Vapor Intrusion, Indoor Air, and Your Health

Narrator: When harmful pollutants on hazardous waste sites leach into groundwater or soil, some of these contaminants can become vapors or gases. When this happens, the chemicals may move up into the air of nearby homes and businesses. This process, called vapor intrusion, may pose serious health risks if the contaminant levels in indoor air get too high.

Dr. Kelly Pennell, an associate professor in the College of Engineering at the University of Kentucky, studies the movement of contaminants through vapor intrusion and is a leading expert in the field.

Pennell: The sources of contamination are typically groundwater contamination that resulted from previous spills at hazardous waste sites, legacy contamination that occurred, or even an ongoing manufacturing site that had a spill of a chemical and they're actively remediating it. But when that spill moves into a residential or a commercial area where you have businesses or neighborhoods, then there's a potential for any inhabitants within buildings to be exposed to vapor intrusion and their indoor air to be contaminated.

Narrator: Dr. Pennell says that for many years, clean-up efforts at hazardous waste sites only focused on reducing the risk of exposures associated with the primary contaminant source – groundwater or soil. It wasn't until the 1990's that researchers and others involved in clean-up, or remediation, began to think about vapor intrusion as a way that people could potentially be exposed to contaminants.

Pennell: Hazardous waste cleanup had for quite a while considered soil and groundwater remediation and being concerned with dermal exposure and ingesting groundwater, but then we started thinking, are we really mitigating these inhalation exposure risks that might result from vapors moving through the soil and then coming into indoor air spaces.

It almost seemed improbable that something like that would happen, but we really saw this occur at a couple of sites where we saw it affected large communities. These were at sites where we had already addressed groundwater contamination, or we were actively addressing groundwater and soil remediation.

Narrator: According to Dr. Pennell, the potential health impacts of these chemicals, including volatile organic compounds, or VOCs, vary by contaminant. Some VOCs are known to cause cancer. Long-term exposure to VOCs may cause damage to the liver, kidneys, and the central nervous system. Short-term exposure can also cause health problems, including headaches, dizziness, allergic skin reactions, nausea, and memory problems.

Given these health risks, Dr. Pennell says that it can be very challenging for communities living near hazardous waste sites to learn about the potential for vapor intrusion in their homes. She says that people often feel alarmed and concerned about this information, especially when they thought contamination near their communities was already being addressed through other remediation efforts.

Pennell: You don't typically have any indication that you're breathing indoor air that's contaminated by VOCs. A community would really have no way of knowing that they have a vapor intrusion problem unless a regulatory official comes in and says, "we need to screen your entire community," and that would involve an entire neighborhood.

Narrator: According to Dr. Pennell, researchers are now taking the initiative to identify areas that may have a vapor intrusion problem early in the remediation process. She and her team are at the forefront of research that seeks to identify and predict areas that may be at risk for vapor intrusion. She says identifying these areas upfront will help communities and officials as they consider different strategies for clean-up and mitigation.

Dr. Pennell says that variability is a key challenge to studying vapor intrusion. For example, there may be variations between mathematical model predictions and real-world measurements. Another example that Dr. Pennell describes is the variability in what is measured at different places in the same area.

Pennell: There's a lot of variability from home to home, so if you have vapor intrusion occurring, you really are assessing individual buildings within an entire community or neighborhood. Sometimes you have one building located next to another building, but their vapor intrusion exposure risk might be completely different.

Narrator: Dr. Pennell says that there can also be variability in what is measured at the same site over time and between seasons. She and her team are working to better understand the different factors that cause variability in vapor intrusion. They are conducting field studies, developing more robust prediction models, and creating better methods to measure vapor intrusion.

As part of the University of Kentucky Superfund Research Program, a collaborative NIEHS-funded Center, Dr. Pennell says a critical part of her research is leveraging the transdisciplinary network of other Superfund Research Program grantees. Dr. Pennell and her team are working with collaborators across the country to draw on expertise in diverse fields, including small businesses that are developing novel chemical sensors, public health scientists, community officials, regulators, and teams that specialize in community outreach and engagement.

Pennell: We've really tried to pull all different vantage points together and then think about what knowledge comes from each of them. By thinking about all these different perspectives we develop a new perspective as well, and that's really the way that we approach all of our research.

Narrator: These partnerships have allowed Pennell to gain insights and make important discoveries. For example, she says that one of the common vapor intrusion pathways for VOCs to enter homes and businesses is through cracks in the building foundation. Through a field study, Dr. Pennell and her team found a new vapor intrusion pathway where a faulty plumbing connection was allowing VOCs to enter the home from the sanitary sewer.

According to Dr. Pennell, their team has also worked with partners to host community forums, where impacted communities learn more about vapor intrusion, how it could affect their health, and how indoor air contaminants can be reduced in their homes.

Now, if you don’t live near a site that is undergoing clean-up or remediation, you may wonder how all of this relates to your everyday life. According to Dr. Pennell, VOCs are also commonly found in consumer products where they can contribute to indoor air pollution. Despite these potential sources of exposure, there *are* things you can do in your home to improve your indoor air quality.

Pennell: Volatile organic compounds are actually in our indoor air commonly anyhow. So these are in consumer products, and many times people aren't aware of this. A common source of these are hobby

and crafts. Another common source are automotive products. Unfortunately, most consumer products aren't labeled, but there are different sources you can look for online for VOCs in consumer products. So one thing is just being more aware of what types of products you keep in your home. Also, just making sure your home is well-ventilated, and those are things you can just be more aware of.

One thing that I think is really important is educating people about their indoor air quality and how we can improve our indoor air quality, because if we can improve our indoor air quality by removing these from our indoor air, whether it's coming from consumer products or mitigating a vapor intrusion source, I think it's a benefit to our overall health.

Narrator: You can learn more about vapor intrusion, VOCs, and how to protect your health on our website niehs.nih.gov/podcasts.

Thanks to today's guest, Dr. Kelly Pennell for joining us.

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