

BUILDING SERVICES & SUPPLIERS

By, Ajay Kathuria, P.E., Christopher Richter; EWMA and Arthur Clarke, Esq.; Gibbons Law

Toxic Vapor Intrusion: Vapor phase migration of volatile organic compounds

Do you wonder if your building may have a case of the "toxic" vapors? The recurring complaints of headache, dry cough, itchy skin, fatigue, and other signs of acute discomfort are not likely the result of some "toxic" vapors but due to inadequate ventilation, ineffective heating and air conditioning, or biological contaminants thriving on excessive moisture (e.g. mold). These are the usual suspects behind a majority of the indoor air quality (IAQ) complaints and the term "sick building syndrome" (SBS).

In some cases, especially in chemical-use intensive industrial and commercial buildings, "toxic" vapors from indoor sources of volatile organic compounds (VOCs) may accumulate at concentrations high enough to cause acute health effects and discomfort. However, VOC levels in occupational settings rarely exceed existing occupational standards and guidelines, such as those issued by Occupational Health and Safety Administration (OSHA) for workers' protection.

Although short-term health effects are rare, "toxic" vapors

may cause potential long-term health effects even at extremely low concentrations, at times well below the laboratory detection limits.

"Toxic" vapors may persist in

buildings from indoor sources such as adhesives, carpeting, upholstery, paint and other finishes, typewriter correction fluids, lubricants, pesticides, household solvents, cleaning

agents, freshly dry-cleaned clothes, carbon monoxide, kerosene and gas space heaters, fireplaces, and gas stoves.

Another unsuspecting and long-term potential source of "toxic" vapors that is most often overlooked is "vapor intrusion" that lurks beneath the floor slabs at many buildings.

Vapor Intrusion

The term "vapor intrusion" is defined by the United States Environmental Protection Agency (USEPA) as the vapor phase migration of VOCs into occupied buildings from underlying contaminated soil and/or groundwater.

"Toxic" vapors from subsurface contamination slowly migrate up through the underlying soils and into indoor air through open sumps, joints or cracks in the floor slabs, footings, or foundation walls of overlying buildings.

Some of the common "toxic" vapor compounds with potential long-term health risks include benzene, tetrachloroethylene (PCE), trichloroethene (TCE), methylene chloride, etc. These compounds are susceptible to vapor intrusion and may persist for long periods due to their unique physical and chemical properties.

What's the Risk?

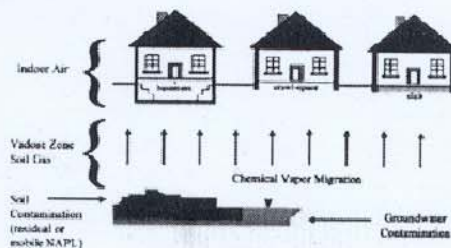
For occupational settings, OSHA has established Permissible Exposure Limits (PELs) of airborne contaminants, including "toxic" vapors, in order to protect workers against occupational hazards.

In residential and other commercial buildings, the main question is whether there is an unacceptable risk of long-term or "chronic" health effects due to an exposure to low levels of "toxic" vapors over an extended period of time. USEPA has established that vapor intrusion, coupled with "toxic" vapors from unsuspecting indoor sources may pose a significant long-term human health risk.

Regulatory Framework

USEPA's Office of Solid Waste and Emergency Response (OSWER) issued one of the first comprehensive guidance documents on vapor intrusion issue in November 2002. The document outlines a tiered approach to investigating vapor intrusion potential and sources, and identifying potential exposure pathways and receptors that may

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be at risk.

Some states have established their own guidance on this issue although, most states are still in the process of refining or developing strict regulations and policies. States that have led this effort include Massachusetts, Connecticut, Michigan, Pennsylvania, California, Washington, New York, New Jersey, and South Carolina.

For example, as part of an interim guidance, State of New Jersey requires a comparison of the indoor air "toxic" vapors concentrations to the risk-based concentrations (RBCs) developed by USEPA Region III for ambient air, in order to establish a long-term potential health risk. In general, these RBCs are orders of magnitude below OSHA PELs, and well below detection limits of many common "toxic" vapor compounds.

There is significant controversy over some regulators enforcing such risk-based exposure models and criteria instead of OSHA PELs in commercial and industrial buildings. However, for buildings with non-occupational sources of "toxic" vapors (e.g. vapor intrusion), the focus is to establish potential long-term health risks since OSHA PELs were developed to safeguard only against short-term occupational hazards.

In some states, regulators are also requiring building owners to record deed notices to alert the public that a potential vapor intrusion source exists and that indoor air exceeds risk-based criteria. However, the associated stigma may impact the building owner's ability to sell, lease or finance the building, and exposes owners to lawsuits by building occupants.

