Establishing Permit Limits for Toxic Pollutants without Criteria

In some instances, potentially toxic materials for which no specific numerical criteria have been developed are used in a treatment process or are present in an effluent. Where necessary, permit limits are developed for these materials using available toxicity data and the method described in this section. For substances without standards that are reported in the permit application, TCEQ staff screen the reported value against the agency-specified minimum analytical level (MAL). Parameters less than the MAL are screened out with no further action necessary. Numerical criteria and permit limits are developed, if appropriate, for parameters exceeding the MAL. For substances that commonly occur naturally at concentrations above the MAL, alternative screening criteria are used.

Aquatic Life Criteria

The TCEQ develops permits that protect against acute and chronic toxicity in receiving waters at and above critical conditions, as appropriate. Critical conditions in receiving waters are established using methods discussed in the chapter of this document entitled "Mixing Zones and Critical Conditions" beginning on page 70. As stated in § 307.6(c)(7) of the Standards, water quality criteria for the protection of aquatic life are established using the methods described in this subsection.

Specific numerical criteria are calculated using the method outlined in the following documents if toxicity data requirements outlined in these documents are met:

- Guidelines for Deriving Water Quality Criteria for the Protection of Aquatic Life and Its Uses (45 FR 79341-79347 November 28, 1980).

- Summary of Revisions to "Guidelines for Deriving Numerical National Water Quality Criteria for the Protection of Aquatic Organisms and Their Uses" (50 FR 30792-30793, July 29, 1985).

Acute Criteria

If the data requirements in the documents cited above are not met, acute water quality criteria are calculated as follows:

$$\textit{ACUTE CRITERIA} = 0.30 \times \textit{LC50} \text{ of most sensitive species}$$

where: *LC50* = the concentration of a toxicant that is lethal (fatal) to 50% of the organisms tested in a specified time period

Chronic Criteria

The derivation of chronic water quality criteria for the protection of aquatic life depends on the

persistence and bioaccumulative capacity of the material. A pollutant's potential to bioaccumulate can be expressed by any of the following:

- the bioaccumulation factor (BAF)
- the bioconcentration factor (BCF)
- the octanol-water partition coefficient (K_{ow}).

The BAF and the BCF measure the concentration of a substance in a living organism relative to the concentration of the substance in the surrounding medium. The BAF accounts for substance intake from both food and the surrounding medium, while the BCF accounts for intake from the surrounding medium only. The K_{ow} estimates the tendency of a substance to partition from water to organic media, such as lipids present in living organisms. The K_{ow} can be used in place of the BCF or BAF when limited experimental data are available.

For the purposes of this section, the TCEQ will use the following criteria to determine whether a chemical is persistent or bioaccumulative:

- A chemical is **persistent** if it has a soil, sediment, or water half-life of 60 days or greater. It is **highly persistent** if it has a soil, sediment, or water half-life of six months or greater. Half-life is defined as the time required for 50% of a chemical to degrade or to be removed from the local environment by some physical process.[1]

- A chemical is **bioaccumulative** if its BAF or BCF is 1,000 or greater. It is **highly bioaccumulative** if either its BAF or BCF is 5,000 or greater.

The following methods for deriving chronic criteria are consistent with § 307.6(c)(7) of the Standards.

Nonpersistent toxic compounds:

$$\textit{CHRONIC CRITERIA} = 0.10 \times \textit{LC50} \text{ of most sensitive species}$$

Persistent toxic compounds:

$$\textit{CHRONIC CRITERIA} = 0.05 \times \textit{LC50} \text{ of most sensitive species}$$

Bioaccumulative toxic compounds:

$$\textit{CHRONIC CRITERIA} = 0.01 \times \textit{LC50} \text{ of most sensitive species}$$

Data Considerations

- Toxicity data used in these equations should be derived from tests using the most sensitive native species.

[1] Rand, Gary M. (ed.), 1995. *Fundamentals of Aquatic Toxicology (Second Edition)*. CRC Press.

- If no LC50 data are available for native species, non-native species data may be used.

- LC50s are selected that have appropriate end points (mortality), appropriate duration (96 hours for vertebrates and 48 hours for invertebrates), and appropriate species (freshwater or saltwater).

- LC50 data based on a freshwater species are not appropriate for saltwater criteria development and vice versa.

- Data from flow-through tests is preferred over static renewal tests.

- Where more than one acceptable test endpoint is available for a given species, a geometric mean of the LC50 data should be used for the criteria calculation.

- Toxicity tests using aquatic plants are not considered at this time.

- When evaluating BAFs and BCFs for a persistence determination, lab-derived BAFs/BCFs are preferred over $\log K_{ow}$-based regression equations.

