13. Quantitative Risk Assessment Calculations

13.1 Steps in Risk Assessment

This chapter summarizes information on conducting risk assessments. More detailed information is available in the Interpretive Assistance Document for Discrete Chemicals available on the Sustainable Futures web site at http://www.epa.gov/oppt/sf/pubs/iad_discretes_doc_june2012.pdf.

As discussed in chapter 2 of this document, the steps in Risk Assessment were described by the National Academy of Sciences* which developed a four step paradigm describing risk assessment and risk managment*:

- **Hazard (Toxicity) Identification** – Identify potential adverse effects and levels at which effects may occur by determining if a particular chemical is or is not causally links to particular health effects (for example, could it increase cancer cases, birth defects, or kill fish);
  An important part of the Hazard Identification step is Dose-Response Assessment – Determining the relation between the magnitude of exposure and the probability of occurrence of the toxicity / hazard effects of concern, also referred to as Hazard Characterization. This is the step at which effects levels like No Observable Adverse Effect Levels (NOAELs) and Lowest Observable Adverse Effect Levels (LOAELs) are determined;
- **Exposure Assessment** – Estimate how much of the chemical humans or the environment may be exposed to by determining the extent (magnitude, frequency, and duration) of exposure before or after application of regulatory controls; and
- **Risk Characterization** – Compare Hazard (Toxicity) to Exposure and determine the potential for, and magnitude of, risk to an exposed individual or population nature, including accompanying uncertainty.

*NRC. 1983. Risk Assessment in the Federal Government: Managing the Process. National Research Council. National Academy Press, Washington, DC. ISBN: 0-309-03349-7. http://www.nap.edu/books/0309033497/html

Sustainable Futures (SF) submissions should include an assessment of risk to humans (non-cancer endpoints only) and to the environment (aquatic ecosystem). Each type of risk assessment uses different methods.

Why is a screening level assessment for cancer not required under Sustainable Futures?
The general assumption for non-cancer effects assumes that a safe exposure level does exist. For cancer effects it is assumed that most carcinogens do not have any "safe" exposure level. Any exposure to a carcinogen can result in increased probability of getting cancer.

Under Sustainable Futures the cancer hazard assessment is conducted using OncoLogic™ thus limiting the ability to conduct a quantitative risk assessment. OncoLogic™ provides qualitative results unless the chemical is within the look-up database in the model.

For a quantitative cancer assessment measured data on the chemical or analog must be identified in either bioassay studies conducted in laboratory animals, or in human epidemiology studies. Cancer assessment methods are more complex than the non-cancer assessments and use "slope factors" in the calculation.

For these reasons, a cancer hazard assessment is not required for Sustainable Futures assessments.

13.2 Performing an Aquatic Risk Assessment for SF Submissions

You should always conduct a risk assessment in two situations: (1) when measured data or estimation methods indicate a chemical may present a moderate or high toxicity concern level, and (2) where there is a potential for high exposure. Of course there may be other situations when an assessor wants to evaluate potential risk of a chemical.

The New Chemical Program defines aquatic toxicity concern levels as:

	Low Concern	Moderate Concern	High Concern
Acute	> 100 mg/l	1 - 100 mg/l	< 1 mg/l
Chronic	> 10 mg/l	0.1 - 10 mg/l	< 0.1 mg/l

Source: Clements, R.G.; Nabholz, J. V.; Johnson, D.E.; and Zeeman, M.G. The Use of Quantitative Structure-Activity Relationships (QSARs) as Screening Tools in Environmental Assessment. Environmental Toxicology and Risk Assessment, 2nd Vol., edited by J.W. Gorsuch, F.J. Dwyer, C.G. Ingersoll, and T.W. LaPoint, pp 555-570. ASTM STP 1216. Philadelphia: American Society for Testing and Materials, 1993.

Chemicals with high Production Volumes are expected to have high exposure potentials as well. Even low hazard compounds, if they have high Production Volumes may automatically trigger a risk assessment. The TSCA 5(e) Exposure-Based Policy is explained online at http://www.epa.gov/oppt/newchems/pubs/expbased.htm.

