**Section 302.570 Procedures for Deriving Bioaccumulation Factors for the Lake Michigan Basin**

A bioaccumulation factor (BAF) is used to relate the concentration of a substance in an aquatic organism to the concentration of the substance in the waters in which the organism resides when all routes of exposure (ambient water and food) are included. A BAF is used in the derivation of water quality criteria to protect wildlife and criteria and values to protect human health.

a) Selection of Data. BAFs can be obtained or developed from one of the following methods, listed in order of preference.

1) Field-measured BAF.

2) Field-measured biota-sediment accumulation factor (BSAF).

3) Laboratory-measured bioconcentration factor (BCF).

The concentration of particulate organic carbon (POC) and dissolved organic carbon (DOC) in the test solution must be either measured or reliably estimated.

4) Predicted BCF.

Predicted baseline BCF = Kow.

b) Calculation of Baseline BAFs for Organic Chemicals

The most preferred BAF or BCF from above is used to calculate a baseline BAF which in turn is utilized to derive a human health or wildlife specific BAF.

1) Procedures for Determining the Necessary Elements of Baseline Calculation

A) Lipid Normalization. The lipid-normalized concentration, C1, of a chemical in tissue is defined using the following equation:

C1 = Cb / f1

Where:

|  |  |  |
| --- | --- | --- |
| Cb | = | concentration of the organic chemical in the tissue of aquatic biota (either whole organism or specified tissue) (μg/g) |
| f1 | = | fraction of the tissue that is lipid |

B) Bioavailability.

The fraction of the total chemical in the ambient water that is freely dissolved, ffd, must be calculated using the following equation:

ffd = 1 / {1 + [(DOC)(Kow)/10] + [(POC)(Kow)]}

Where:

|  |  |  |
| --- | --- | --- |
| DOC | = | concentration of dissolved organic carbon, kg of dissolved organic carbon/L of water |
| Kow | = | octanol-water partition coefficient of the chemical |
| POC | = | concentration of particulate organic carbon, kg of particulate organic carbon/L of water |

C) Food Chain Multiplier (FCM). For an organic chemical, the FCM used must be taken from Table B-1 in Appendix B of 40 CFR 132, incorporated by reference at 35 Ill. Adm. Code 301.106.

2) Calculation of Baseline BAFs

A) From Field-Measured BAFs

Baseline BAF = { [measured BAFtT / ffd] – 1 }{ 1 / f1 }

Where:

|  |  |  |
| --- | --- | --- |
| BAFtT | = | BAF based on total concentration in tissue and water of study organism and site |
| f1 | = | fraction of the tissue of study organism that is lipid |
| ffd | = | fraction of the total chemical that is freely dissolved in the ambient water |

B) From a Field-Measured Biota-Sediment Accumulation Factor (BSAF)

(Baseline BAF)i = (baseline BAF)r (BSAF)i (Kow)i /

(BSAF)r (Kow)r

Where:

|  |  |  |
| --- | --- | --- |
| (BSAF)i | = | BSAF for chemical "i" |
| (BSAF)r | = | BSAF for the reference chemical "r" |
| (KOW)i | = | octanol-water partition coefficient for chemical "i" |
| (KOW)r | = | octanol-water partition coefficient for the reference chemical "r" |

i) A BSAF must be calculated using the following equation:

BSAF = C1 / Csoc

Where:

|  |  |  |
| --- | --- | --- |
| C1 | = | the lipid-normalized concentration of the chemical in tissue |
| Csoc | = | the organic carbon-normalized concentration of the chemical in sediment |

ii) The organic carbon-normalized concentration of a chemical in sediment, Csoc, must be calculated using the following equation:

Csoc = Cs / foc

Where:

|  |  |  |
| --- | --- | --- |
| Cs | = | concentration of chemical in sediment (μg/g sediment) |
| foc | = | fraction of the sediment that is organic carbon |

C) From a Laboratory-Measured BCF

baseline BAF = (FCM) { [measured BCFtT / ffd ] - 1 } { 1 /f1 }

Where:

|  |  |  |
| --- | --- | --- |
| BCFtT | = | BCF based on total concentration in tissue and water. |
| f1 | = | fraction of the tissue that is lipid |
| ffd | = | fraction of the total chemical in the test water that is freely dissolved |
| FCM | = | the food-chain multiplier obtained from Table B-1 in Appendix B to 40 CFR 132,, incorporated by reference at 35 Ill. Adm. Code 301.106, by linear interpolation for trophic level 3 or 4, as necessary |

D) From a Predicted BCF

baseline BAF = (FCM) (predicted baseline BCF) = (FCM)(Kow)

Where:

|  |  |  |
| --- | --- | --- |
| FCM | = | the food-chain multiplier obtained from Table B-1 in Appendix B to 40 CFR 132, incorporated by reference at 35 Ill. Adm. Code 301.106, by linear interpolation for trophic level 3 or 4, as necessary |
| Kow | = | octanol-water partition coefficient |

c) Human Health and Wildlife BAFs for Organic Chemicals

1) Fraction freely dissolved (ffd). By using the equation in subsection (b)(1)(B), the ffd to be used to calculate human health and wildlife BAFs for an organic chemical must be calculated using a standard POC concentration of 0.00000004 kg/L and a standard DOC concentration of 0.000002 kg/L:

ffd  = 1 / [1+ (0.00000024 kg/L)(Kow)]

2) Human health BAF. The human health BAFs for an organic chemical must be calculated using the following equations:

A) For Trophic Level 3

Human Health BAFHHTL3 = [(baseline BAF)(0.0182) + 1] (ffd)

B) For Trophic Level 4

Human Health BAFHHTL4 = [(baseline BAF) (0.0310) + 1] (ffd)

Where:

0.0182 and 0.0310 are the standardized fraction lipid values for trophic levels 3 and 4, respectively, that are used to derive human health criteria and values

3) Wildlife BAF. The wildlife BAFs for an organic chemical must be calculated using the following equations:

A) For Trophic Level 3

Wildlife BAFWLTL3 = [(baseline BAF)(0.0646) +1] (ffd)

B) For Trophic Level 4

Wildlife BAFWLTL4 = [(baseline BAF)(0.1031) + 1] (ffd)

Where:

0.0646 and 0.1031 are the standardized fraction lipid values for trophic levels 3 and 4, respectively, that are used to derive wildlife criteria

d) Human Health and Wildlife BAFs for Inorganic Chemicals. For inorganic chemicals, the baseline BAFs for trophic levels 3 and 4 are both assumed to equal the BCF determined for the chemical with fish.

1) Human Health. Measured BAFs and BCFs used to determine human health BAFs for inorganic chemicals must be based on concentration in edible tissue (e.g., muscle) of freshwater fish.

2) Wildlife. Measured BAFs and BCFs used to determine wildlife BAFs for inorganic chemicals must be based on concentration in the whole body of freshwater fish and invertebrates.

(Source: Amended at 47 Ill. Reg. 4437, effective March 23, 2023)