Selection of Safer Chemical Alternatives

SOT-NCAC & Mixtures Specialty Section Fall Symposium

November 20, 2014

Managing Director and Chief Toxicologist
ToxServices LLC
Goals for Today’s Presentation

- Discuss the need to identify safer chemicals
- Provide an overview of process to identify safer chemicals
- Discuss emerging techniques to identify safer alternatives
- Identify resources to select chemical alternatives
Urgent Need to Find Safer Chemicals

- There is growing pressure to disclose or phase out priority chemicals
  - State lists of Priority Chemicals
  - California’s Safer Consumer Products Regulations
  - April, 2013 Hazardous 100+ List released by Safer Chemicals/Healthy Families [http://www.saferchemicals.org/](http://www.saferchemicals.org/)
  - Walmart’s Sustainable Chemistry Initiative Phasing Out Priority Chemicals [http://www.walmartsustainabilityhub.com/app/answers/detail/a_id/316](http://www.walmartsustainabilityhub.com/app/answers/detail/a_id/316)

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**Most US states plan chemicals legislation in 2014**

NGO says 11 legislatures set to consider broader controls

29 January 2014 / United States, Priority substances

At least 33 US states are expected to introduce legislation addressing chemicals in consumer products in 2014, according to analysis by the NGO Safer States.
Challenge: Priority Chemicals

• The National Conference of State Legislatures’ (NCSL) environmental health legislation database reports that 484 environmental health bills have been enacted in 2014 in 46 U.S. states
  – Numerous states now have lists of chemicals of high concern (e.g., California’s Prop 65, State of Washington’s Reporting List of Chemicals of High Concern to Children (CHCC), Maine, Minnesota, Vermont)

2014 Enacted Environmental Health Legislation

Based on the 484 environmental health bills that were enacted in 2014
California’s Safer Consumer Products Regulations

- **California’s Safer Consumer Product (CSCP) Regulations**
  - In 2008, California’s Green Chemistry Law authorized DTSC to establish a process to identify and prioritize chemicals in consumer products and establish a process to evaluate chemicals of concern and their alternatives.

- **CSCP Regulations: A Step-Wise Approach**
  - **Chemicals** – CSCP regulations created a Candidate Chemicals (~1,200) list and process for DTSC to identify Candidate Chemicals (CCs).
  - **Products** – DTSC will evaluate and prioritize Product/Candidate Chemical combinations to develop a list of “Priority Products” that will require Alternatives Analyses.
  - **Alternatives Analysis** – Responsible entities (manufacturers, importers, assemblers, and retailers) must perform an Alternatives Analysis (AA) for the product.
  - **First three groups of products identified in 2014:**
    - Children’s foam padded sleeping products containing TDCPP
    - Spray polyurethane foam containing unreacted isocyanates
    - Paint strippers containing methylene chloride
Status Quo: Finding Safer Chemicals

• There is no “one stop” shopping option to identify chemicals with “safer” human health and environmental profiles...

• Current approach to finding safer ingredients is hit or miss...

**Identify Potential Safer Ingredient**
- Databases/Lists: CleanGredients, DfE Safer Chemical Ingredient List (SCIL), Pharos
- Journal Articles: Happi, GCI, Ecotextile News, Plastics News
- Meetings: Sustainable Cosmetics Summit, In-Cosmetics, HBA Global Expo, ISSA, GreenBuild
- **Supplier sales pitch (primary way)**

**Internal RSL List Check**
- Search Restricted Substances List (RSL)
- No CMR, PBTs
- Check needs to be performed on both ingredient and residuals!!
- Check Databases:
  - ChemAdvisor’s LOLI database
  - U.S. EPA’s ChemView database
  - PCPC’s CosmeticsInfo
  - EU’s CosIng and ECHA databases

**Evaluate Ingredient’s “Safety”**
- Evaluate new ingredient based on product’s end use and exposure
- Dermal, inhalation, ocular safety
- Use in sensitive subpopulations?
- Review supplier’s safety data summary
- What is their basis for concluding ingredient is safe?