These are the Four Steps in Assessing Aquatic Risk
Step 1. Develop a Standard Aquatic Toxicity Profile
Step 2. Determine Concentration of Concern (COC)
Step 3. Calculate potential environmental (surface water) exposure concentrations (PEC)
Step 4. Perform Risk Characterization: Compare potential environmental concentrations to effect levels

13.2.1 Step 1. Develop a Standard Aquatic Toxicity Profile

The standard aquatic toxicity profile includes acute and chronic endpoints for three species that are representative of the aquatic food chain: fish, *Daphnia spp.* (invertebrates) and green algae.

Acute Toxicity	Chronic Toxicity
Fish 96-hr LC50	Fish ChV
Daphnid 48-hr LC50	Green algae ChV
Green algae 96-hr EC50	Daphnid ChV

If ECOSAR does not predict an endpoint, acute-to-chronic ratios can be used fill data gaps. Applying the appropriate acute-to-chronic ratios is explained in the Methodology Document for ECOSAR available at http://www.epa.gov/oppt/newchems/tools/ecosartechfinal.pdf. Here are the acute-to-chronic ratios used in ECOSAR:

	Acute-to-Chronic Ratio		
Chemical Class	Fish	Daphnid	Green algae
Neutral Organics	10	10	4
Classes with Excess Toxicity	10	10	4
Polycationic Polymers*	18	14	4
Nonionic Surfactants	5	5	4
Anionic Surfactants	6.5	6.5	4

* Currently there are no computerized QSARs programmed into ECOSAR for Polycationic Polymers.

Here is an example Aquatic Toxicity Profile showing Acute-to-Chronic Ratios applied to generate the missing Green algal and Daphnid Chronic Values (ChV).

Acute Toxicity (mg/L)		Chronic Toxicity (mg/L)	
Fish 96-hr LC50	0.900*	Fish ChV	0.005
Daphnid 48-hr LC50	0.550*	Green algae ChV	0.060†
Green algae 96-hr EC50	0.070	Daphnid ChV	0.020†

* The log Kow was slightly above the cutoff for the fish and *Daphnid* acute toxicity SARs; therefore, the value is reported, but no effect at saturation may occur.

† These values were calculated using an acute-to-chronic (ACR) ratio of 10 for *Daphnia* and an ACR of 4 for green algae

13.2.2 Step 2. Determine the Concentration of Concern

The Concentration of Concern (COC) is the value (effect level) at which harm to the aquatic environment is likely to occur if that concentration is exceeded. There is typically an acute and a chronic COC developed as part of the risk assessment and those values are compared to the predicted environmental concentrations, also known as surface water concentrations, to estimation potential for risk.

Deriving a Concentrations of Concern for Risk Assessment

For chemicals classified as having a moderate to high toxicity hazard based on the paradigm above, a chronic concentration of concern (COC) for ***at least*** the most sensitive species needs to be determined. This value is necessary as input to the E-FAST model for calculating downstream aquatic exposure exceedance which will be needed for subsequent exposure and risk assessment. For chemicals with a low hazard concern, typically an exposure assessment will not be done (assume low potential for risk) EXCEPT for chemicals that meet the EPA New Chemical Production Volume or Exposure based triggers which are outlined on the EPA website at: http://www.epa.gov/opptintr/newchems/pubs/expbased.htm

For setting chronic COCs, the assessment factors below are used:

Chronic COC for fish = ChV / (10)
Chronic COC for daphnia = ChV / (10)
Chronic COC for algae = ChV / (10)

Example calculation:
Daphnid ChV = 0.02 mg/L
Calculated daphnid chronic COC = (0.02 mg/L) /10 = 0.002 mg/L (ppm)

If ONLY an NOEC value (and not a ChV) is available from what appears to be the most sensitive species, that value can be used to derive a chronic COC by applying the same assessment factor of 10. Even though using an NOEC value from a study represents setting a more conservative toxicity value, there is still uncertainty associated with extrapolation from lab to field studies that needs to be accounted for. Therefore a factor of 10 is still applied, with an understanding that the approach yields setting a more conservative chronic COC or threshold level. If only an LOEC is available from a chronic test, it is a likely indication that you have a poorly designed test, and study validity should be questioned.

