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Episode 669| July 9, 2022 | 12:00 PM EST

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National Academy of Sciences, Engineering and Medicine (NASEM)

Why Indoor Chemistry Matters;
What the Findings Mean for Practitioners

This week we welcomed Dr. Dave Dorman, Dr. Rima Habre, and Dr. Megan Harries for Part 1 of our 2 part show on the National Academy of Sciences, Engineering and Medicine report called Why Indoor Chemistry Matters! We discussed what the findings mean to practitioners.

David C. Dorman, DVM, PhD is a professor of toxicology in the Department of Molecular Biomedical Sciences at North Carolina State University. Dr. Dorman's research interests include neurotoxicology, nasal toxicology, pharmacokinetics, and cognition and olfaction in animals. Dr. Dorman is an elected fellow of the Academy of Toxicological Sciences and a fellow of the American Association for the Advancement of Sciences. Dr. Dorman is a diplomate of the American Board of Veterinary Toxicology and the American Board of Toxicology. He has chaired or served on several National Research Council committees and is a National Associate of the National Academies of Sciences, Engineering, and Medicine. He completed a combined PhD and veterinary toxicology residency program at the University of Illinois at Urbana-Champaign and holds a Doctor of Veterinary Medicine from Colorado State University.

Rima Habre, ScD is an associate professor of environmental health and spatial sciences at the University of Southern California (USC). She leads the Exposure Sciences Research Program in the USC National Institute of Environmental Health P30 Center. Her expertise lies in environmental health, air pollution, and exposure sciences. Her research aims to understand the effects of complex air pollution mixtures in the indoor and outdoor environment on the health of vulnerable populations across the life course. Dr. Habre's expertise spans measurement, spatiotemporal and geographic information system–based modeling, and mobile health approaches to assessing personal exposures and health risk. She co-chairs the Geospatial Working Group in the nationwide National Institute of Health's Environmental Influences on Child Health Outcomes program. Dr. Habre received her ScD in environmental health from the Harvard T.H. Chan School of Public Health.

Megan E. Harries, Ph.D., is a program officer with the Board on Chemical Sciences and Technology at the National Academies of Sciences, Engineering, and Medicine. She is the director of the Committee on Emerging Science on Indoor Chemistry, which authored the recently released report on *Why Indoor Chemistry Matters*. Trained as an analytical chemist, Dr. Harries received a BA from Fordham University and a PhD from the University of Colorado Boulder. Prior to joining the National Academies, she was the recipient of a National Research Council Research Associateship, which she spent at the National Institute of Standards and Technology developing methods for more sensitive and repeatable chemical characterization of trace forensic evidence.

Nuggets mined from today's episode:

Overview of the document.

The National Academy of Sciences can be traced back to Abraham Lincoln. The Academy advises the government on scientific issues. Researchers provide their services pro bono. Areas of interest for the report included new findings and underreported chemical species.

Main Messages of the Document:

- Indoor environmental chemistry is widely variable.
- Indoor Chemistry is a Complex Exposure because we spend most of our time indoors.
- Researchers know little about indoor chemistry.
- Indoor chemistry changes over time.
- Indoor chemistry effects human health.

- We live in a changing world. (e.g. climate change, wildfires, urbanization, etc.)
- Indoor chemistry is studied with analytical methods and equipment. We need improved analytical methods, tools, equipment and sensors.
- Science is translated into practice and policy.
- Role of human activity in indoor chemistry.
- More investment needed.
- Need to communicate the science and the risks.
- The team is proud of the research and efforts that went into developing the report.
- Need to have multiple disciplines collaborate and then translate their work into practice.

The study was sponsored by the National Institutes of Health, Department of Health and Human Services, Centers for Disease Control and Prevention, Environmental Protection Agency, and SLOAN.

Document Table of Contents with Comments

INTRODUCTION

Why Indoor Chemistry Matters
Prior Efforts on Which This Report Builds
Statement of Task- ***focus on nonindustrial buildings, new findings, under reported chemical species.***
Committee's Approach- *consensus approach*
Organization of This Consensus Report

PRIMARY SOURCES AND RESERVOIRS OF CHEMICALS INDOORS

Major Primary Sources, Reservoirs, and Factors That Influence Emission Rates
Classes of Compounds in Indoor Environments
Indoor Chemical Inventories
Analytical Methods and Challenges
Conclusions
Research Needs

