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**.

INDOOR AIR TREATMENT TECHNOLOGY INFORMATION SHEET

Overview

Air treatment units, commonly referred to as air purifying units (APUs) or air cleaners, can be used to mitigate vapor intrusion (VI) and are most often used when a temporary reduction of the concentrations of vapor-forming chemicals (VFC) in indoor air is needed while a longer-term mitigation and/or source remediation strategy is designed, permitted, and installed (e.g., sub-slab depressurization system). APUs are intended to actively circulate indoor air within a certain room or building area and remove VFCs present in the air stream. They are considered a versatile, easy-to-implement, short-term solution, but still require some oversight.

APUs can be ineffective if not properly selected for the target compounds or sized for building- and site-specific conditions. Considerable variability in effectiveness has been reported, with reductions of VFC concentrations in indoor air ranging from 25 to 99 percent. For that reason, follow-up verification testing / performance monitoring may be appropriate when warranted by site conditions (e.g., elevated VFC concentrations, sensitive settings, such as daycares or schools) prior to the installation of the long-term mitigation design. In addition, certain regulatory frameworks may require indoor air monitoring to verify that an APU is meeting its performance objectives. Because VFC contributions to indoor air unrelated to the subsurface may complicate interpretation of indoor air sampling results, additional lines of evidence should also be considered when evaluating performance (e.g., assessment of indoor or outdoor background VFC sources).

Components

Classes of commercially available APUs include the following:

- Adsorption-based APUs (i.e., treatment using a sorbent bed or layer, commonly granular activated carbon [GAC])
- Photocatalytic oxidation APUs (i.e., use of light and catalysts to break down VFCs into water, carbon dioxide, and other compounds)
- Other types, including ozone generation, chemisorption (e.g., permanganate), or biofiltration (using plants or microbes)

Adsorption-based APUs are most common and are discussed further in this information sheet. Primary issues associated with the other classes listed above include the potential for the formation of by-products released to the indoor air (e.g., other VFCs, ozone, hydrochloric acid) and overall lack of verification through peer-reviewed case studies.

APUs can be used in different configurations. Stand-alone APUs include portable (**Figure 1**), wall-mounted, or ceiling-mounted units. APUs can also be installed within the ducts of existing heating, ventilation, and air conditioning (HVAC) systems. The units are often equipped with particulate filters to protect the VFC-adsorbent material.

Figure 1. Examples of portable air purifying units.

Sources: Jacobs Engineering Group, U.S. Navy, used with permission.

Typical design specifications for an APU include airflow (for portable units), pressure drop (for duct-mounted units), VFC removal efficiency, sorbent capacity or lifetime, reliability and uptime, noise levels, power usage, physical dimensions, and weight.

Multiple factors should be considered when selecting the number of units and individual capacity of APUs. These factors include the following:

- Chemical characteristics of the air to be treated (e.g., type and concentrations of target VFCs, presence of nontarget VFCs, particles, other air contaminants)
- Physical characteristics of the air stream (e.g., humidity, temperature)
- Building characteristics (e.g., size of space to treat, air exchange rate [AER])
- Occupant characteristics (e.g., frequency of occupancy, noise tolerance, acceptance by occupants)
- Other characteristics (e.g., power requirements, equipment theft or tampering concerns, equipment visibility, and aesthetics)

The number of APUs and individual flow rate should be such that the total airflow is several times the baseline airflow through the space to be treated. The baseline airflow is the amount of air flowing though the space under ambient conditions and can be estimated using the space volume and baseline AER. Typical AERs range from less than one air change per hour in residential settings to a few air changes per hour in nonresidential settings. APUs essentially increase AER by recycling clean air within the room several times per baseline AER. The expected reduction in VFC concentration can be estimated from the increased AER and an assumed VFC removal efficiency by the APU (i.e., 100 percent or a lower level). VFC mass loading and GAC consumption should also be considered. The VFC mass loading rate (i.e., the rate of both target and nontarget VFC mass entering the space to be treated) can be estimated from the indoor air concentrations and baseline AER. This mass loading rate can then be used to estimate the amount of GAC needed for treatment and the expected replacement frequency.

Advantages

Advantages associated with APUs include their versatility and ease of implementation in a variety of settings. APUs are well suited for implementing a rapid response. This approach can quickly lower indoor air concentrations to acceptable indoor air quality levels while long-term VI mitigation is designed and implemented. APUs can also be used to supplement an existing mitigation system or installed within an operating HVAC system.

Limitations

Numerous limitations are associated with APUs, which can be summarized as follows:

- APUs treat indoor air and, therefore, do not cut off the VI pathway or address the VFC source.
- Manufacturer-recommended media changeout frequencies can underestimate the actual time between changeouts, which, ideally, should be determined on a site-specific basis, and many commercially available units have limited media capacity resulting in frequent changeouts.
- Overestimating and exhausting the sorptive capacity of the media may cause certain contaminants with a lower affinity for the media to desorb from the media, leading the APU to become a source of some indoor air contaminants.
- Purchasing APUs and media changeouts can be expensive.
- The treatment GAC ultimately needs to be replaced or regenerated and may create waste—in some cases, with special disposal considerations in areas of high VFC potential.
- APUs can be noisy and subject to human interference (i.e., unit turned off or doors shut, interfering with the treatment of air in other rooms).
- APUs can be maintenance- and power-intensive and costly to operate to meet performance objectives.
- Adsorption performance can be limited by moist environments and competition from nontarget VFCs, which are common in indoor air due to a variety of sources (e.g., cooking, upholstery, consumer products).
- APUs may require specialized filter media (e.g., potassium permanganate) to be effective in meeting indoor air criteria for VFCs with poor adsorption performance (e.g., vinyl chloride) or when indoor air concentrations are high.
- Overall performance is subject to uncertainty, such that follow-up verification testing and the development of a performance monitoring plan may be appropriate when warranted by the severity of the conditions (e.g., elevated contaminant concentrations, daycare, or school settings) prior to the installation of the long-term mitigation design.

Cost Considerations

Deploying APUs includes the initial cost of the units, which increases with the size of the building, size, and number of units, concentrations of VFCs, and the length of time that APUs are operated and maintained to treat indoor air. APUs require media changeouts, often at a frequency greater than what the manufacturer recommends due to site-specific conditions, which also increases the overall cost. Relatively low media capacity of commercially available APUs results in more frequent media changeouts and greater expense.

Special Circumstances

As indicated previously, certain classes of APUs use photocatalytic oxidation (in lieu of adsorption) to transform VFCs into water, carbon dioxide, and other compounds. These APUs use ultraviolet light and a catalyst (commonly, titanium dioxide). Laboratory and field studies have shown that VFCs can be effectively broken down, assuming enough air passes (recirculates) through the units. Some studies, however, have also shown the formation of intermediate oxidation products, including acetone, formaldehyde, and others. Because multiple air passes are needed before complete breakdown of the VFCs is achieved, building occupants could potentially inhale these by-products while the APUs operate in the space that is treated.

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**.