For setting acute COCs, the assessment factors below are used:

Acute COC for fish = LC_{50} / (5)
Acute COC for daphnia = LC_{50} / (5)
Acute COC for algae = ChV value (preferred) or EC_{50} / (4)

Example calculation:
Fish LC50 = 10.2 mg/L
Calculated acute fish chronic COC = (10.2 mg/L) /5 = 2 mg/L (ppm)

The only time an assessment factor is not used (or more correctly an AF of 1) is for an actual field study or when an extensive species sensitivity distribution is available.

PLEASE NOTE: COCs are rounded up to 1 significant digit (e.g., a COC of 1.75 ppb is rounded up to 2 ppb) because the assessment factor applied to calculate COCs are 1 significant digit. EPA does not typically report COCs less than 1 ppb due to costs/limitations in reliable analytical methods to test below 1 ppb. Therefore, no values less than 1 ppb (traditional lower detection limit) should be reported; unless SAR, analogs, or experimental data analysis directly support a COC < 1 ppb.

13.2.3 Step 3. Determine Potential Exposure Concentrations

You will need aquatic exposure values generated by E-FAST to complete the aquatic risk assessment. The values you need are the “Predicted Environmental Concentration” (PEC) or “Surface Water Concentration” (SWC). The PEC is the concentration of the chemical calculated to be in receiving waters and is determined using a simple stream flow dilution model.

Other aquatic exposure values generated by E-FAST are the 7Q10 for the 10^{th} percentile facility. The 7Q10 is the lowest 7-consecutive day average stream flow over a 10 year period. The 10th percentile facility represents lower release and stream flow values such that only 10% of all facilities have values lower than the 10^{th} percentile facility.

Additional information provided by E-FAST includes the “Number of Days Exceeded” or “% year Exceeded”. Both values are used to determine the potential for chronic risk.

13.2.4 Step 4. Risk Characterization

In this last step you will characterize the Acute and Chronic risk to aquatic organisms by comparing potential environmental concentrations to effect levels.

Evaluation of Acute Aquatic Risk
You will compare Acute COCs directly to the PEC. A potential for risk exists if the PEC is greater than the acute COC.

For example, if the LOWEST Acute COC predicted by ECOSAR for the three target species (fish, daphnia, green algae) is 20 ppb for Algae and E-FAST results show a Predicted Environmental Concentration (PEC) of 45 ppb **there is a potential for acute risk** because the PEC is greater than the Acute COC. In this case you should looking at risk potential for the remaining species in profile (fish and daphnids), to determine if risk exists for these species also.

Evaluation of Chronic Aquatic Risk
Chronic aquatic risk is evaluated by determining the number of days per year the COC is exceeded. This information is provided by E-FAST. If the COC is exceeded LESS THAN 20 days per year the potential for chronic risk is low because organisms will not be exposed long enough for chronic effects to occur.

Source: Lynch, DG; Macek, GJ; Nabholz, JV; Sherlock, SM; Wright, R. 1994. Ecological risk assessment case study: assessing the ecological risks of a new chemical under the Toxic Substances Control Act. In: A review of ecological assessment case studies from a risk assessment perspective, vol. II. Washington, DC: Risk Assessment Forum, U.S. Environmental Protection Agency, pp. 1-1 to 1-35. EPA/630/R-94/003.

For an example scenario, in a situation where the Chronic COC is 1 ppb based on LOWEST (most toxic) ChV value predicted by ECOSAR, and E-FAST gives a Predicted Environmental Concentration (PEC) of 45 ppb as well as the Number of Days of Exceedance as 1 day/year there is **low potential for chronic risk.** Even though the PEC of 45 ppb is greater than the COC of 1 ppb the COC is exceeded only 1 day per year and exposure will not occur long enough to induce chronic effects. Since the lowest COC does not present chronic risk you can assume others species in the typical profile will not be at risk either.

If Aquatic Risk is Possible
If you determine that a potential aquatic risk exists be sure you have correctly identified all releases to water. Will it be possible to minimize or eliminate the releases to water? Can you test fate parameters to identify higher removal rates of the chemical? Should you perform confirmatory aquatic toxicity testing?

