

Foresight

CIRI Provides Key Insights on Sources of VOCs in Indoor Environments and Steps to Reduce Exposure



People breathe more than 15,000 liters of air every day and consume four times more air than food and drinks combined. Therefore, control and mitigation of indoor air pollution is important to have safe and healthy environments. Typical indoor air can have anywhere from about 100 - 1,000 different volatile organic compounds (VOCs) at any one time and many of them have known health concerns. Read on to learn about Chemical Insights Research Institute (CIRI) of UL Research Institutes' research regarding VOC sources and how to mitigate harmful exposure.

Common Air Pollutants



Have you ever wondered about the sources and health effects associated with indoor air pollutants that people encounter in their daily lives? Some questions might be: Why does this material smell funny, or why might I have headaches in this new building? On a global basis, there are more than 140,000 chemicals used to manufacture products consumers use and many show up in our indoor air. Common sources of VOCs in homes include furnishings, cooking, personal care products, hobbies and cleaners. Visit CIRI's [chemical exposure webpage](#) to learn about some of the most frequently found VOCs and their health effects.

Global Research Identifies Sources of VOCs in Suburban Shanghai Homes and Measures the Impact of Filtration



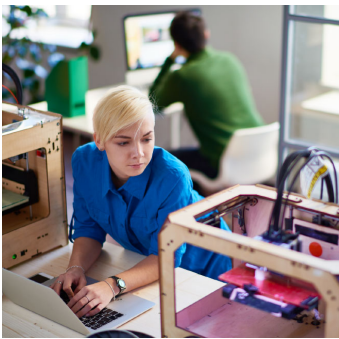
Indoor air pollution is a human health concern, especially with vulnerable subsets of the population (e.g., children with asthma). Although the rise in buildings with tighter, better seals for energy conservation does a good job of keeping outdoor pollutants out, such as particulate matter, it can lead to increased VOCs inside due to decreased ventilation. CIRI and our university research partners conducted a study to quantify VOCs, identify their sources and find air filtration's impact on VOC concentrations in suburban homes in Shanghai, China. Researchers found that many VOCs, including acetaldehyde, benzaldehyde, formaldehyde and d-limonene, originated from consumer and building products, cooking, and vehicle emissions. Findings also indicated commercial air cleaners may be helpful in removing these VOCs. For more information read the article: "[Sources of Volatile Organic Compounds in Suburban Homes in Shanghai, China, and the Impact of Air Filtration on Compound Concentrations.](#)"

Additional Global Research on Indoor and Outdoor Pollutants in Urban India



VOC exposure has been understudied in areas where air quality is a major concern. CIRI and our university research partners conducted a first-in-its-kind pilot study of 26 homes in two large cities in India to identify and quantify VOCs inside and outside of homes. Researchers detected 381 VOCs inside, including formaldehyde, naphthalene, benzene and hexane. Overall, VOC concentrations were higher inside than outside and total indoor VOCs were higher in winter compared to summer. Additionally, VOC concentrations were higher later in the day compared to the morning, likely due to rising temperatures during the day and increased activity in the home. Notably, plastics contributed to poor indoor air quality (IAQ) in the summer because of off-gassing with warmer temperatures. Read the full article: [“A Pilot Study to Quantify Volatile Organic Compounds and Their Sources Inside and Outside Homes in Urban India in Summer and Winter During Normal Daily Activities.”](#)

CIRI’s Research Identifies 3D Printing as a Source of VOC Emissions



The U.S. had 422,000 installed 3D printers in [2020](#) and likely has far more currently. Operating 3D printers are a source of indoor air pollution because they can emit an array of VOCs, ultrafine particles (UFPs) and metals into the air, therefore deteriorating IAQ. CIRI’s [research](#) has identified 216 individual VOCs commonly emitted across different common printing filaments (ABS, HIPS, nylon and PLA). Six specific VOCs — acetaldehyde, ethylbenzene, formaldehyde, methylene chloride, styrene and toluene — have known health risks. You can protect yourself and 3D printer users by following these [key safety tips](#) while selecting and using a 3D printer. Read the summary report: [“Characterization of Volatile Organic Compound Emissions From Consumer Level Material 3D Printers and Their Relationship With Particle Emissions.”](#)

Vaping is Found to Emit More VOCs Beyond Those Listed on the Label



Another increasing source of VOCs indoors is from vaping. CIRI's latest research on VOC emissions from consumer use of electronic nicotine delivery systems (ENDS), often called e-cigarettes and vapes, shows that ENDS aerosols can include chemicals beyond those listed on the label. More than 70 VOCs were identified in ENDS vapor, including numerous aldehydes, glycols, alcohols, fragrances, siloxanes and aromatics. Key VOC emissions were linearly correlated with the number of puffs, or the mass of e-liquid consumed, although specific amounts varied across vaping devices and e-liquids. Read the full report: "[Volatile Organic Compounds \(VOCs\) Released From Electronic Nicotine Delivery Systems \(ENDS\)](#)."

Stay Connected for Additional Actionable Insights



Through our research and outreach materials, CIRI tells the story behind science for a safer, healthier tomorrow. Stay connected for the latest insights on how to manage and improve IAQ. Visit CIRI's [website](#) to see technical briefs and reports, e-learning, handouts, videos and other actionable information to protect human health.

Publications and Events

Recent Publications



- Technical Report, "[The Effect of Wildfires and the Wildland Urban Interface on Residential Homes: Pilot Study Results](#)"
- Recorded Presentation, "[NeoCon 2023: Building Resiliency for Health](#)"
- Tailored Resource Collection, [Resources for Promoting Resiliency and Human Health in the Built Environment](#)
- News Alerts:

- [“Chemical Insights Research Institute Addresses Building Resilience and Wildfire Smoke at Greenbuild International Conference + Expo”](#)
- ["The Effect of Wildfires and the Wildland Urban Interface on Residential Homes: Pilot Study Results"](#)

Upcoming Events



- [American Association for Aerosol Research Annual Conference](#), October 2 – 6, 2023, “Particle Emission and Metal Composition Characterizations for Fused Filament Fabrication 3D Printers Using Emerging Materials”
- [Land Trust Alliance Webinar](#), October 26, 2023, "Preparing for Natural Disasters Part One: Fire and Smoke"
- [Ron Blank GreenCE](#), November 6, 2023, "The Latest Science on WUI Fires and the Built Environment"
- [American College of Toxicology 44th Annual Meeting](#), November 12 – 15, 2023, “Real-Time Exposure to 3D Printer Emission Elicits Inflammatory Responses and Metabolic Perturbations in Human Airway Epithelial Cells”



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