The vapor intrusion policies of many states may also have a chilling effect on Brownfields redevelopment. If risks associated with redevelopment projects are too great due to increased costs of additional engineering and/or remedial controls, the developer may not be able to obtain financing, or sell the project due to resulting stigma.

Is Your Building at Risk?

Since vapor intrusion was not a routine consideration until recently, a vast number of current and former indus-

trial and commercial buildings exist with known or potential vapor intrusion sources and associated health risks.

Per the OSWER guidance document, any buildings within 100 feet of a known or suspected soil and/or groundwater source of VOCs is at risk from vapor intrusion. However, a number of complex site and building specific factors can greatly enhance or reduce this risk.

Most buildings induce vapor intrusion through utility lines that serve as preferential pathways, or through advective transport caused by un-

der-pressurization of the building interiors. Under-pressurization usually results from due to increased "stack effects."

Chasing the Vapor Trail

Although short-term health effects are rare, "toxic" vapors may cause potential long-term health effects even at extremely low concentrations, at times well below the laboratory detection limits.

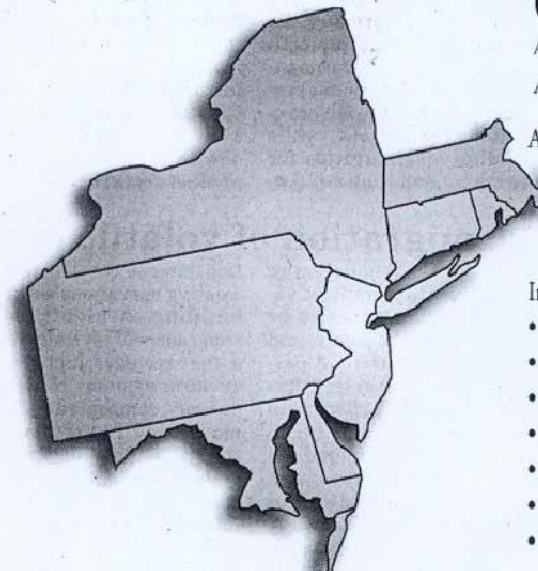
thermal differences with the outside air/soil, wind and pressure changes, "stack effects" of chimney's and flues, exhaust fans/ vents operation, and use of combustion air in gas and oil furnaces. Buildings are most at risk from vapor intrusion during the winter months

As per the tiered approach recommended by USEPA's OSWER, the first step in a vapor intrusion investigation involves gathering sufficient knowledge and/or analytical data to establish a potential source near the building. However, in many cases, only lim-

ited information may be available. The collection of soil and groundwater data can prove to be expensive for many building owners, and is often inconclusive whether the "toxic" vapors actually persist in the building. Furthermore, lack of awareness and inexperience with the regulatory framework and risk communication make it difficult for building owners to effectively tackle this issue.

Based on EWMA's experience in the States of New Jersey and New York, a reverse or top to bottom approach, generally accepted by state regu-

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New hires supplement commercial RE division

Daniels of Skanska is ASADV Project Manager of the Year

BLUE BELL, PA, — According to Skanska USA Building Inc., Ted Daniels, project director in the Philadelphia office, has been named "Project Manager of the Year" by The American Subcontractors Association of Delaware Valley (ASADV). This prestigious award is given to a project manager whose efforts over the year represent superior communication, efficiency and partnership with local subcontractors and contractors, as well as enhance the construction processes among the builder, designer and owner.

"We are extremely proud of Ted and the outstanding work he has accomplished over the past year," said Edwin Jorden, executive vice president of Skanska's Philadelphia office. "His construction expertise, professionalism and dedication to ensuring that our services adhere to our high standards of quality make him the consummate project manager and deserving recipient of this award."

Daniels joined Skanska in 1997, responsible for managing key projects in the corpo-



Shown from left: Ted Daniels and Mario Rapanaro

rate and healthcare industries. He is currently completing work on Reading Hospital and Medical Center's new 340,000 s/f building "N." Daniels is a member of the American Society of Civil Engineers.

ASADV is a non-profit organization, comprised of 150 local firms in the construction

trades. ASADV's members, construction subcontractors, specialty trade contractors, suppliers and vendors are committed to improving the professionalism and competitiveness of its member companies through educational programs, government advocacy and industry liaisons, while providing opportunities for networking and leadership. ■

Promotes construction windows & doors Crystal Window & Door Sys. launches builder program

FLUSHING, NY — Crystal Window & Door Systems launched a national, marketing program aimed at promoting its products with residential homebuilders and those who distribute building products to residential builders. The program is the first in a series of marketing initiatives to support the company's new national sales organization.

The Crystal National Builders Marketing Program promotes the company's new construction vinyl windows and pre-hung fiberglass entrance doors through a package of incentives and sales tools. The Crystal Program includes special product pricing, co-op advertising, builder rebates, model home incentives, as well as easy-to-use explanatory literature and forms. The program will be highlighted in the company's trade print advertising and direct mail campaigns.