13.3 Performing a Non-Cancer Human Health Risk Assessment for SF Submissions

These are the Three Steps in Assessing Human Health Risk
Step 1. HAZARD: Identify potential toxicity / hazard and dose levels (NOAEL or LOAEL)
Step 2. EXPOSURE: Determine potential exposure levels in the workplace, through use of consumer products, or through surface water releases to the general population.
Step 3. RISK: Compare toxicity values to the expected exposure doses by calculating a Margin of Exposure (MOE) for all effects.

13.3.1 Step 1. Identifying Potential Toxicity / Hazard

All potential toxicity / hazards need to be assessed. Quantitative risk assessment is only performed for reproductive, developmental, systemic, neurotoxic, and immunotoxic effects. Sensitization, mutagenicity, and irritation studies do not provide NOAEL/LOAEL determinations and risk cannot be quantified.

Search for toxicity data on the chemical of concern. See chapter 3 of this document to help identify sources of measured data. Remember that data on the chemical itself is always preferred over analog data.

Potential toxicity / hazard may be identified using category data however toxicity studies will be necessary to perform a quantitative risk assessment. For category data refer to the TSCA New Chemicals Program Chemical Categories Report at http://www.epa.gov/oppt/newchems/pubs/npcchemicalcategories.pdf and appendix D of this document.

Important Factors to Consider when Evaluating Toxicity Data
It is important to remember that finding NO data is NOT equivalent to finding negative (indicative of low toxicity) data. Hazard concerns are always based on scientific judgment and if conflicting data exist, a weight-of-evidence approach should be used to support conclusions.

Try to identify a NOAEL dose (this is generally a "safe" level because it is below the level which effects did occur) from an appropriate toxicity study. Long term studies such as 28-day or 90-day studies are preferred. The study used should be comparable to the predicted exposures in duration and route. For example for acute exposures use acute study and for inhalation exposures try to use an inhalation study, however many studies are conducted by the oral route.

Important Toxicity Study Details to Record
When toxicity studies are located on the chemical of interest it is important to record the critical details from the studies. These specific details include:

- Hazard concern that is identified
- Type of study (e.g., 2-generation reproductive toxicity study, 28-day repeated-dose study)
- Study duration
- Animal species
- Exposure route (oral gavage, diet, dermal, inhalation)
- Effect Levels
    - No adverse effect levels (NOAEL) for each hazard identified
    - Lowest adverse effect levels (LOAEL) for each hazard identified
- References (include who conducted the study, study date, study code number, etc.)

Additional guidance for evaluating studies can be found at
http://www.epa.gov/opptsfrs/publications/OPPTS_Harmonized/870_Health_Effects_Test_Guidelines/Series/

Remember that a quantitative assessment can be performed if toxicity studies providing a NOAEL (preferred) or LOAEL values can be identified on the chemical itself or on a close analog.

13.3.2 Step 2. Determine Exposure Levels

Guidance on exposure assessment is available in EPA's Guidelines for Exposure Assessment at http://cfpub.epa.gov/ncea/cfm/recordisplay.cfm?deid=15263

Worker / Occupational Exposure (ChemSTEER)
You can determine exposure doses for Workers (Occupational Exposure) using ChemSTEER. All potential exposure scenarios (manufacture, processing, or use) are evaluated in ChemSTEER. The assumption used by the model is an 8 hr day and units are mg/kg/day.

ChemSTEER provides the following Inhalation and Dermal exposure values:

- Potential Lifetime Average Daily Dose (LADD) which represents chronic exposures over a lifetime (usually 75 years) and is used for cancer risk calculations.
- Potential Average Daily Dose (ADD) which represents chronic exposure (the default for the time spent working over a life is 40 years) and generally used for non-cancer human health risk assessment.
- Acute Dose Rate (APDR) is used for acute toxicity and developmental toxicity risk assessments.

General Population and Consumer Exposure (E-FAST)

ADRs for General Population and Consumer exposures are generated using E-FAST, assumes a 100% absorption rate, and uses an adult male body weight of 71.8 kg. DO NOT divide by body weight again, since BW has already been factored into the value from E-FAST.

