Region 7

Iowa
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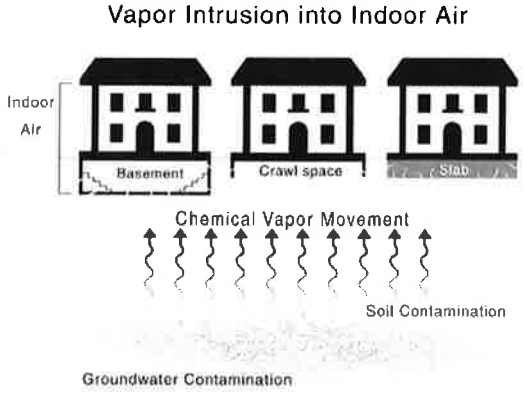
Fact Sheet

February 2010

What You Should Know About Vapor Intrusion

Introduction

EPA has developed this fact sheet to answer frequently asked questions about an important health issue known as vapor intrusion. Vapors and gases from contaminated groundwater and soil have the potential to seep into indoor spaces and cause health problems.



What is vapor intrusion?

Vapor intrusion occurs when liquid chemicals give off gases that seep into buildings through cracks in basement walls, foundations, sewer lines or other openings. Sometimes these liquid chemicals are spilled on the ground or leak from underground storage tanks. They trickle down into the soil and groundwater, and the gases they give off travel through soil particles as vapors. These vapors then move up through the soil and into nearby buildings, contaminating indoor air.

Homes in the same neighborhood, even right next door, can be affected differently by vapor intrusion. The effects can be dependent upon the condition of the home. For instance, a home with more cracks in its foundation could be more prone to vapor intrusion. Vapor intrusion is similar to the process that occurs when radon, a naturally occurring radioactive gas, enters a home through cracks in the foundation. Vapor intrusion from chemicals is uncommon, but should be considered when there is a known source of soil or groundwater contamination nearby.

What chemicals might enter my home and how would they get there?

Volatile organic compounds (VOCs) are one group of chemicals that can easily become gases or vapors which can migrate through soil and enter buildings. Well-known examples of VOCs are petroleum products, such as gasoline or diesel fuel, dry cleaning solvents and industrial de-greasers.

One of the most common ways that vapor intrusion occurs is when petroleum that has leaked from underground storage

tanks at gas stations gives off vapors that enter people's homes. This occurrence is usually accompanied by a petroleum odor. Solvents from other commercial and industrial sites are not usually accompanied by an odor. In many cases, underground chemical and petroleum leaks are not discovered until contamination has had time to travel through the soil.

When the EPA investigates possible vapor intrusion, we also take into account VOCs found in household products stored in your home. Paints, paint strippers and thinners, glues, solvents, stored fuels and dry-cleaned clothing all contain VOCs. These household products are more likely to be a source of indoor air quality problems than vapor intrusion from a chemical spill.

What are the health concerns with vapor intrusion?

When vapor intrusion does occur, the health risk will vary based on the type of chemicals, the levels of chemicals found, the length of exposure and the health of the exposed individuals. When chemicals build up in indoor air at high levels, some people may experience health effects such as eye and respiratory irritation, headaches and/or nausea. These symptoms are temporary and should go away when the person moves to fresh air. Usually, health officials are more concerned about low-level chemical exposures over many years. Long-term exposure to some chemicals may raise a person's lifetime risk of developing cancer or other chronic diseases.

The likelihood of indoor air contamination by vapor intrusion is low at most cleanup sites. When vapor intrusion does occur, the health risk will often be lower than the risk posed by radon or by household chemicals used by the residents. Even though the risk is quite low, the EPA and many health agencies consider these risks to be unnecessary and avoidable.

What should I do if vapor intrusion is a concern in my home?

If you live near a cleanup site where petroleum or other VOCs have contaminated soil or groundwater, you should ask the officials overseeing the cleanup if the potential for vapor intrusion is being investigated. You may be contacted by the cleanup team working on the site. They may provide information about the project or request assistance from you. Your cooperation and consent may be requested, so that testing can be done on your property.

How is vapor intrusion discovered?