**Retest Reformulated Product**
- Performance testing
- Safety testing (e.g., dermal safety, ocular safety, etc.)
- Label claim testing
- Placement testing among consumers
- **START OVER IF RETESTING FAILS!**

• START OVER IF RETESTING FAILS!
Risk Assessments are designed to answer the question: “Is this chemical or product safe enough for the intended use?”

- In an AA framework, risk assessment methods fall short

Hazard Assessments are designed to answer the question: “Which chemical is inherently safer/lower hazard?”

Chemical Hazard Assessment methods typically share common hazard endpoints relating to human toxicity, environmental toxicity, and environmental fate.

Making Better Environmental Decisions by Mary O’Brien is a cornerstone of Chemical Alternatives Assessment Methodology.
Chemical Alternatives Assessments (CAAs)

- CAAs focus on finding alternative chemicals, materials and/or product designs to substitute for the use of hazardous chemicals

CAA featured for the first time in the new edition of the Encyclopedia of Toxicology
In October, 2014 the National Academy of Sciences published a framework to guide selection of chemical alternatives. The goal is to create a flexible decision framework for comparing human health and ecological risks of chemicals that is applicable across a diverse set of users.
Existing CAA Frameworks Considered by NAS

• CAA paradigms in the U.S.:
  • The Lowell Center for Sustainable Production’s AA Framework
  • BizNGO’s CAA Protocol
  • The Interstate Chemicals Clearinghouse (IC2) Guidance for AA and Risk Reduction
  • U.S. EPA Design for the Environment’s (DfE’s) AA Methodology
  • California Safer Consumer Products Regulation
  • TURI Alternatives Assessment Process Guidance
  • UCLA Multi-Criteria Decision Analysis

• CAA frameworks around the world
  • In the EU, AAs are prepared by applicants for SVHC authorization (REACH)
  • German Guide on Sustainable chemicals (through SUBSPORT); UNEP POP Review Committee General Guidance on Alternatives
The NAS identified common elements among AA frameworks:

- Assessing human health & ecological hazards, evaluating critical physicochemical properties, LCA, performance and social assessment
- Often use tools to classify hazards: UN Globally Harmonized System (GHS) for Classification and labeling and GreenScreen® for Safer Chemicals

The NAS identified key issues:

- Exposure vs. hazard considerations
- How to handle data gaps/uncertainty
- Decision rules for resolving trade-offs among different categories
- Incorporation of new data streams
- Need for research and innovation

### TABLE 2-1 Comparison of Selected Attributes Found in Selected Frameworks

<table>
<thead>
<tr>
<th>Framework</th>
<th>Exposure at the Use Phase</th>
<th>Cost &amp; Availability</th>
<th>Other Life-Cycle Impacts</th>
<th>Social Impacts</th>
<th>Includes Comparison of Materials and/ or Processes</th>
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</thead>
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<tr>
<td>BioNGO (Rossi et al. 2012)</td>
<td>As needed</td>
<td>Yes</td>
<td>As needed</td>
<td>Not mentioned</td>
<td>Yes</td>
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<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>CA DTSC (CA DTSC 2013a)</td>
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<td>As needed</td>
<td>As needed</td>
<td>As needed</td>
<td>Can be added</td>
</tr>
<tr>
<td>CIE (EPA 2014)</td>
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<td>Yes</td>
<td>Yes</td>
<td>No</td>
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<tr>
<td>German Guide (Kehlen et al. 2011)</td>
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<td>No</td>
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<td>IC2 (IC2 2013)</td>
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<td>As needed</td>
<td>As needed</td>
<td>As needed</td>
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<td>Lowell Center (Rossi et al. 2006)</td>
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<td>UNEP (UNEP 2009)</td>
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<td>As needed</td>
<td>Yes</td>
<td>As needed</td>
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<tr>
<td>REACH (EC 2011)</td>
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<td>Yes</td>
<td>As needed</td>
<td>Yes</td>
<td>Yes (but in the Socio-Economic Analysis)</td>
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<td>TURI (TURI 2006a)</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
<td>UCLA MCDA (Malloy et al. 2011)</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Not mentioned</td>
<td>Can be added</td>
</tr>
</tbody>
</table>

* MCDA tools should be able to accommodate this impact, even if not mentioned in the UCLA application of them. SOURCE: Adapted from OECD, 2013a.
Risk = f(Hazard, Exposure)

Green chemistry is “the design of products and processes that reduce or eliminate the use or generation of hazardous substances.”