Potentially the most enticing feature of the Crystal National Builder Marketing Programs is the provision allowing qualifying firms to be first in line to introduce the revolutionary Crystal self-contained Hideaway Fire Escape Ladder Window to their customers. This product feature, currently in

development by Crystal, will soon be available with several of the company's most popular new construction and replacement windows. Demand for this new window "up-sell" safety feature, especially with new homebuyers, is expected to be very strong. Qualified participants in the Crystal National Builder Marketing Program will receive preferred status for ordering the Hideaway Fire Escape Ladder Window as it comes on-line.

"Crystal wants to become the preferred window and door manufacturer of new home builders nationally. That's why we've launched this new program that provides the products, pricing, sales tools and incentives this market needs now. And I think the new Crystal Hideaway Fire Escape Ladder Window will be an especially attractive product with homebuyers, homebuilders and building supply companies throughout the nation," said James Barbara, Crystal VP for sales.

Crystal Window & Door System is a manufacturer of replacement and new construction vinyl and aluminum window and door products in Flushing, NY. ■

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latory agencies, has proven to be practical and yet effective in identifying the risks and potential solutions. The most important steps in this approach involve building survey to eliminate background sources at least 48 hours prior to collecting representative indoor air samples to determine the presence and extent of "toxic" vapors, followed by the collection of sub-slab (immediately beneath the floor slab) air samples to establish a potential vapor intrusion pathway. Additional investigations including soil gas, soil, and groundwater can then be undertaken, if necessary, to complete the pathway assessment.

If tetrachloroethylene (PCE) is one of the target VOCs, dry cleaning pick-up/ drop-off services or excessive use of freshly dry cleaned clothes should also be prohibited at least 48 hours in advance of the air sampling.

In most cases, the identification and remediation of the actual vapor intrusion source, i.e. contaminated soil and/ or groundwater may either take years or be outside of the build-

ing owner's liability and/or control. Therefore, building owners may be forced to establish alternative near and long-term protective measures in an expeditious and cost-effective manner.

Vapor Abatement Strategies

Based upon EWMA's experience, HVAC adjustments to either increase the outdoor air exchange rates or to create a positive pressure in the building have been highly effective in minimizing vapor intrusion. For residential or smaller buildings, such adjustments can serve as a long-term solution. However, for many small and larger buildings, additional, more active and long-term abatement strategies must be employed.

Some of the immediate and long-term abatement strategies include the installation of vapor barriers, passive vents, sub-slab depressurization (SSD) systems, modification of building foundations, remediation technologies such as soil vapor extraction, indoor air purification systems, etc.

For existing buildings, modi-

fications to the foundation or installation of a retrofitted vapor barrier can prove to be highly disruptive, costly, and potentially ineffective. A passive or active SSD system has proved to be highly effective in mitigating vapor and radon gas intrusion at hundreds of residences across the country. For larger commercial and industrial buildings, a carefully tested, designed and installed SSD system can prove to be the most cost effective strategy.

An SSD system involves the installation of several 2 to 4 inch diameter vacuum extraction points through the existing floor slab in inconspicuous areas, and above grade piping to connect the extraction points to passive or active exhausters, vacuum blowers, or fans installed on the roof-top or outside in order to depressurize the sub-slab and directly vent any accumulating "toxic" vapors to the outside air.

The cost-effectiveness and appropriateness of an SSD system is largely dependent upon the building subgrade, founda-

tion, interior construction, and existing operations within the building. A highly porous subgrade will typically require a less expensive, high flow/ low vacuum system. However, a densely compacted subgrade may dictate the need for a more costly low flow/ high vacuum system due to higher number of extraction points required.

Risk Communication

The most difficult aspect of dealing with vapor intrusion issues can be appropriate and adequate risk communication to the public. The regulatory acceptance of potential risks and abatement strategies may not be readily accepted or understood by the public, and may induce negative perception and stigma.

In EWMA's experience, risk communication is most effective when it's honest, direct and compassionate, and provides an opportunity for the public to express their concerns, receive feedback, and get involved in the process.

New Buildings: Thinking Ahead

Owners of new developments in close proximity to known or

suspected sources of "toxic" vapors can greatly offset future costs of addressing vapor intrusion issues by a few upfront design modifications.

Installation of a uniform 4 to 6 inch stone or highly porous layer immediately below the floor slab can provide a considerable radial influence and minimize the future costs of installing an SSD system, if required. Furthermore, upfront installation of an affordable perforated sub-slab piping network and a passive venting system can protect buildings from all types of gas and vapor intrusion risks at affordable cost. Additional installation of vapor barriers (especially spray on barriers) immediately below the floor slab can permanently lower or eliminate the vapor intrusion risks.

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