mechanisms, including dilution and separation distance, refer to TGC VA30007.14.016.

One simple method for determining soil cleanup objectives is based on the Water-Soil Equilibrium Partition theory, which relies on the ability of organic carbon in soil to adsorb contaminants. The concentration that could be left in soil and still be protective of ground water may be calculated using the following method:

$$C_s = F_{oc} * K_{oc} * C_w$$

where,

$C_s$ = allowable soil concentration or soil screening number, ppm (mg/kg)

$F_{oc}$ = fraction of organic carbon in soil, unitless

$K_{oc}$ = partition coefficient between octanol and carbon (obtained from literature), L/kg, and

$C_w$ = appropriate water quality standard (MCL/background/risk-based), ppm (mg/L)

Note: The product of $F_{oc}$ and $K_{oc}$ is also referred to as $K_d$ (soil adsorption coefficient).

**APPLICATION:** The application of this method is demonstrated through the following example: Given a water quality standard for TCE of 5 ppb (0.005 ppm), a Koc for TCE of 204 L/kg, and an organic fraction in soil of 0.15% (0.0015), the allowable concentration of TCE in soil is calculated as 0.00153 ppm (1.53 ppb). The calculation is as follows:

0.005 mg/L * 204 L/kg * 0.0015 = 0.00153 mg/kg.

Therefore, any concentration of TCE in the soil exceeding 1.53 ppb could pose a risk to the groundwater pathway. However, this does not mean that the soil cleanup standard must be set at 1.53 ppb. The volunteer has the option to conduct a property-specific leaching assessment or use generic leaching standards appropriate for the soil type to establish an alternative cleanup level. The key inference is that if soil concentrations are below 1.53 ppb and other site conditions (such as geology) suggest that leaching is unlikely to be a concern, the volunteer may not need to perform a property-specific leaching study.

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