#3 Less hazardous chemical syntheses
#4 Design safer chemicals and products
#5 Use safer solvents and auxiliaries
#10 Design chemicals and products to degrade after use
#12 Minimize the potential for accidents

Five of the 12 Principles of Green Chemistry are focused on Hazard Reduction.
Key Concept to Safer Chemical Identification: Focus on Chemical Functionality

• The functionality of a chemical is the job it performs in a formulation, material or product;
  – Function is related to chemical structure and physical chemical properties

• Examples of functional use classes for chemicals include:
  – Surfactants
  – Solvents
  – Plasticizers
  – Colorants
  – Anti-oxidants
  – Stabilizers
  – Processing aids
  – Chelants

• Goal of a CAA: To find a science-based solution that identifies and completely characterizes chemical hazards

• A CAA should promote the selection of less hazardous chemical ingredients or technologies

• A CAA should avoid unintended consequences of switching to a poorly characterized chemical substitute
NAS Alternatives Assessment Framework

#1: Identify Chemical of Concern
#2: Scoping and problem formulation
#3: Identify potential alternatives
#4: Initial screening of identified alternatives
#5: Assess physicochemical properties
#6: Assess human health hazards
  -> Assess ecotoxicity
  -> Conduct comparative exposure assessment
#7: Integration of information to identify safer alternatives
#8: Life cycle thinking
#9: Additional life cycle assessment*
  -> Performance assessment*
  -> Economic assessment*
#10: Integrate data and identify acceptable alternatives
#11: Compare alternatives*
#12: Implement alternatives*
#13: Research and innovation

* = optional activity
Safer Chemical Identification: From Frameworks to Practical Application

- Robust CAA Frameworks now exist to identify safer chemicals
  - The new NAS Framework is a great example
- Tools to implement these frameworks are still being created
- Ideally, tools to identify safer chemicals should:
  - Facilitate the assessment of health hazards and risks for a wide variety of health effect endpoints
  - Facilitate the assessment of a chemical’s environmental fate and toxicity
  - Facilitate the assessment of a chemical’s transformation product(s)
- The tools are not completely harmonized, and individuals using such tools have a wide range of skill sets, so output of more complex tools may be incomplete or incorrect
Safer Chemical Identification:
Harmonization of Tools

U.S. Green Building Council and the Google Foundation Have Funded Data Harmonization Efforts
Safer Chemical Identification Tools: Lists, Databases, and Software

Databases that Identify Safer Chemicals
- DfE Safer Chemical Ingredient List (SCIL), CleanGredients, Pharos Material Health Library, GreenWercs, IC2 database

Databases that Identify Regulatory, Hazard, Risk, or Exposure-Related Information About a Chemical
- U.S. EPA ChemView database, IC2 Chemical Hazards Database, ChemAdvisor LOLI

Software to Assess Hazards for Human Health and Environmental Endpoints
- U.S. EPA Expo-Box, ECOSAR, T.E.S.T., EPI SUITE, VEGA, OECD Toolbox, Oncologic
Core Elements of CAA

- Chemical hazard assessment (CHA): a method for comparing chemicals based on their inherent hazard properties
- Life cycle thinking
- Exposure assessment
- Technical/functional assessment
- Economic assessment
- Social impact assessment
### Finding Safer Chemicals: What’s in a GreenScreen® for Safer Chemicals?

#### Three Steps to a GreenScreen®
1. Assess and classify hazards for 18 hazard endpoints
2. Apply the Benchmarks to identify an overall benchmark score
3. Make informed decisions

- Apply GreenScreen Inspector™ to confirm that GreenScreen®’s scoring paradigm was properly followed!

http://www.greenscreenchemicals.org (for GS criteria)
https://www.toxservices.com (for the GS Inspector)

<table>
<thead>
<tr>
<th>Chemical Abstract Service Registry Number (CASRN)</th>
<th>Human Health Effects</th>
<th>Ecotox.</th>
<th>Fate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carcinogenic</td>
<td>Mutagenic</td>
<td>Reproductive</td>
<td>Developmental</td>
</tr>
<tr>
<td>--------------------------------------------------</td>
<td>----------------------</td>
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</tr>
<tr>
<td>57583-54-7</td>
<td>L</td>
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</tr>
<tr>
<td>98165-92-5</td>
<td>L</td>
<td>L</td>
<td>L</td>
</tr>
</tbody>
</table>
Genesis of GreenScreen®