The General Population can be exposed by drinking water or eating fish from waters to which the chemical of interest has been discharged or by fugitive air emissions from various scenarios. All exposure scenarios should be considered in the risk assessment.

E-FAST provides the following Drinking Water, Fish Ingestion, and Consumer exposure values:

- Potential Lifetime Average Daily Dose (LADDpot) Note that E-FAST uses slightly different abbreviations than ChemSTEER does.
- Potential Average Daily Dose (ADDpot)
- Acute Dose Rate (ADRpot)

Exposure Route Considerations

- Toxicity data may be available for only one exposure route (e.g., oral or inhalation)
- Exposure scenarios may include several exposure routes (inhalation, dermal, oral)
- Exposure concentrations predicted by E-FAST and CHEMSTEER may need to be adjusted to account for absorption for the specific exposure route
- Only adjust exposure value if potential risk exists without the adjustment

Adjusting for Absorption

- Not appropriate for chemicals that have portal of entry effects (e.g., are irritating or corrosive)
- Adjustment may vary by exposure route
- Absorption differences can be estimated using measured data (chemical or analog) or by chemical and physical properties
- P/Chem properties that give information on general absorption are:
    - Molecular weight (higher MW means poorer absorption)
    - Water solubility (low WS means poorer absorption), and
    - Physical state (solids are more poorly absorbed than liquids)

13.3.3 Step 3. Risk Characterization

The goal of risk characterization is to compare hazard / toxicity levels with exposure doses to determine if risk may occur under the specific scenarios. Ideally you will do a quantitative analysis based on a Margin of Exposure (MOE) calculation.

Margin of Exposure

A Margin of Exposure (MOE) is calculated to determine human health risk from exposure to the PMN. This "margin" is essentially the established "safety buffer" between the toxicity effect level dose (in this case the NOEC) and the predicted exposure dose. The MOE is a ratio of the toxicity effect level to the estimated exposure dose. Uncertainty factors are used to determine the acceptable Margin of Exposure. An **acceptable MOE** for a NOAEL/NOEC-based assessment is 100 and for a LOAEL/LOEC-based assessment add an additional factor of 10 to give an acceptable MOE of 1000 for a LOAEL/LOEC-based assessment. The lower the MOE (margin between the toxicity effect level and the exposure dose), the more likely a chemical is to pose an unreasonable risk. For example, if the margin indicates that a particular toxicity effect level is 10,000 times higher than the expected exposure dose there is little concern that concentrations will reach levels where toxicity is possible. However, if the toxicity level is only 1 time higher than the exposure dose and considering potential uncertainty in experimental measurement, there is a significant chance the exposure dose may reach the toxicity effect level.

Interspecies and intraspecies factors are used to develop a traditional Margin of Exposure as follows:

Interspecies uncertainty = 10

Intraspecies uncertainty = 3 X 3 = 9 (rounded to 10)

Intraspecies PK (pharmacokinetic) = 3 X Intraspecies PD (pharmacodynamic) = 3

PK is how the body handles the chemical

PD is how the chemical affects the body

Interspp X Intraspp = 10 X 10 = 100

MOE Calculations for Occupational Exposure:

$$\frac{\text{(Per Day Dose X Exposure Route Abs \%)}}{\text{Avg Adult } \male \text{ BW*}} = \text{PMN Absorbed Dose}$$

$$\text{(NOAEL Dose X NOAEL Route Abs Percentage)} = \text{NOAEL Absorbed Dose}$$

$$\text{Margin of Exposure} = \frac{\text{NOAEL Absorbed Dose}}{\text{PMN Absorbed Dose}}$$

MOE Calculations for General Population and Consumer Exposure

$$\frac{\text{(ADR X Exposure Route Abs \%)}}{} = \text{PMN Absorbed Dose}$$

$$\text{(NOAEL Dose X NOAEL Route Abs Percentage)} = \text{NOAEL Absorbed Dose}$$

$$\text{Margin of Exposure} = \frac{\text{NOAEL Absorbed Dose}}{\text{PMN Absorbed Dose}}$$

*Body weight is from USEPA 2011. Exposure factors handbook, final report, EPA/600-R09/052F, 2011, http://www.epa.gov/ncea/efh/pdfs/efh-chapter08.pdf. Remember you cannot determine a Margin of Exposure for some endpoints (e.g., genotoxicity, sensitization), and low risk is implied when MOE > 100 for NOAEL-based assessments and MOE > 1000 for LOAEL-based assessments.