In most cases, the potential for vapor intrusion can be ruled out by collecting soil gas or groundwater samples near the contamination site. If contamination can be ruled out near the site, then it may be unnecessary to look any farther out. If contamination is found in soil gas near the homes, the next step is to take vapor samples from the soil under the home's foundation; these are called sub-slab samples. EPA does not generally recommend indoor air sampling before sub-slab sampling. Sub-slab samples are more reliable indicators of potential vapor intrusion than indoor air samples and are not affected by other indoor chemical sources. If no soil vapors are detected outside the home, additional indoor air sampling may not be necessary as long as the site is being cleaned up effectively. If sub-slab vapors are detected outside

the home above EPA's projected health concern levels, additional indoor air sampling should be done to determine if those vapors are present inside and at what levels. Indoor air quality changes a lot from day to day. Therefore, sampling one day may not show a problem, and the next day it will. A variety of VOC sources are present in many homes and in outside air, which replaces indoor air constantly. Therefore, testing will not necessarily confirm that the VOCs in the indoor air are entering the home from outside underground sources.

What happens if a problem is found?

The most common solution is to install systems often used to reduce naturally occurring radon that seeps into homes in some parts of the country. These systems, called radon mitigation systems, remove soil vapors from below basements or foundations before they enter homes. Vapors are vented outside of the homes where they become dispersed and harmless. These systems use minimal electricity and do not noticeably affect heating and cooling efficiency. They also prevent radon from entering homes - an added health benefit in radon prone areas. Once the source of the vapors is eliminated, the systems should no longer be needed. In homes with radon problems, these systems should remain in place permanently.

What can I do to improve my indoor air quality?

Consider these tips to improve indoor air quality in your home:

►Do not buy more chemicals than you need. Be aware of which products contain VOCs.

►Store unused chemicals in appropriate containers in well-ventilated areas.
►Don't make your home too air tight. Fresh air helps prevent chemical build-up in the air and mold growth.
►Fix all leaks promptly to discourage mold growth.
►Make sure all appliances and fireplaces are in good condition. Have them checked annually.
►Test your home for radon. Test kits are available at hardware and home improvement stores; more information is available at http://www.epa.gov/radon.
►Install carbon monoxide monitors in your home. They are also available at home improvement and hardware stores.

For more information:

For health-related questions regarding vapor intrusion, contact your local health department or the Agency for Toxic Substances and Disease Registry at **1-888-422-8737** or visit their website at www.atsdr.cdc.gov.

For more information on indoor air quality, visit EPA's website at: http://www.epa.gov/iaq or call the Indoor Air Quality Information hotline at **1-800-438-4318.**

For more information about ongoing site cleanup actions or vapor intrusion investigations in EPA Region 7 (Iowa, Kansas, Missouri, Nebraska and associated tribal nations), contact:

Mary Peterson, Superfund Division
Telephone: 913-551-7882
E-mail: peterson.mary@epa.gov or
Dan Nicoski, Environmental Services Div.
Telephone: 913-551-7230
E-mail: nicoski.dan@epa.gov

Tetrachloroethylene - ToxFAQs™

CAS # 127-18-4

This fact sheet answers the most frequently asked health questions (FAQs) about tetrachloroethylene. For more information, call the CDC Information Center at 1-800-232-4636. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It's important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Tetrachloroethylene is a manufactured chemical used for dry cleaning and metal degreasing. Exposure to very high concentrations of tetrachloroethylene can cause dizziness headaches, sleepiness, incoordination confusion, nausea, unconsciousness, and even death. Tetrachloroethylene has been found in at least 945 of the 1,699 National Priorities List sites identified by U.S. Environmental Protection Agency (EPA).

What is tetrachloroethylene?

Tetrachloroethylene is a nonflammable colorless liquid. Other names for tetrachloroethylene include perchloroethylene, PCE, perc, tetrachloroethene, and perchlor. Most people can smell tetrachloroethylene when it is present in the air at a level of 1 part in 1 million parts of air (1 ppm) or more.

Tetrachloroethylene is used as a dry cleaning agent and metal degreasing solvent. It is also used as a starting material (building block) for making other chemicals and is used in some consumer products.