May 2000
Green Chemistry Book Published

2003 USEPA DfE Convened 1st Stakeholder Group for Alternatives to PentaBDE

December 2004 interim

WA published Chemical Action Plan for PBDE’s

January 2006 Final

September 2005 DfE Published Report on Alternatives to PentaBDE

October 2011 GreenScreen V1.2 (Method)

March 2007 GreenScreen v1.0 (DecaBDE Case Study)

August 2011 USEPA DfE published Alternatives Assessment Criteria for Hazard Evaluation v2.0

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GreenScreen® Tools

1. **Full GreenScreen®**
   - Comprehensive evaluation based on 18 hazard endpoints
     - Addresses transformation products and data gaps
   - Identifies inherently safer chemicals
   - Requires technical expertise
     - Best to use licensed profiler

2. **GreenScreen® List Translator**
   - Readily identifies chemicals of concern
   - Based on authoritative lists
   - Doesn’t require toxicology expertise
Where do GreenScreen® Hazard Endpoints and Criteria come from?

Sources of GreenScreen® 18 Hazard Endpoints:

- GHS/CLP – Globally Harmonized System of Classification and Labeling of Chemicals (United Nations)
- OECD Screening Information Data Sets (SIDS) and test methods
- USEPA Design for the Environment Program (DfE) Alternatives Assessment Criteria for Hazard Evaluation
- USEPA New Chemicals Program and test methods
- Others: e.g., Canadian DSL
GreenScreen®: Benchmarks

GreenScreen®′s hazard-based continuum

- A GreenScreen® can identify known “bad actor” chemicals
- A GreenScreen® can rank chemicals
  - To prioritize chemicals for further review and/or phase out
  - To select more preferable chemicals

**BENCHMARKS** = GreenScreen® Decision Logic

Benchmark U = Undetermined due to insufficient data

Aligned with Regulatory Drivers
The GreenScreen® List Translator can be used manually or automated versions are available...

1. Manual Version
   – Available on CPA website
     http://www.greenscreenchemicals.org/method/greenscreen-list-translator

2. Automated Tools
   – Developed and offered for a fee through CPA Partners
     a. Incorporated into Pharos by Healthy Building Network
        http://www.pharosproject.net/
     b. Incorporated into GreenWERCS by The Wercs
Finding Safer Chemicals: GreenScreen® List Translator Through Pharos

DECAMETHYLCYCLOPENTASILOXANE

CAS RN: 541-02-6
Synonyms: Cyclopentasiloxane, decamethyl-; CYCLIC DIMETHYSILOXANE PENTAMER

Direct Chemical and Compound Hazard Quickscreen

Very High Hazard Level

PBT
Oregon DEQ - Priority Persistent Pollutant (OR P3); Priority Persistent Pollutant - Tier 1 - GreenScreen Possible Benchmark 1 [and 2 others]

Restrict List
Hazardous 100 (SCHF): Chemicals of high concern [and 1 other]

This chemical is NOT present on the hazard lists scanned for the following health and ecotoxicity endpoints...

- CANCER - DEVELOPMENTAL - REPRODUCTIVE - ENDOCRINE - GENE MUTATION
- RESPIRATORY - NEUROTOXICITY - MAMMALIAN - EYE IRRITATION - SKIN IRRITATION
- SKIN SENSITIZE - ORGAN TOXICANT - ACUTE AQUATIC - CHRON AQUATIC - TERRESTRIAL
- FLAMMABLE - REACTIVE - GLOBAL WARMING - OZONE DEPLETION

Lifecycle Hazard Quickscreen

Research Status: Preliminary literature review drafted
The Pharos team has undertaken a preliminary literature review of some of the processes involved in the manufacture of this substance and identified the following chemicals. This list of chemicals is not exhaustive of all chemicals that may be involved in the production or use cycle of this substance.
## Applying the Benchmarks to the Hazard Classifications