Setting Non-Cancer Hazard Concern Levels

The following general conclusion can be made regarding hazard / toxicity levels:

Hazard Concern	Definition Based on Experimental Data
Low	No basis for concern identified or systemic toxicity with NOAEL > 1000 mg/kg/day; only minor clinical signs of toxicity; liver and/or kidney weight increase or clinical chemistry changes with LOAEL ≥ 500 mg/kg/day
Moderate	Suggestive animal studies for chemical or analog(s) or chemical class known to produce toxicity or organ pathology (gross and/or microscopic) with LOAEL < 500 mg/kg/day; clinical chemistry changes and organ weight changes at < 500 mg/kg/day; NOAEL < 1000 mg/kg/day
High	Evidence of adverse effects in humans or conclusive evidence of severe effects in animal studies. Death, organ pathology (microscopic) at LOAEL ≤ 100 mg/kg/day; multiple organ toxicity; NOAEL ≤ 10 mg/kg/day.

13.4 Example Risk Assessment Using Isodecyl Acrylate

13.4.1 Aquatic Risk Assessment

Toxicity Data

No aquatic toxicity data were located on Isodecyl acrylate (CAS 1330-31-6), however aquatic toxicity data on Isooctyl acrylate (CAS 29590-42-9), a close analog to Isodecyl acrylate were located in the High Production Volume (HPV) Challenge Program web site at http://www.epa.gov/chemrtk/. A Robust Summary was submitted by the American Chemistry Council (ACC) Specialty Acrylates and Methacrylates (SAM) HPV Work Group and can be found at http://www.epa.gov/chemrtk//pubs/summaries/2propnae/c15031rt.pdf. The aquatic toxicity data identified for Isooctyl acrylate (IOA) are:

Acute Toxicity to Fish (fathead minnow), OECD 203
96-hr LC50 = 0.67 mg/L

Acute Toxicity to Aquatic Invertebrates (*Daphnia magna*) OECD 202
48-hr EC50 = 0.4 mg/L

Toxicity to Aquatic Plants (green algae), OECD 201
72-hr ErC50 = 2.13 mg/L

Chronic Toxicity to Aquatic Invertebrates (*Daphnia magna*), OECD 202
14-Day IC50 (Reproduction) = 0.97 mg/L, 21-Day IC50 (Reproduction) = 1.02 mg/L

For comparison, the following ECOSAR predictions for Isodecyl acrylate were included in the SF Summary Assessment Worksheet and will be used for the aquatic risk assessment. Note that if the measured values for the analog are used in place of the ECOSAR predictions for isodecyl acrylate the outcome will be the same.

Acute Toxicity		Chronic Toxicity	
Fish 96-hr LC50	0.503 mg/L	Fish ChV	0.00009 mg/L
Daphnid 48-hr LC50	0.387 mg/L	Green algae ChV	0.10 mg/L
Green algae 96-hr EC50	0.098 mg/L	Daphnid ChV	0.038 mg/L

Hazard Concern for Aquatic Toxicity is predicted to be High with a Concern Concentration of 1 ppb.

Exposure Estimates

E-FAST results for Isodecyl acrylate are shown in both chapter 2 (SF Summary Assessment Worksheet Completed for Isodecyl Acrylate) and chapter 12 (Running E-FAST on the Sample Chemical Isodecyl acrylate) of this document.

The Predicted Environmental Concentration (PEC) provided by E-FAST is 84 µg/L (ppb), and the PEC will exceed the Chronic COC (1 ppb) 1 day per year. As explained in section 13.2.4 of this chapter even though the PEC will exceed the COC, because this will happen less than 20 days per year, the potential for chronic risk is low because organisms will not be exposed long enough for chronic effects to occur.

