ARCHIVE: **Archived due to the 2014 rule revision. Revision was necessary to update rule citations within the TGC. Refer to VA30007.14.015 for the updated document.**

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

DATE EFFECTIVE: August 2005

HISTORY: Update of VA30007.05.004 - Revision was necessary to reflect changes in the rule citations that became effective in March 2009.

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

RULE/ AUTHORITY: OAC 3745-300-07(F)(3)(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)(3)(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 portions of OAC 3745-300-10(E), which details ground water response requirements depending on the classification of the ground water zone.

ANSWER: Although a simple method does exist, the leaching of contaminants is an extremely property-specific phenomenon and any one method may not be appropriate for all situations. Therefore, property-specific contaminant conditions, geology, climate, and sub-surface conditions should always be taken into account before using any method. In addition, there are many physical, chemical, and biological mechanisms that can impact the amount of contamination reaching a ground water zone. Major contaminant loss mechanisms may include volatilization of the contaminant, sorption of the contaminant to the soil particles, dissolution of the contaminant in the soil water, and natural degradation of the chemical compound. The method discussed below takes into account only the sorption of the contaminant on the soil particles and ignores all other mechanisms. Hence, the method is simple but conservative, and is best used as a tool to develop screening levels. For additional methods that can account for other contaminant loss mechanisms, including dilution and separation

distance, see TGC VA30007.05.005.

A simple method on which to base the determination of soil cleanup objectives is to use the Water-Soil Equilibrium Partition theory. This theory relies on the ability of organic carbon in soil to sorb contamination. 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 illustrated through the use of the following example: If the water quality standard for TCE is 5 ppb (0.005 ppm), Koc for TCE is 204 L/kg, and the organic fraction in soil is 0.15% (0.0015) then the allowable concentration of TCE in soil is 0.00153 ppm (1.53 ppb), i.e.,

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

Thus, any concentration of TCE in the soil in excess of 1.5 ppb may be a concern for protecting the ground water pathway; however, this does not infer that the soil cleanup number must be 1.5 ppb. The volunteer can conduct a property-specific leaching assessment or use the generic leaching standards for the appropriate soil type to determine an alternate soil cleanup number. The inference that can be drawn, however, is that if the concentrations in the soil are less than 1.5 ppb and other site conditions (such as geology) favor the conclusion that leaching is not a problem then the volunteer need not perform a property-specific leaching study.

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