BioVapor, a 1-D Vapor Intrusion Model with Oxygen-limited Aerobic Biodegradation

What is BioVapor?

1.0 Analytical Model
2. Oxygen Mass Balance
3. User Friendly

Scenario of Johnson & Slierger vapor intrusion model modified to include aerobic biodegradation (Sevall, 2007). Controlled calculation methodology account for reduced availability of oxygen in response zones.

KEY POINT:
Free, easy-to-use vapor intrusion model that accounts for oxygen-limited aerobic vapor intrusion.

Conceptual Model

1. Advection, diffusion, and dilution through building foundation
2. Diffusion & 1st order biodegradation in aerobic zone
3. Diffusion only in anaerobic zone

BioVapor: Conceptual Model

Calculate Oxygen Demand:
- Depth of aerobic zone
- HC vapor concentration
- 1st order biodegradation

Oxygen Boundary Condition

Open-Flow (Dissolved Air Flow)
Constant oxygen free air across top of control zone of NAPL build up information

Closed-Flow (Dissolved Air Flow)
Constant oxygen free air across top of control zone of NAPL build up information

Vapor Intrusion Risk Results

Vadose Zone Vertical Profile

Chemicals

Risk Drivers
- Only vadose zone transport
- Only vadose zone transport
- No well accepted toxicity values

Hydrocarbon Surrogates
- Only vadose zone transport
- No well accepted toxicity values

Detailed Results

Acknowledgements

Reference:
- BioVapor Analytical Model: Georgia Tech Research Corporation
- BioVapor Software Interface: Paul Newbury GSI Environmental
- Project Funding: Support API Soil and Groundwater Task Force

Contact Information:
- API Soil and Groundwater Task Force
- Harlow Hopkins & Roger Claff

Biodegradation Rates

- Petroleum rapidly biodegrades in aerobic zones with oxygen
- Geometric mean concentration ratio: 0.0127 = 0.0004
- Alkanes in 21.8m (Direction: S)
- Biodegradation occurs in pore water
- Interface with default biodegradation rate

Iterative Calculation Method

Iterative calculations to determine depth of aerobic zone

Final Model Solution:
- No demand support
- Yes, increase depth of aerobic zone

Biogas Mass Balance

- Oxygen-limited Aerobic Biodegradation

Model Inputs

Environmental Factors

Model Outputs

Oxygen Boundary Condition

Vadose Zone Vertical Profile