PARTITIONING OF CHEMICALS IN INDOOR ENVIRONMENTS

"Partitioning of Indoor Chemicals Partitioning refers to both the thermodynamic state of chemicals distributed among phases in a system and the processes that transfer chemicals among phases. Partitioning determines the concentration of a chemical in air, on surfaces or elsewhere and distributes chemicals from their initial sources throughout indoor spaces, to air, building materials, furnishings, dust, and so forth. For example, phthalates emitted from plastics can partition to surfaces, porous materials, settled dust, and other compartments. These compartments buffer the air concentrations of chemicals, reducing the short-term effectiveness of controls by ventilation or filtration. Partitioning also influences occupant exposure to chemicals. For example, partitioning of indoor chemicals to aerosols increases inhalation exposure, while partitioning to dust and surfaces increases ingestion exposure, especially by toddlers."

Indoor Environmental Reservoirs and Surfaces
Partitioning among Reservoirs and Phases Found in Indoor Environments
Size and Capacity of Different Indoor Reservoirs
Partitioning Thermodynamics: Effects of Temperature and Relative Humidity
Partitioning Dynamics, Timescales, and Limitations on the Equilibrium Concept
Current Science on Partitioning of Chemicals in Indoor Environments
Models for Partitioning Behavior
Conclusions
Research Needs

CHEMICAL TRANSFORMATIONS

Airborne Chemistry
Surface Chemistry
Modeling Indoor Chemistry- ***reactions and byproducts***
Conclusions
Research Needs

MANAGEMENT OF CHEMICALS IN INDOOR ENVIRONMENTS

Types of Control
Management through Capture and Removal
Management through Chemical Transformations

Other Considerations for Management of Chemicals
Conclusions
Research Needs

INDOOR CHEMISTRY AND EXPOSURE

Exposure Routes
Exposure Definitions, Settings, and Timing
Environmental Health Disparities and Exposure Variables
The Intersection of Indoor Chemistry and Exposure Modeling
Measurement Science for Exposure
Conclusions
Research Needs

A PATH FORWARD FOR INDOOR CHEMISTRY

Chemical Complexity in the Indoor Environment- ***VOC's are not a chemical, rather a range of homogeneous products.***
Indoor Chemistry in a Changing World
Future Investments in Research
Communicating Science and Risks: Indoor Chemistry and Environmental Quality
Closing Comments

When looking at PRIMARY SOURCES AND RESERVOIRS OF CHEMICALS INDOORS what unexpected or underappreciated sources were reported? ***Human activity is a primary source. Dust is a reservoir of chemicals, new flame retardants are found in dust, old flame retardants "legacy chemicals" are also found in dust. Dust exposure is via oral, dermal and inhalation routes.***

What kind of future research in this area will help us do a better job creating and maintaining healthy indoor environments? ***We don't have a good handle on the disclosure of ingredients of consumer products due to trade secret protection. Research is analytically driven. We critically need real time monitoring of real world environments. Exposure is a factor of time.***

Please explain what PARTITIONING OF CHEMICALS IN INDOOR ENVIRONMENTS is and how it's important to people's overall exposure to chemicals in the indoor environment? ***Time scales, the lifetime of a chemical is greater in dust. Exposure changes when chemical phase changes (e.g. oral, dermal, or inhalation). Chemicals can be in dust, organic, gaseous, or liquid phase. Heat, moisture can cause chemicals to emit. Moisture causes hydrolysis.***

What variables affect partitioning that IEP's can help with now? ***While we can remove the dust we see, dust can also be found in inaccessible areas: attics, interstitial spaces and HVAC systems. Air cleaners can trap chemicals. Air cleaners can also re-volatize chemicals when turned off. Subtractive processes such as filtration, activated carbon adsorption and ventilation are recommended over chemical additive processes.***

When it comes to the CHEMICAL TRANSFORMATIONS and MANAGEMENT OF CHEMICALS IN INDOOR ENVIRONMENTS our audience also includes restoration contractors and HVAC contractors that are commonly pitched on equipment that uses ozone, hydroxyls, TO2, etc. What is the takeaway from these chapters for these practitioners? ***Device testing is currently not mandated. Device testing is not performed to a uniform standard. Testing done in a "shoe box" is extrapolated to reflect what occurs in a much larger space in the real world. This results in hype and unsubstantiated claims.***

- Link to 4 page report summary.
- Link to download entire report.
- Link to locate microbiomes report.

Z-Man signing off

Trivia:

Name the collection of unsaturated bicyclic monoterpenes as the majority liquid extract of conifers?

Answer: Pinene, answered by Victor Cafaro