### GreenScreen® Hazard Ratings for Carnauba Natural Wax

<table>
<thead>
<tr>
<th>Chemical Name</th>
<th>Benchmark</th>
<th>Rationale</th>
</tr>
</thead>
</table>
| Carnauba Natural Wax (CAS #8015-86-9) | 3 – Use But Opportunity for Improvement (Yellow) | 3b. Moderate Ecotoxicity  
3c. Moderate Group II or II* Human toxicity |

Carnauba natural wax was assigned a GreenScreen® Benchmark Score of 3
- Moderate ecotoxicity (Mod AA and CA))
- Moderate human toxicity (Mod skin sensitization (SnS*) and high skin and eye irritation (IrS and IrE).
U.S. EPA’s DfE Safer Chemical Ingredient List (SCIL)

- The DfE (SCIL) is a list of chemicals that have been identified as having low low hazard.
- The SCIL is organized by functional class
- SCIL chemicals have been evaluated against U.S. EPA DfE class-based criteria; these criteria include multiple human health and environmental toxicity and fate endpoints.
- Chemicals that are listed on the DfE SCIL may receive one of three hazard symbols: a full green circle, a green half-circle, or a yellow triangle

http://www.epa.gov/dfe/saferingredients.htm

<table>
<thead>
<tr>
<th>DfE SCIL Hazard Symbols</th>
<th>Symbol Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DfE Green Circle</strong></td>
<td>The chemical has been verified to be of low concern based on experimental and modeled data.</td>
</tr>
<tr>
<td><strong>DfE Green Half-Circle</strong></td>
<td>The chemical is expected to be of low concern based on experimental and modeled data. Additional data would strengthen our confidence in the chemical’s safer status.</td>
</tr>
<tr>
<td><strong>DfE Yellow Triangle</strong></td>
<td>The chemical has met DfE criteria for its functional ingredient-class, but has some hazard profile issues. Specifically, a chemical with this code is not associated with a low level of hazard concern for all human health and environmental endpoints. While it is a best-in-class chemical and among the safest available for a particular function, the function fulfilled by the chemical should be considered an area for safer chemistry innovation.</td>
</tr>
</tbody>
</table>
## Finding Safer Chemicals: U.S. EPA’s DfE Safer Chemical Ingredient List

### DfE's Safer Chemical Ingredients List

**Safer Chemical Ingredients for Use in DfE–Labeled Products**

- The listed chemicals are safer alternatives, grouped by their functional-use class.†
- Chemicals are marked as a green circle, green half-circle, yellow triangle, or grey square.
- This list includes many of the chemicals evaluated through the DfE Safer Product Labeling Program. It does not include confidential chemicals. There may be chemicals not included in this list that are also safer.

### Chelating Agents

<table>
<thead>
<tr>
<th>Common Name</th>
<th>CAS Registry Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>2-Butenedioic acid (2Z)-, ammonium salt (1:7), homopolymer, hydrolyzed, sodium salts</td>
<td>181828-06-8</td>
</tr>
<tr>
<td>Alanine, N,N-bis(carboxymethyl)-, sodium salt (1:3)</td>
<td>164462-16-2</td>
</tr>
<tr>
<td>Aspartic acid, N-(1,2-dicarboxyethyl)-, tetrasodium salt</td>
<td>144538-83-0</td>
</tr>
<tr>
<td>Citric acid, anhydrous</td>
<td>77-92-9</td>
</tr>
<tr>
<td>D-Gluconic acid</td>
<td>526-95-4</td>
</tr>
<tr>
<td>Dipotassium hydrogen citrate</td>
<td>3609-96-9</td>
</tr>
<tr>
<td>L-Lactic acid</td>
<td>79-33-4</td>
</tr>
<tr>
<td>Monosodium D-glucoheptonate</td>
<td>31138-65-5</td>
</tr>
<tr>
<td>N,N′-Ethlyenediamine disuccinic acid</td>
<td>20846-91-7</td>
</tr>
</tbody>
</table>

Example of Safer Chelators
CleanGredients database also lists safer chemicals by functional class (these are also screened using U.S. EPA DfE Criteria)
Finding Safer Chemicals: CleanerSolutions Database