What happens to tetrachloroethylene when it enters the environment?

- Tetrachloroethylene can be released into air, water, and soil at places where it is produced or used.
- Tetrachloroethylene breaks down very slowly in the air and so it can be transported long distances in the air. Half of the amount in the air will degrade in approximately 100 days.
- Tetrachloroethylene evaporates quickly from water into air. It is generally slow to break down in water.
- Tetrachloroethylene may evaporate quickly from shallow soils or may filter through the soil and into the groundwater below. It is generally slow to break down in soil.

How might I be exposed to tetrachloroethylene?

- When you bring clothes from the dry cleaners, they will release small amounts of tetrachloroethylene into the air.
- When you drink water containing tetrachloroethylene, you are exposed to it. You might also be exposed to tetrachloroethylene that is released into the air during showering and bathing.
- People residing near contaminated sites or dry cleaning locations may be exposed to higher levels than the general population.
- People working in the dry cleaning industries or using metal degreasing products may be exposed to elevated levels of tetrachloroethylene.

How can tetrachloroethylene affect my health?

Breathing high levels of tetrachloroethylene for a brief period may cause dizziness or drowsiness, headache, and incoordination; higher levels may cause unconsciousness and even death.

Exposure for longer periods to low levels of tetrachloroethylene may cause changes in mood, memory, attention, reaction time, and vision.

Studies in animals exposed to tetrachloroethylene have shown liver and kidney effects, and changes in brain chemistry, but we do not know what these findings mean for humans.

How likely is tetrachloroethylene to cause cancer?

Studies in humans suggest that exposure to tetrachloroethylene might lead to a higher risk of getting bladder cancer, multiple myeloma, or non-Hodgkin's lymphoma, but the evidence is not very strong.

Agency for Toxic Substances and Disease Registry
Division of Toxicology and Human Health Sciences

ATSDR

CS265956-A

Tetrachloroethylene

CAS # 127-18-4

In animals, tetrachloroethylene has been shown to cause cancers of the liver, kidney, and blood system.

EPA considers tetrachloroethylene likely to be carcinogenic to humans by all routes of exposure. The International Agency for Research on Cancer (IARC) considers tetrachloroethylene probably carcinogenic to humans. The Department of Health and Human Services (DHHS) considers tetrachloroethylene to be reasonable anticipated to be a human carcinogen.

How can tetrachloroethylene affect children?

It is not known whether children are more susceptible than adults to the effects of tetrachloroethylene.

A few studies in humans have suggested that exposure to tetrachloroethylene increased the numbers of babies with birth defects, but these studies were not large enough to clearly answer the question. Studies in animals exposed by inhalation or stomach tube have not shown clear evidence of specific birth defects.

How can families reduce the risks of exposure to tetrachloroethylene?

- Tetrachloroethylene has been found in low levels in some food. You can minimize the risk of your family's exposure by peeling and thoroughly washing fruits and vegetables before cooking.
- Use bottled water if you have concerns about the presence of tetrachloroethylene in your tap water. You may also contact local drinking water authorities and follow their advice.
- Prevent children from playing in dirt or eating dirt if you live near a waste site that has tetrachloroethylene.
- Tetrachloroethylene is widely used as a scouring solvent that removes oils from fabrics, as a carrier solvent, as a fabric finish or water repellant, and as a metal degreaser/cleaner. Follow instructions on product labels to minimize exposure to tetrachloroethylene.

Is there a medical test to show whether I've been exposed to tetrachloroethylene?

Tetrachloroethylene and its breakdown products (metabolites) can be measured in blood and urine. However, the detection of tetrachloroethylene or its metabolites cannot predict the kind of health effects that might develop from that exposure. Because tetrachloroethylene and its metabolites leave the body fairly rapidly, the tests need to be conducted within days after exposure.

Has the federal government made recommendations to protect human health?

The Occupational Safety and Health Administration (OSHA) has set an 8-hour time weighted average permissible exposure limit of 100 ppm, an acceptable ceiling exposure limit of 200 ppm, and a maximum peak of 300 ppm (not to be exceeded for more than 5 minutes of any 3-hour period).

