SVOCs in the Indoor Environment: Mechanistic Insights to Support Sustainable Product Design, Safe Use and Improved Public Health

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http://epa.gov/ncct/expocast/svoc.html

Participants Included:

Virginia Tech
Boston U
U Michigan
U Toronto
UMDNJ, Rutgers
U of Washington
UC Berkley
UC Davis
Tsinghua U
ETH, Zurich
Exxon Mobile
Harlan Laboratories
Health Canada
US CPSC
US EPA
Silent Spring Institute

SVOC Workshop Objectives

- Considering a broad range of SVOCs to demonstrate extent to which mechanisms along the source-to-dose continuum are controlled by physical/chemical properties

- Consider holistic systems-based approach that enables relevant processes to be linked across the source-to-effect continuum

- Consider evaluation of potential exposures across the product lifecycle for all chemical classes and for all use scenarios

- Propose screening-level, rapid exposure assessment approaches based on simplified forms of mechanistic exposure models

Workshop Highlights –

Lessons learned in exposure assessment (Christine Norman, Health Canada)

- Indirect exposures from environmental media not major driver of assessment outcomes
- Direct exposures (i.e. user of consumer products) more typically key driver
  - **Mandatory information-gathering tools inadequate to collect necessary inputs to inform exposure assessment**
- Near-field exposure tools
  - 'worst case' nature of exposure characterization criticized
  - For the inhalation route, available tools focus on VOCs
- Exposure to substances that are present only as a residual/by-product often drive assessment outcomes (e.g., residual monomers)
- Substance-by-substance approach inefficient for both risk assessment and management
- Priority-setting and assessment tool development needs for SVOCs
  - Common exposure triggers
  - Predictive tools for the characterizing exposure to substances in consumer products and built environments
  - Predictive tools for estimating indoor exposure (peak and long-term average),
  - **Empirical data to validate predictive tools.**

Workshop Highlights

Research Challenges for REACH (Rosemary Zaleski)

- **Focused on Model inputs -** Future considerations

- Consumer behavior (habits & practices)
  - What are important interrelationships that determine consumer behavior
- Emissions
  - Improved realism in emission estimates
  - More extensive use of traditional technologies
  - New sensor techniques
- Product characteristics
  - weight fraction in product
  - physical form
  - packaging size
  - performance – ex. link amount used to room size, emissions to estimated product lifetime
  - Can a public database of CP determinants be developed?

Workshop Highlights –

Informing green chemistry solutions (Megan Schwarzman, UC Berkeley)

As we seek to better characterize the behavior of SVOCs, ask:

- 1. What information could effectively inform the design of new, safer chemicals and products (green chemistry)?
- 2. What information can guide the selection of safer substitutes (alternatives assessment)?
- 3. How can better data on SVOCs help us approach the 10,000s of unstudied compounds (address the data gap)?

What would a chemical look like that…

- Doesn't migrate from electronics, building materials, or packaging?
- Isn't taken up through dermal contact?
- Doesn't accumulate in food webs?

How can products be…

- Flexible without phthalates?
- Stain resistant without fluorinated surfactants?
- Flame retardant without halogenated compounds?

Workshop Highlights –

Sources, Emissions & Exposure—Flame Retardants & Other SVOCs(Thomas Webster, Boston U)

Presented a series of empirical studies to interrogate model and demonstrate the need for complementary use of two approaches.

sources → micro-environment → personal exposure → internal dose

- **Exposure factor approach:**
  e.g., media concentration X exposure factor

representative?
methods?

how well known?

