

Considerations in Human Health Risk Assessment of Vapours

Ross Wilson, M.Sc., DABT

Introduction

- Human health risk assessment of vapours is a tool for use under the CSR
- Similar to other media, risk-based standards can be obtained for vapour
- Nevertheless, risk assessors should be aware of various potential issues that should be considered in a drinking water HHRA

Key Differences Between HHRA of Soil vs Vapour

Soil

- Often exposure potential is reduced due to depth or coverage by building/pavement
- Chemicals may sometimes show reduced bioavailability
- Lots of precedent

Vapour

- Often no adjustment in exposure potential (unless specific conditions are included)
- Little ability to adjust the bioavailability potential
- Not as much precedent

General Principles for HHRA of Vapours

- Must have DSI level information
 - Risk assessment cannot be used as rationale for not fully investigating a site (including delineation of vapours to numeric standards)
 - On the other hand, DSI level information often suffices for completion of a HHRA
- Include all chemicals exceeding standards plus those that can act additively

General Principles for HHRA of Vapours

- Generally preferred to use the following equation for evaluation of non-cancer risks (Hazard Quotient):

$$HQ = \frac{\text{Amortized Air Conc (ug/m}^3\text{)}}{\text{Reference Concentration (ug/m}^3\text{)}}$$

- Nevertheless, it is acceptable to convert into dose rates (ug/kg bw/day) provided that it is done in a toxicologically relevant manner
 - Make sure that irritant effects are not overlooked
- Note that improper exposure amortization is one of the more common errors in HHRA when short-term exposure scenarios are present at a site

General Principles for HHRA of Vapours

- Generally preferred to use the following equation for evaluation of cancer risks (Incremental Lifetime Cancer Risk):

$$\text{ILCR} = \text{Lifetime Air Conc (ug/m}^3\text{)} \times \text{Unit Risk (ug/m}^3\text{)}^{-1}$$

- Nevertheless, it is acceptable to convert into dose rates (ug/kg bw/day) provided that it is done in a toxicologically relevant manner
- Exposure amortization of carcinogens is a continued area of research by health agencies

HHRA of Vapours: Adjustment of TRVs

- Risk assessment of vapours would use Technical Guidance 7 as an important source of guidance
 - Stresses US EPA as a primary source of TRVs
 - MoE has stressed that this really is only guidance
 - Nevertheless, this hierarchy needs to be followed for Protocol 6 submissions (unless Director's pre-approval is received)
- It is possible that this may result in the justifiable selection of different TRVs in a HHRA than were used for development of Schedule 11 Standards
 - In some cases, vapours that may exceed Schedule 11 standards will not exceed risk-based standards due to differing TRVs

HHRA of Vapours: Adjustment of TRVs

VPHv Risk-Based Example

- Schedule 11 RL standard for VPHv = 1,000 ug/m³
- Health Canada/CCME TRVs that have been used are as follows:
 - C₆₋₈ aliphatics = 18,400 ug/m³
 - C_{>8-10} aliphatics = 1,000 ug/m³
 - C_{>8-10} aromatics = 200 ug/m³
- In a risk-based approach, if the aliphatic/aromatic breakdown was known (i.e., measured) and shown to be skewed towards C₆₋₈ aliphatics, it is possible that vapours that may exceed Schedule 11 standards while not exceed risk-based standards

HHRA of Vapours: Adjustment of TRVs

- It is important to regularly review the literature since TRVs change with time
- It is quite uncommon for consultants to derive their own TRVs
 - Requires extensive documentation
 - Difficult to find qualified reviewers
 - Can raise suspicion
- Nevertheless, development of TRVs for addressing short-term exposures may be more justifiable
 - Nevertheless, it is a very serious issue and there are no shortcuts to doing this properly
 - No default adjustment factors exist

HHRA of Vapours: Adjustment of Time Spent

- Schedule 11 standards assume that persons are present at sites on a full-time residential and/or occupational basis (depending on the land use)
- If a site or an area of a site is not used as frequently, it is sometimes possible to assume less than full-time exposure
 - Parkade areas of buildings
 - Buildings used on an infrequent basis
- However, it needs to be clear that this will be one of the conditions of the regulatory instrument and it will be important that site owners ensure that the site continues to be used in the manner assumed in the risk assessment.

HHRA of Vapours: Background Conc.

- For carcinogens, Schedule 11 standards actually represent the incremental concentration of a chemical above background that is considered to be acceptable
- Thus, if the background concentration can be reliably reported, an argument can sometimes be made to subtracting this from the measured site concentration
- Nevertheless, it is stressed that:
 - There is not much precedent on accurately determining background concentrations of chemicals in air to meet MoE requirements
 - This approach only applies for carcinogens

HHRA of Vapours: Trench Workers

- For trench work, it can be difficult to predict trench air concentrations when contamination is shallow (e.g., side walls of trench) since:
 - Few approved models
 - Few precedents
- Some have used the Schedule 11 IL standards as the TRVs for trench workers
- It does seem that it is acceptable to conclude unacceptable risks exist and that a worker health and safety plan is required if trench work is to occur in the future
 - Under such circumstances, the need for a worker health and safety plan for trench work is specifically listed in the Schedule B conditions of the CoC

HHRA of Vapours: Attenuation Factors

- MoE considers it to be acceptable to develop site-specific attenuation factors in a risk assessment
- However, this is only for:
 - Risk-based CoCs
 - May only apply to a specific building configuration
 - If too specific, it may mean that an Approval in Principle is the only option until it can be shown that the building was constructed to configuration
 - Few precedents
 - May require verification and/or monitoring

Conclusions

- HHRA may be able to assist Schedule 11 standard exceedences in some cases but not others
- MoE has indicated that they are available for consultation (preferably by email)