The National Institute for Occupational Safety and Health (NIOSH) recommends that workplace exposure to tetrachloroethylene be minimized due to concerns about its carcinogenicity.

References

This ToxFAQs™ information is taken from the 2014 Toxicological Profile for Tetrachloroethylene (Draft for Public Comment) produced by the Agency for Toxic Substances and Disease Registry, Public Health Service, U.S. Department of Health and Human Services in Atlanta, GA

Where can I get more information?

For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology and Human Health Sciences, 1600 Clifton Road NE, Mailstop F-57, Atlanta, GA 30329-4027.

Phone: 1-800-232-4636, FAX: 770-488-4178.

ToxFAQs™ Internet address via WWW is http://www.atsdr.cdc.gov/toxfaqs/index.asp.

ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

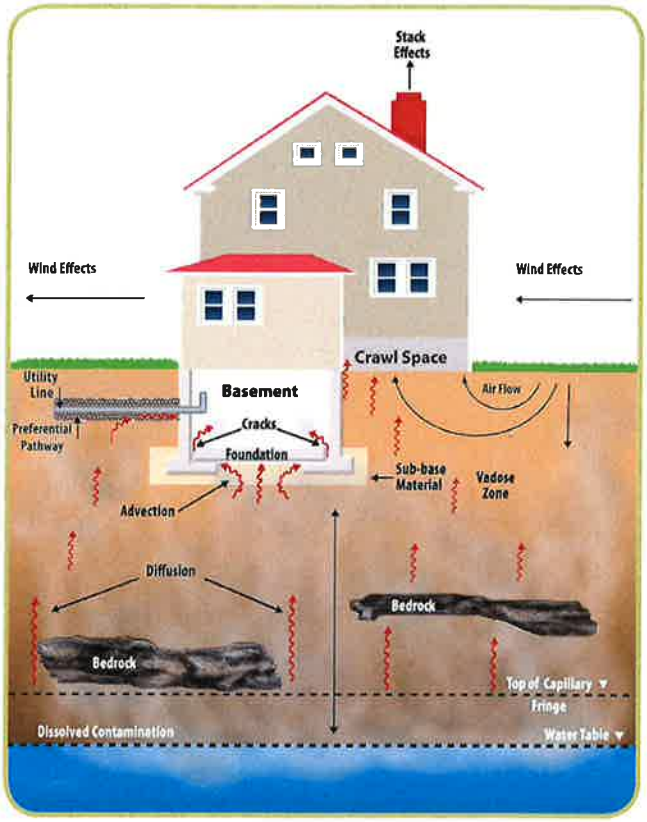
Vapor Intrusion

What is vapor intrusion?

Vapor intrusion is a way that volatile chemicals in soil and groundwater can enter and build-up inside buildings. Volatile chemicals are a class of chemicals that are volatile (evaporate easily) and form a vapor in the air.

- Common sources of volatile chemicals include gas stations, dry cleaners, and industrial operations.
- When a chemical is spilled or leaks into the ground, it can contaminate the soil and the groundwater.
- The chemical can move with the groundwater and travel under a building (migration route).
- If that chemical is volatile, it can become a gas and seep into nearby buildings and contaminate indoor air.

This fact sheet explains how vapor intrusion occurs and what factors can cause vapors (sometimes called gases) to move into indoor air.



Why is vapor intrusion important to me?

When chemicals move indoors, you can be exposed to them by breathing indoor air. This exposure can cause health effects, depending on the type and amount of chemical and the length of exposure.

You can learn more about the possible health effects of individual volatile chemicals in ATSDR's Toxic Substances Portal: http://www.atsdr.cdc.gov/substances/index.asp.

How does vapor intrusion occur?

Vapor intrusion does not occur every time there is contaminated soil or groundwater. It occurs only when volatile chemicals move from a source (like a chemical spill) along an underground migration route and into a building.

The type and amount of chemicals coming from a source will determine whether vapor intrusion occurs at levels of possible health concern.

What factors affect vapor intrusion?

The following factors affect vapor intrusion:

- The type of soil beneath your building
- The type and condition of your building (foundation, leaks, air exchange)
- The weather conditions in your area

The amount of vapors entering a building can be different over time—changing hourly, daily, weekly, and seasonally.