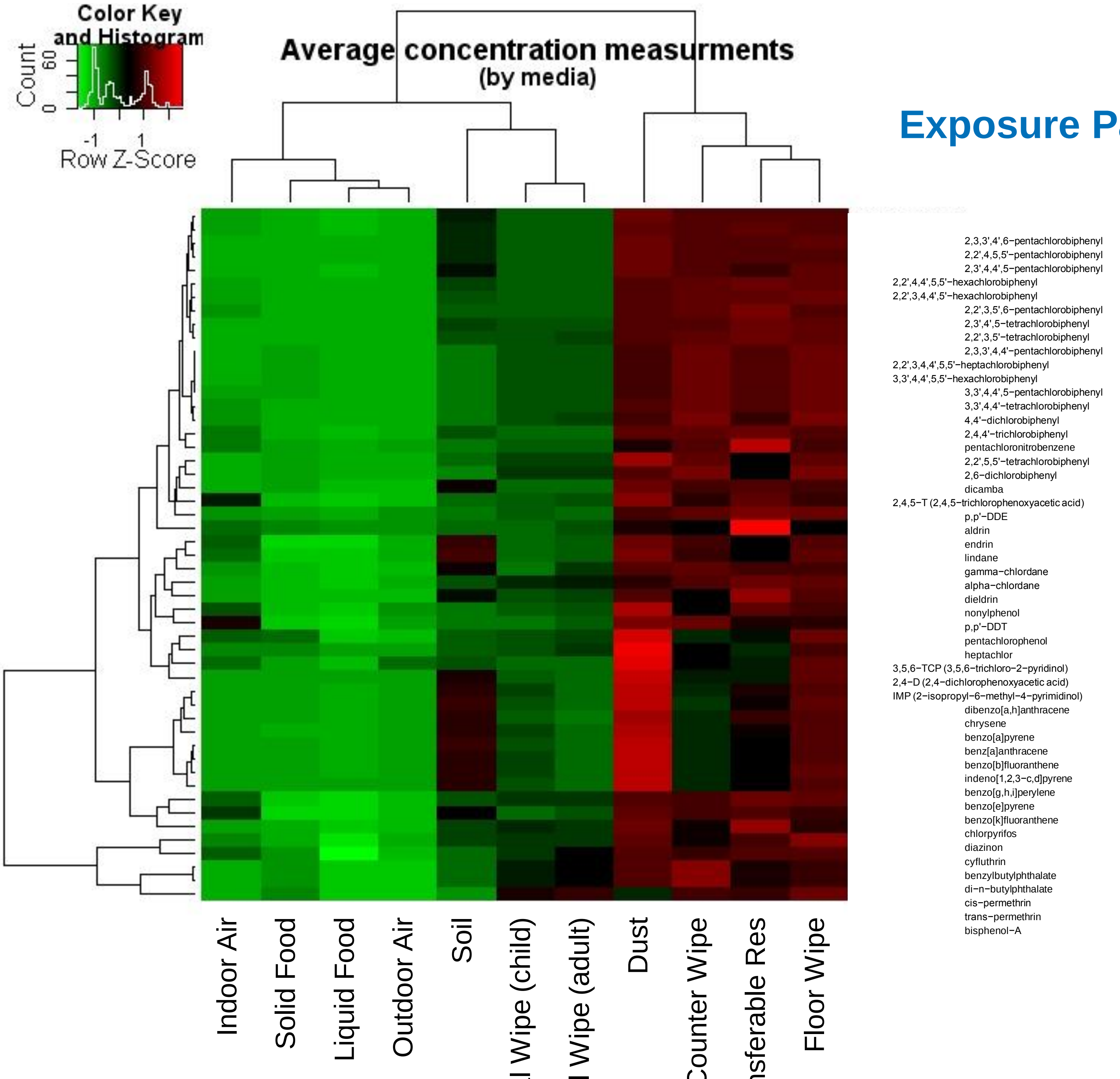
- **Empirical studies linking boxes:**
  e.g., association of dust concentrations & body burden

Workshop Highlights –

- **Key factors for transfer into food (Natalie von Götz, ETH, Zurich)**

- Persistence → DT50 in different media
- Transport → complex of properties
- Partitioning → solubility, vapor pressure, K_{OC}, K_{OW}
- Uptake by organism → molecular weight / size, K_{OW}
- Use pattern → amount of use, region of use
- Product matrix → e.g. additive or covalently bound/monomer
- Use in food contact materials

Exposure Pathways



Workshop Highlights

<u>Uptake to production ratio -UPR (Bill Nazaroff, UC Berkeley)</u>

- Result of SVOC 1
- UPR defined as the rate of chemical uptake in a human population divided by the rate at which the chemical is produced (used) in the population's economy.
- Economy-wide assessment of exposure potential
- Mechanism-free evaluation
- Simple in principle (but data availability a major issue)
- UPR is a *magnitude estimate* that characterizes the level of exposure intimacy between a chemical and a population.
- Provided examples calculations for 5 compounds.

Brainstorming – Exposure Indices

- Source Classification
  - Chemical: functional classes
  - Product: form
  - Product: use, application (Look to Consexpo for bins/categories)

- Pathways
  - Kow, Kaw (to predict media)
  - Indoor IF (intake fraction)
  - Multiple

- Scale
  - Indoor persistence

United States Environmental Protection Agency

Brainstorming – Exposure Indices

- Use
  - Intimacy factor – use categories
  - Approximate concentration/mass of chemical in product/house (magnitude)
  - Exposure “persistence” – timing of exposure/use – pattern of exposure
  - Multiple uses/products per compound
- Target –
  - Potential for child and fetal exposure
- Production:Dose
  - UPR – uptake:production ratio

United States Environmental Protection Agency

Top Research Priorities

- **Who's high and why?**
  - Using NHANES or other, see what the drivers are for high exposure
  - Studies of the relationship between biomarkers and sources indoors
  - Subset when biomonitoring is conducted, adding in detailed consumer behavior
  - Occupational exposures

- **How are people exposed to SVOCs in the indoor environment and how does it depend on the properties of the SVOCs: intersection between experiment and theory**
  - Intensive characterizations of real indoor environments to determine sources, emission rates, different exposure routes for different (all) types of sources; also consider different ages of population

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High Research Priorities

- What SVOCs are actually in indoor environments
- What chemicals are in products now, understanding the sources
- **Models to estimate SVOCs in air surfaces, and dust using phys-chem properties and validated with empirical data across a range of properties**
- Extend the uptake production ratio; pick a set of compounds that are applied to body, versus in house/furniture. Consider imports/exports.
- **Better approaches for quantifying exposure related to consumer use**
- Harmonized data sets for the description of consumer behavior for modeling
- Better understand of relationship between particle and vapor phase
- Role of dust on fate, transport and exposure, (esp for very high Kow)
- **Standard method for characterizing persistence in indoor environment of new and existing chemicals**