This document references Chapters and Sections from the ITRC Vapor Intrusion Technical and Regulatory Guidance, and Fact Sheets and Technology Information Sheets from the ITRC Vapor Intrusion Toolkit, published January 2026. These resources can be accessed at: **https://itrcweb.org/vapor-intrusion-toolkit**.

AEROBIC VAPOR MITIGATION BARRIER TECHNOLOGY INFORMATION SHEET

This technology information sheet describes a method for in situ vapor intrusion (VI) mitigation and remediation at sites with existing buildings situated above subsurface sources of vapor-forming chemicals (VFCs) that rapidly biodegrade aerobically—namely, petroleum hydrocarbons and methane. The approach has not been widely used but is described in greater detail in Luo et al. (2013). The method involves the delivery of atmospheric air below and around a building foundation at rates sufficient to maintain aerobic conditions in the vadose zone; these aerobic conditions act as a biobarrier to VI. The technology can also enhance the remediation of certain shallow subsurface vapor sources. The method represents an alternative to other petroleum VI mitigation and remediation technologies (e.g., soil vapor extraction and sub-slab depressurization [SSD]) and is applied in situ and does not require expensive vapor treatment or intrinsically safe equipment. This technology information sheet provides basic information to assist the practitioner in potential aerobic vapor mitigation barrier (AVMB) application and decision-making.

Similar to performance evaluation for VI mitigation strategies, the effectiveness of using AVMB to address VI is reflected by indoor air concentrations of VFCs (primarily petroleum hydrocarbons and methane) over time. Additionally, measurement of sub-slab vapor VFC concentrations over time provides evidence that the AVMB system is effectively reducing petroleum hydrocarbon and methane VFCs.

Overview

AVMB is an in situ VI mitigation and remediation technology designed to aerobically biodegrade hydrocarbons in the vadose zone before they migrate to indoor air. The technology is primarily applicable for VFCs, such as petroleum hydrocarbons (e.g., benzene, toluene, ethylbenzene, and xylenes) and methane, that tend to biodegrade rapidly under aerobic conditions at rates that exceed rates of gas migration by diffusion and advection (DeVaull 2007). The technology involves the slow delivery of atmospheric air containing 21 percent oxygen (O_2) below and around existing building foundations at low rates via sub-slab vents, drain tiles, or horizontal wells (**Figure 1**). The technology can also serve as a remediation technology at certain sites with shallow vapor sources. The technology is described in greater detail in Luo et al. (2013).

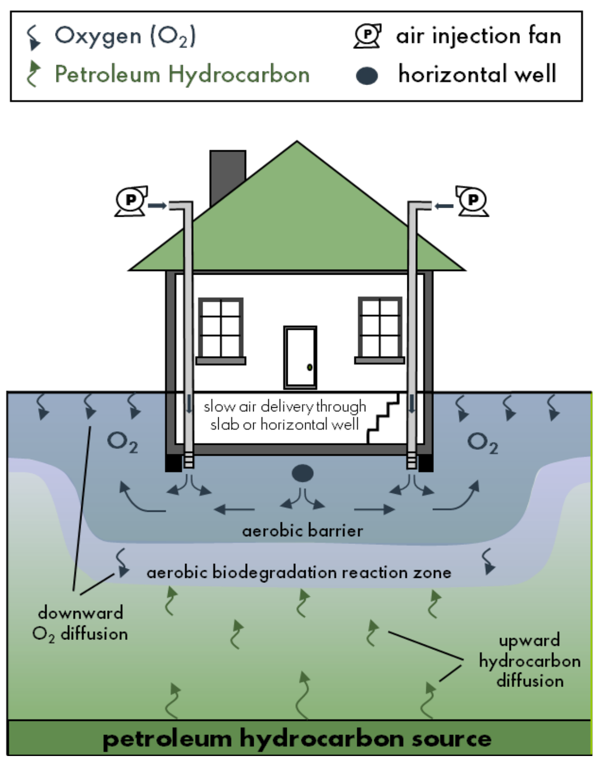

Figure 1. Conceptualization of an aerobic vapor barrier.

Source: Shell Global Solutions, Inc., used with permission.