- Developed by Toxics Use Reduction Institute UMass Lowell
- Can help replace solvents, shows safety screening results
- Identifies solvent to replace -> can filter by contaminant type, substrate, equipment used, product cleaning type, effectiveness

Replace a Solvent Search Results

Current Search Information

Search Criteria
Solvent: [Solvent Name], Acetone (31)
Cleaning Type: [Cleaning Type]
Effective trials only

Results
Found 1 records
Showing records 1 - 24

Help
Search Results Field Definitions
Contact the lab

<table>
<thead>
<tr>
<th>Company Name</th>
<th>Safety Score</th>
<th>Classification</th>
<th>Contaminant</th>
<th>Substrate</th>
<th>Equipment</th>
<th>Client #</th>
<th>Project #</th>
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<tr>
<td>Today &amp; Beyond</td>
<td>37</td>
<td>Alkaline Aqueous</td>
<td>Cutting/Tapping Fluids</td>
<td>Steel</td>
<td>Immersion/Soak</td>
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<tr>
<td>Beyond 2004 [compare]</td>
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<tr>
<td>Today &amp; Beyond</td>
<td>37</td>
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<td>Inks</td>
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<td>Immersion/Soak</td>
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</table>

http://www.cleanersolutions.org/
Tools to Identify, Reduce, Eliminate Priority Chemicals

Approach: Ecolabel Recognition/Certification

• Pros:
  – Formulators, not retailers, bear responsibility and cost of complying
  – Third-party assessment ensures independence and adherence to evaluation criteria
  – Confidential Business Information (CBI) is protected, and more easily disclosed by suppliers
  – Formulations undergo regular re-evaluation and adherence to continuous improvement

• Cons:
  – There are costs involved with certification/recognition

• Examples: The ecolabel index identifies 108 textile ecolabels!
  (www.ecolabelindex.com)

bluesign® Cradle to Cradle™ Oeke-Tex® 100 Standard
• Material Health is one pillar of C2C Certification

• Material Health Certificates are now awarded on their own!

• Seven Steps of C2C Material Health Assessment Process

  1) Screening materials for presence of banned list chemicals
  2) Assessing toxicological hazard of individual chemicals using Pharos
  3) Exposure Assessment
  4) Assigning individual chemical and material assessment ratings
  5) Cyclability assessment
  6) ABC-X assessment
  7) C2C™ material health certification rating assignment
Tox21 and CAA/CHA

- Tox21: Incorporation in CAA/CHA Methods
  - The NAS AA report notes that innovation is needed to advance CAA and CHA
  - Tox21 was created in 2008 and is a multi-agency effort (NIH, EPA, FDA) is aimed at developing better toxicity assessment methods
  - Tox21 implements High Throughput Screening (HTS) methods
  - The goal of Tox21 is to quickly and efficiently test whether chemical compounds have the potential to disrupt processes in the human body that may lead to adverse health effects
Tox21 and CAA/CHA

• Tox21 data relating to Endocrine Activity were recently incorporated into 16 GreenScreen® assessments
  – These GreenScreens ® were conducted for the State of Washington’s Department of Ecology to pilot the IC2 AA Framework

• This is the first example of HTS being used in an alternatives assessment frame
  – This will be presented at the Society of Risk Analysis annual meeting in December, 2014 (Gurrette et al.)
  – The 16 GreenScreens ® will be published on the IC2 database
Tox21 and CAA/CHA

- Example of Tox21 data output (accessed through PubChem)
Tox21 and CAA/CHA

• HTS Output for 1,3,5-Trimethylbenzene
Tox21 and CAA/CHA

- Among 14 Androgen Receptor HTS assays, only 1 was positive, 11 were inactive, and 2 inconclusive
Interstate Chemicals Clearinghouse (IC2) Chemical Hazard Assessment Database

Source: Identifies who did assessment and when

Score: Identifies if assessment draft or validated
• The GreenScreen® for trimethylbenzenes identified a moderate hazard for reproductive toxicity but datagap (DG) for endocrine activity (E)

  – Trimethylbenzenes were assigned a score of Moderate for reproductive toxicity based on effects on male fertility, litter size, birth weight, and postnatal survival in a two-generation study performed with the surrogate aromatic naphtha, type I