- When multiple BAF/BCF data points are available for similar taxa (same genus), the geometric mean of these values should be used as opposed to one single data point.

There may be instances when toxicity data are only available for species not representative of the receiving waters, test durations are varied, or other undesirable circumstances exist. In this instance, it may be more appropriate to rely on a quantitative structure-activity relationship (QSAR) model for LC50 prediction or to use a method that differs from the one described in this section.

If acute or chronic criteria need to be derived for biocides, other water treatment chemicals, or other constituents present in the effluent for which water quality standards are not established, the methods just described are used. The following information is typically needed to determine these criteria:

- product information sheet
- material safety data sheet (MSDS) if available
- product toxicity data
- permitted discharge volume
- expected concentration of product in effluent
- discharge location.

Human Health Criteria

Water quality criteria for human health protection are derived as stated in § 307.6(d)(8) and (9) of the Standards.

- For known or suspected carcinogens, a cancer risk of 10^{-5} (1 in 100,000) is applied to the most recent numerical criteria adopted by EPA and published in the *Federal Register*.

- For toxic materials not defined as carcinogens, the most recent numerical criteria adopted by EPA and published in the *Federal Register* are applicable.

- Criteria calculations for noncarcinogens are based on childhood exposure, and criteria calculations for carcinogens are based on a lifetime of exposure.

- In both cases, if a maximum contaminant level (MCL) applies and is less than the resulting criterion, then the MCL applies to public drinking water supplies as stated in § 307.6(d)(3)(G) of the Standards.

- Numerical criteria for pollutants that bioconcentrate are derived in accordance with the general procedures in the EPA guidance document entitled *Assessment and Control of Bioconcentratable Contaminants in Surface Waters* (March 1991).

In the absence of available criteria, numerical criteria may be derived from available information and calculated using the following formulas:

WATER AND FISH, CARCINOGENS

$$HH\ CRITERIA\ (\mu g/L) = \frac{(RL)(BW)(U)}{CPF\,[WI + (FC)(LC)(BCF)]}$$

$$HH\ CRITERIA\ (\mu g/L) = \frac{(RL)(BW)(U)}{CPF[WI+(FC)(BCF)]}$$

FISH TISSUE ONLY, CARCINOGENS

$$L) =$$

$$HH\ CRITERIA\ (\mu g/L) = \frac{(RL)(BW)(U)}{(CPF)(FC)(LC)(BCF)}$$

$$HH\ CRITERIA\ (\mu g/$$

$$\frac{(RL)(BW)(U)}{(CPF)(FC)(BCF)}$$

where:

RL =	risk level (1 in 100,000, or 10^{-5})
BW =	body weight of average adult (70 kg)
U =	unit conversion factor to express criteria in µg/L (1000 µg/mg)
CPF =	carcinogenic potency factor (oral slope factor, kg-day/mg)
WI =	amount of water consumed per day (2 L/day)
FC =	amount of fish tissue consumed (0.0175 kg/day)
~~*LC* =~~	~~lipid correction factor to adjust BCFs normalized to 7.6% lipids to represent a 3% lipid content (3% ÷ 7.6%)~~
BCF =	bioconcentration factor (L/kg)

WATER AND FISH, NONCARCINOGENS

$$HH\ CRITERIA\ (\mu g/L) = \frac{(RfD)(BW)(U)}{WI + (FC)(LC)(BCF)}$$

$$HH\ CRITERIA\ (\mu g/L) = \frac{(RfD)(BW)(U)}{WI+(FC)(BCF)}$$

FISH TISSUE ONLY, NONCARCINOGENS

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$$HH\ CRITERIA\ (\mu g/L) = \frac{(RfD)(BW)(U)}{(FC)(LC)(BCF)}$$

where:

RfD =	reference dose (mg toxicant/kg human body weight/day)
BW =	body weight of average child (15 kg)
U =	unit conversion factor to express criteria in µg/L (1000 µg/mg)
WI =	amount of water consumed per day (0.64 L/day)
FC =	amount of fish tissue consumed (0.0056 kg/day)
~~*LC* =~~	~~lipid correction factor to adjust BCFs normalized to 7.6% lipids to represent a 3% lipid content (3% ÷ 7.6%)~~
BCF =	bioconcentration factor (L/kg)

~~These formulas convert BCFs that are normalized to 7.6% lipid content to represent a 3% lipid content. The majority of recently developed BCFs have been normalized to represent a 3% lipid content; therefore, it is essential to research the BCF being used in the equation to ascertain what lipid content the BCF represents. When using a BCF that is already normalized to 3% lipid content, the lipid correction factor (LC) equals one.~~