Design Considerations

The aim of the AVMB is to create an atmospheric oxygen boundary condition between the contaminant source and building foundation sufficient to aerobically biodegrade petroleum hydrocarbon concentrations (and methane) below risk-based screening levels for VI. The air is delivered at a slow rate (e.g., 1–10 liters per minute) that is sufficient to develop and maintain a 3- to 5-foot-thick aerobic biodegradation zone (defined by oxygen concentrations greater than 5 percent by volume) between the building foundation and the source of petroleum vapors in the subsurface. An equation to estimate the minimum air-injection rate is provided in Luo et al. (2013). This airflow rate is approximately 10–1,000 times lower than airflow rates associated with typical 90-watt fans used for SSD or sub-slab ventilation (SSV) systems. The technology relies predominantly on molecular diffusion (concentration gradient–driven transport) rather than advection (pressure gradient–driven transport) for oxygen delivery and VI mitigation. Minimizing the formation of pressure gradients avoids the displacement of hydrocarbon vapors through and around building foundations that could potentially occur during the initial few days after system start-up. Key variables affecting the air-injection rate include the following:

- The area of the building foundation
- Total petroleum hydrocarbons (TPH), methane, or hydrocarbon-specific source vapor concentrations
- The oxygen concentration and depth below the foundation for which aerobic conditions are targeted
- The vertical separation distance between the hydrocarbon vapor source and the air-injection point
- The effective diffusion coefficient of the soil around the injection point, which can either be estimated from theoretical relations or measured in situ (Johnson et al. 1998)

Components of Aerobic Vapor Mitigation Barrier Systems

Components of an AVMB system generally include the following:

- An air-injection fan that can generate airflow rates in excess of 100 liters per minute at 20 pounds per square inch gauge
- A valve and flowmeter to regulate and measure airflow, respectively
- Horizontal wells, drain tiles, or sub-slab vents for air injection
- A network of multilevel soil-gas monitoring points located adjacent to and beneath the building foundation for measuring concentrations of hydrocarbon vapors (TPH, including methane and/or specific hydrocarbons, such as benzene) and certain fixed gases (e.g., oxygen, carbon dioxide, methane, and nitrogen)

Optional equipment and measurements include the following:

- Oxygen sensors to measure concentrations in real time and allow for automated and optimized air injection
- The moisture content and total porosity of the soil around the injection point for estimating the effective diffusion coefficient, if not measured in situ

The equipment and materials needed for AVMB applications are reported in greater detail in Luo et al. (2013).

Applicability of Aerobic Vapor Mitigation Barriers for Vapor Intrusion Mitigation

AVMB systems are mainly applicable for existing buildings with petroleum hydrocarbon sources that are susceptible to aerobic biodegradation in the subsurface and sites where individual, discrete building VI mitigation is desired.

Advantages

Primary advantages of AVMB systems include the following:

- Do not require vapor treatment and permitting, intrinsically safe equipment, or mechanisms to treat entrained formation / source water
- Can remediate the vapor source

Limitations

Primary limitations of AVMB systems include the following:

- Novelty of the technology (i.e., no widespread implementation)
- The air-injection pressures required to create the biobarrier in the subsurface may have the potential to exacerbate VI if not controlled
- Inability to effectively achieve the following:
  - Mitigate constituents that do not biodegrade rapidly under aerobic conditions (e.g., most chlorinated solvents) and shallow groundwater sources located within a foot of the building foundation
  - Remediate hydrocarbon sources located beyond 5–10 feet below the injection point or in low-permeability soils
- Need for specialized drill rigs and sufficient open space from the edge of the building foundation (e.g., approximately 20 feet) for horizontal well installations
- Potential to damage under-foundation pipework (e.g., drains and other building penetrations) during horizontal well installation

Cost Considerations

Primary factors affecting the cost of an AVMB system are the size of the building foundation and diffusive properties of the soils located near the injection point. Installation costs are assumed to range significantly depending on the building footprint and number of injection points. Annual system operating costs are estimated to be less than those associated with conventional SSD or SSV systems because of the comparatively low energy demand for air delivery.

Occupant, Community, and Stakeholder Considerations

It is essential to develop and implement a site-specific community involvement plan that addresses how to win trust and gain access to properties, communicate risk to potentially exposed individuals, and minimize the disruption of people's lives and businesses. For more details see **Chapter 3: Community Engagement**.

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