  – Should one positive HTS assay be used to score the Endocrine Activity endpoint (E, below)

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**GreenScreen® Hazard Ratings for Trimethylbenzenes**

<table>
<thead>
<tr>
<th>Group I Human</th>
<th>Group II and II* Human</th>
<th>Ecotox</th>
<th>Fate</th>
<th>Physical</th>
</tr>
</thead>
<tbody>
<tr>
<td>C M R D E AT ST N SnS* SnR* IrS IrE AA CA P B Rx F</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>L M M L DG M M L vH H L DG H H H H H L L M</td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

Note: Hazard levels (Very High (vH), High (H), Moderate (M), Low (L), Very Low (vL)) in italics reflect estimated values, authoritative B lists, screening lists, weak analogues, and lower confidence. Hazard levels in BOLD font are used with good quality data, authoritative A lists, or strong analogues. Group II Human Health endpoints differ from Group II* Human Health endpoints in that they have four hazard scores (i.e., vH, H, M, and L) instead of three (i.e., H, M, and L), and are based on single exposures instead of repeated exposures. Please see Appendix A for a glossary of hazard acronyms.
ToxCast/Tox21 and Systematic Review for Alternatives Assessment

- **Webinar 1:** *Tox21: A U.S. Federal Collaboration to Improve the Human Hazard Characterization of Chemicals, Tuesday Dec 16, 2014, 12 EST*
  - Presenter: Dr. Raymond Tice, Chief of the Biomolecular Screening Branch, NTP/NIEHS)
  - Register at: https://gc3.webex.com/gc3/onstage/g.php?MTID=ece8e7a2b67807facfae7a091b1ea9429

- **Webinar 2:** *Using Tox21 in vitro data for hazard identification, development of prioritization-appropriate points of departure and chemical-class read-across applications, Tuesday, January 7, 12 EST*
  - Presenter: Dr. Richard Judson, NCCT, U.S. EPA
  - Register at: https://gc3.webex.com/gc3/onstage/g.php?MTID=e2f5925cdc90894f9972608d8170f9f05

- **Webinar 3:** *Mechanistic Data in a Systematic Review Framework: Developing Confidence in Bodies of Evidence, Wed Jan 21, 12 EST*
  - Presenter: Dr. Andrew Rooney, Deputy Director, Office of Health Assessment and Translation, Division of the National Toxicology Program, National Institute of Environmental Health Science
  - Register at: https://gc3.webex.com/gc3/onstage/g.php?MTID=e695ea19c924a7aef95f2874e67770ee0
Organizations Involved in CAA/CHA Activities

- **Green Chemistry and Commerce Council (GC3)**
  - Founded in 2005 as part of the Lowell Center for Sustainable Prod. at the Univ. of Mass., Lowell
  - GC3 has recently formed an AA workgroup to identify safer preservatives in cosmetics
    - [http://greenchemistryandcommerce.org](http://greenchemistryandcommerce.org)

- **BizNGO**
  - Founded in 2006 by Clean Production Action
  - BizNGO’s annual meeting is December 8-9 in San Francisco, CA
  - BizNGO has an AA Workgroup that holds monthly calls to advance AA

- **LinkedIn Group on Safer Alternatives Assessment Practitioners**
  - Go to [http://www.linkedin.com](http://www.linkedin.com) type in Safer Alternatives Assessment Practitioners in search box and ask to join
Alternatives Assessment Society is holding a meeting in March, 2013 at NIH in Bethesda

- Registration website through Univ. of Mass, Lowell should go live in the next month
- Email Joel Tickner (Joel_Tickner@uml.edu) or myself (mwhittaker@toxservices.com) for information
Conclusion: CAAs and CHAs Support Informed Substitution

- CAAs/CHAs ensure that new chemicals represent a move to safer chemical or nonchemical alternatives

**Know what you know...and what you don’t know**

- Don’t replace a chemical of concern with an unknown... **regrettable substitution** is expensive, time-consuming, and poses a risk to human health and/or the environment

- CAA/CHA are incorporating Tox21 Output and creating weight of the evidence rules to use when interpreting output
Thank you!

Contact Information

If you have questions or comments, please contact me:

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(202) 429-8787

Thank you!!