The amount of vapor intrusion can also be different on different floors and in different rooms of the same building or in buildings right next to each other.

If scientists suspect vapor intrusion in buildings in a specific location, they may decide to conduct an investigation. See ATSDR's fact sheet "Investigating Vapor Intrusion" for information on what to expect if a vapor intrusion investigation is planned for buildings in your area.

Where can I learn more about vapor intrusion?

U.S. Environmental Protection Agency

- Vapor intrusion website, visit: http://www2.epa.gov/vaporintrusion

Interstate Technology & Regulatory Council

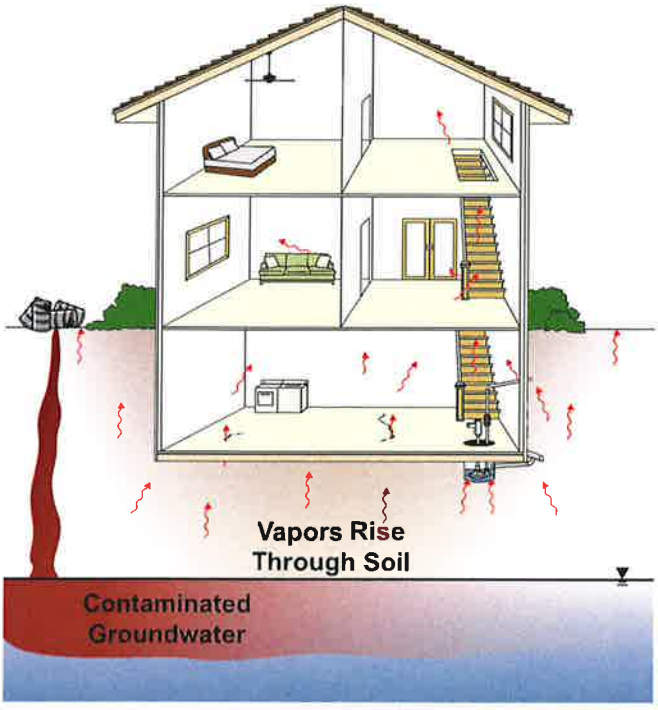
- Vapor intrusion website, visit: http://www.itrcweb.org/Team/Public?teamID=22

A Citizen's Guide to Vapor Intrusion Mitigation

What Is Vapor Intrusion Mitigation?

Vapor intrusion is the movement of chemical vapors from contaminated soil and groundwater into nearby buildings. Vapors primarily enter through openings in the building foundation or basement walls — such as cracks in the concrete slab, gaps around utility lines, and sumps. It also is possible for vapors to pass through concrete, which is naturally porous. Once inside the home or workplace, vapors may be inhaled posing immediate or long-term health risks for the occupants. In rare cases, the buildup of vapors, such as those from gasoline, may cause explosive conditions. Risks will depend on the types of chemical vapors and their concentrations, how much time people spend in the building, and the building's ventilation. Vapor concentrations will be higher indoors when windows and doors remain closed.

Mitigation methods, which lessen the effects of vapor intrusion, may be needed until contaminated soil or groundwater is cleaned up. Mitigation methods are available for both existing buildings and those planned for construction near the contaminated area.



Vapor intrusion into a home.

How Does It Work?

Vapor intrusion mitigation methods are classified as either "passive" or "active." Passive methods prevent the entry of chemical vapors into the building, while active methods change the pressure difference between the sub-slab and the inside of the building to keep vapors out. Passive mitigation methods tend to be cheaper, while active methods tend to be more effective. Examples of each include:

Passive Vapor Intrusion Mitigation Methods:

- **Sealing openings** involves filling in cracks in the floor slab and gaps around pipes and utility lines found in basement walls. Concrete can be poured over unfinished dirt floors.
- Installing **vapor barriers** involves placing sheets of "geomembrane" or strong plastic beneath a building to prevent vapor entry. Vapor barriers are best installed during building construction, but can be installed in existing buildings that have crawl spaces.
- **Passive venting** involves installing a venting layer beneath a building. Wind or the build-up of vapors causes vapors to move through the venting layer toward the sides of the building where it is vented outdoors. A venting layer can be installed prior to building construction as well as within existing buildings. It is usually used with a vapor barrier.