13.4.2 Human Health Risk Assessment

This section goes through the three steps in conducting a human health risk assessment for potentially exposed populations for Isodecyl acrylate which include workers and the general population. Consumer use is not a predicted for the example chemical.

Step 1. Identifying Potential Toxicity / Hazard

No relevant toxicity data for isodecyl acrylate (CAS RN 1330-61-6) were identified but data were available on a close analog isooctyl acrylate (CAS RN 29590-42-9) which had low acute toxicity with a reported developmental toxicity LD50 of >5000 mg/kg for rats in a single dose oral gavage study (IUCLID 29590-42-9). A NOAEL was not identified. The analog data indicates Isodecyl acrylate has a MODERATE human health concern level.

General Population Risk

Step 2. Identify Exposure Values

E-FAST estimates General Population exposure by drinking water and fish ingestion. The Gen. Pop. E-FAST Value was an Acute dose rate (ADR) of 7.02 x 10-3 mg/kg-d. The ADR is used because the health concern is developmental toxicity. The ADRs are generated by E-FAST assuming a 100% absorption rate, and using an adult male body weight of 71.8 kg. See Interpretive Assistance Document to assist in determining appropriate exposure values.

DRINKING WATER INGESTON

Step 3: Risk Characterization

MOE = (LOAEL/ADR)

LOAEL = 1000; ADR = 7.02 x 10^{-3} (0.007) mg/kg-day

MOE = (1000 mg/kg-day / 7.02 x 10-3 mg/kg-d)

MOE = 1000 / 0.007 = >140,000

Because the MOE >> 1000, low risk is implied

FISH INGESTON

Step 3: Risk Characterization

MOE = (LOAEL/ADR)

LOAEL = 1000; ADR = 1.34 x 10^{-3} mg/kg-day (0.00134) mg/kg-d

MOE = (1000 mg/kg-day / 1.34 x 10^{-3} mg/kg-d)

MOE = 1000 / 0.00134 = >700,000

Because the MOE >> 1000, low risk is implied

Occupational (Worker) Risk

Step 2: Identify Occupational Exposure Values

ChemSTEER estimates occupational exposure values for inhalation and dermal exposure. For the sample chemical ChemSTEER estimates the Acute Potential Dose Rate (APDR) for Dermal exposure will be 7.56 mg/kg-day and for Inhalation exposure the APDR will be 0.199 mg/kg-day.

Assumptions: 60 kg person (female) because the effect is developmental toxicity and the babies of pregnant women will be at risk. The assumption is a 70 kg person (male) for other effects.

Step 3: Risk Characterization for Occupational Risk

DERMAL

MOE = (LOAEL/APDR)
LOAEL = 1000; APDR = 7.56 mg/kg-day for Dermal exposure
MOE = (1000 mg/kg-day / 7.56 mg/kg-day)
MOE = 132 for Dermal exposure
Because the MOE < 1000 potential for risk is possible

Because the dermal exposure MOE implied potential risk, the dermal absorption values can be used to adjust the dermal exposure dose. Analog data indicate that dermal absorption is ≈25% of oral absorption and the LOAEL is for an oral (gavage) study. You should multiply dermal exposure value by 0.25 (25%).
MOE = 1000 mg/kg-day/ (7.4 mg/kg-day x 0.25)
MOE adjusted for absorption = 540
MOE is still < 1000 so potential for risk is implied.

INHALATION

MOE = (LOAEL/APDR)
LOAEL = 1000; APDR = 0.199 mg/kg-day for Inhalation exposure
MOE = (1000 mg/kg-day / 0.199 mg/kg-day)
MOE = >5000
Because the MOE > 1000 low risk is implied.

You should repeat the risk characterization process for all hazards that allow for MOE calculations identified in the toxicity assessment

Remember the effect observed at the lowest dose does not always result in the greatest risk because:

- May assess different hazards using different toxicity values (NOAEL vs. LOAEL)
- May assess different hazards using different exposure values (ADR vs. ADD)

CONCLUSIONS

The conclusions are that unprotected workers will be at risk from dermal exposure to the chemical but not from inhalation exposure. The General Population will not be at risk from Drinking Water or Fish Ingestion of the chemical after release to surface waters.