Active Vapor Intrustion Mitigation Methods:

- **Sub-slab depressurization** involves connecting a blower (an electric fan) to a small suction pit dug into the slab in order to vent vapors outdoors. (Most common method.)
- **Building over-pressurization** involves adjusting the building's heating, ventilation, and air-conditioning system to increase the pressure indoors relative to the sub-slab area. This method is typically used for office buildings and other large structures.

How Long Will It Take?

Mitigation will be needed to prevent vapor migration into buildings as long as vapor intrusion poses a health risk to occupants. This may be several years, or even decades, until cleanup of soil and groundwater is complete.

Is It Safe?

Vapor intrusion mitigation systems are quite safe to use and will improve the quality of the indoor air by removing chemical vapors due to vapor intrusion as well as radon (another health risk) and moisture, which may lead to mold growth. However, mitigation systems will not reduce vapors from indoor sources of chemicals, such as paints, plastic items, and hobby supplies.

Until the threat of vapor intrusion is gone, mitigation systems should be inspected regularly to make sure they are working correctly. For example, floors and walls are checked to see that no new cracks develop, a geomembrane in a crawlspace is checked for rips and holes, and electric fans are checked to ensure they are working correctly. Homeowners should not turn off the electric fans until EPA or state agency notifies them that it is appropriate to do so. Homeowners should report broken fans and vent pipes to the lead agency.

How Might It Affect Me?

An occupant of a home or office constructed with a vapor mitigation system will not likely notice it. However, the installation of systems in existing homes typically takes one or two days, and workers may need to access crawl spaces or indoor living areas. They may need to pull back carpet or move furniture to find and seal cracks or to drill holes in the foundation for sub-slab pipes. They typically place these pipes near the basement walls, in closets, and in low-traffic areas for the convenience of the homeowner. The vent pipes and fan may be visible on the outside of the house. However, in some cases, the pipes may be run through a closet to the attic and vented through the roof. Later, workers may need to visit homes periodically to inspect mitigation systems to ensure the systems are working properly.

Homeowners may notice the hum of the electric fans, if they have a depressurization system. These fans use less electricity than an LED television; electric bills will rise slightly.

Why Use Vapor Intrusion Mitigation?

Vapor intrusion mitigation systems are installed to reduce health risks in buildings where chemical vapors from contaminated soil and groundwater may be inhaled by indoor occupants. They also may be installed as a precaution where vapor intrusion might occur in the future. Installing a system during building construction typically is cheaper, more effective, and less disruptive than waiting until after construction. Depressurization systems offer the added benefit of reducing radon, moisture, and mold inside the building.

Mitigation systems have been installed and operated at hundreds of homes near Superfund sites and other contaminated sites across the country.

Typical fan and vent pipe.

Example

Mitigation is reducing possible risks from vapor intrusion at 43 homes near the Nyanza Superfund site in Massachusetts. Dye manufacturing from the 1910s to 1978 contaminated groundwater with trichloroethene (TCE) and other chemicals. By the 1980s, a plume of groundwater contamination was found to extend beneath a nearby neighborhood. Sampling of indoor air, sub-slab air, and groundwater showed that vapor intrusion was occurring, and TCE concentrations posed a risk to some homeowners. Vapor intrusion also had the potential to occur at several other homes.

As a result, EPA installed depressurization systems in homes located above the most contaminated groundwater where vapor intrusion is most likely to be a problem. Before installing the systems in 2007, EPA sealed cracks in basement walls and floors, and covered sump pits. In homes with dirt basements, they poured a concrete floor or installed a vapor barrier. Following installation, each depressurization system was tested to ensure that it worked properly. The systems are inspected annually to ensure that they continue to work.

For More Information

For more information about this and other technologies in the Citizen's Guide Series, visit:

www.cluin.org/remediation
www.cluin.org/products/citguide
www.cluin.org/vi
www.epa.gov/oswer/vaporintrusion/

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