



Design for the Environment (DfE) Program

April 1, 2008

NEWMOA Green Cleaning Web Conference

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Design for the Environment (DfE)

U.S. Environmental Protection Agency

Washington, DC

Presentation Outline

- **DfE Program Overview**
- **DfE Product Recognition**
 - Overview and Purpose
 - What is Green Chemistry?
 - DfE Approach to Safer Chemicals Assessment
 - What does the logo mean?
 - Industry Partners
- **CleanGredients™**
 - Overview
 - Screenshots
- **Environmentally Preferable Purchasing**





DfE Program Overview

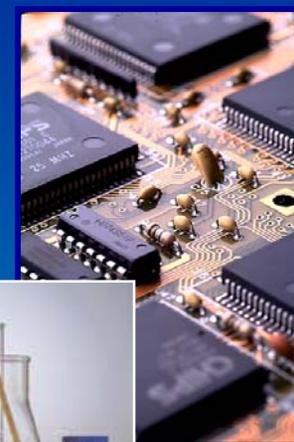
Overview of DfE Program

- Focus
 - Chemicals of concern
 - Informed Substitution
 - OPPT technical tools and expertise
- Considerations
 - Business client
 - Multi-stakeholder participation
 - Business realities
 - Potential benefits for industry and the environment
- Results
 - Industry partners reduced about 180 million pounds of chemicals of concern last year



DfE Partnerships

- **DfE Alternatives Assessments**
 - Furniture Flame Retardancy Partnership
 - Flame Retardants in Printed Circuit Boards
 - Lead-Free Solder in Electronics
 - Wire & Cable
- **DfE Product Recognition Program**
 - Recognizing Safer Formulations
 - Safer Detergents Stewardship Initiative
- **DfE Auto Refinishing Best Practices**





DfE Product Recognition – Overview and Purpose

DfE Product Recognition Program

Overview and Purpose



- Level the Playing Field
 - Information on chemicals of concern currently in commerce used to regulate new, pre-commerce chemicals.
- Suggest Safer, Green-Chemistry Alternatives
 - Use Office of Pollution Prevention and Toxics chemical knowledge and expertise to guide formulators toward safer substitutes.
- Recognize Innovation
 - Many leading raw material manufacturers and formulators are innovators, using safer alternatives to develop new technologies.
 - They deserve ratification and recognition for their success.
 - Recognition encourages further innovation across the industry.

Be a Science Resource for Companies Leading the Way to Sustainability



- It's your government – we'd like to share our chemical expertise.
- Knowledge base and expertise acquired over many years, estimation models expertly applied, access to subject area experts, unique data sources
- Apply the principle of “informed substitution” to guide chemical choices and product reformulation – provide sound scientific information on chemical alternatives, avoid unintended consequences
- Present that information as part of a continuum of improvement, moving toward safer ingredient alternatives and sustainable products

Work with Formulators to Make the Safest Possible High-performing, Cost-effective Products



- Approach product formulation the way formulators do
 - Consider every chemical in the formulation as part of its functional class and how it contributes to the overall product performance
- Make continuous improvement driven by green chemistry innovation part of the sustainability plan



Recognize Only those Products Using the Safest Chemistry



- Offer chemical consultation to all, but recognition only to those companies whose products use the safest possible ingredients
- Give formulators the incentive to reach for the best possible formulations by only recognizing those products that use the safest ingredients
- Help formulators respond to purchaser demand for safer products through product differentiation-the DfE logo



Green Chemistry



What is Green Chemistry?



Green Chemistry is the **design** of chemical products and processes to reduce and/or eliminate substances **hazardous** to human health and the environment.



Green Chemistry

“Because everything is chemical but heat
and light...” PTA



Why Focus on Hazard?

Risk = Hazard x Exposure

Exposure Controls CAN/WILL FAIL



So, Minimize the Hazard

If it's not there, you don't have to worry about it!

- But how do you...
 - ...decide if a chemical is “bad”?
 - ...find an alternative?
 - ...know the alternative is better?



DfE Approach to Safer Chemicals Assessment

Apply Informed Substitution...

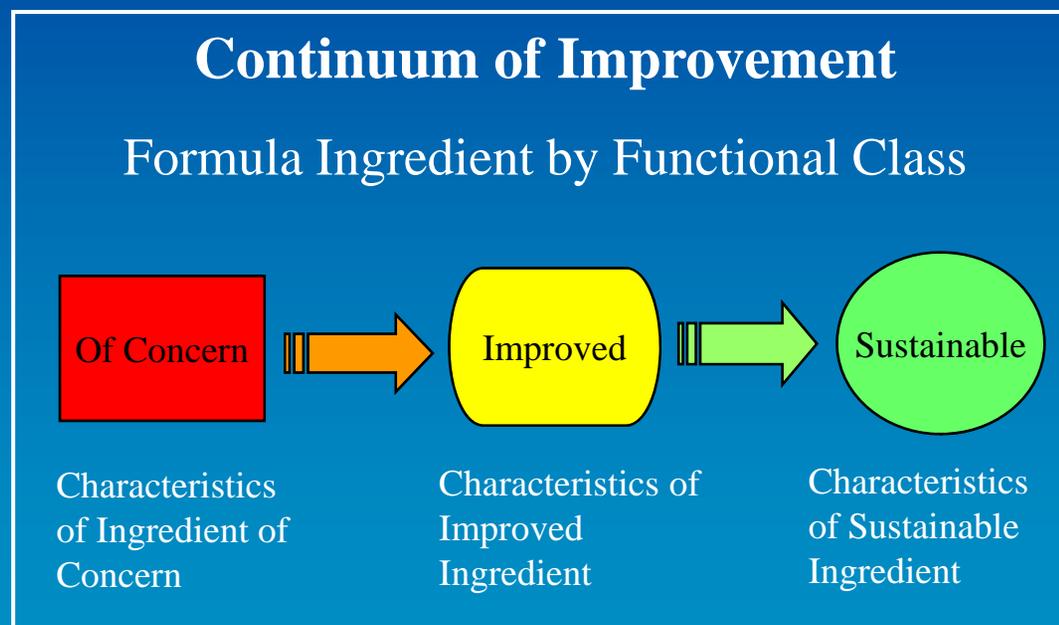
- Identify the **Functionality** of an Ingredient
 - Every chemical in a product is there for a reason.
 - For many ingredients, there are a number of chemicals that can provide similar functionality (e.g. many different surfactants for cleaning products).
- Understand the **Hazard Profile** of an Ingredient and its Alternatives
 - What data are available?
 - Persistent in the environment?
 - Bioaccumulates in animals?
 - Toxicity, e.g. acute toxicity, carcinogenicity
 - Can models or analogs fill data gaps?



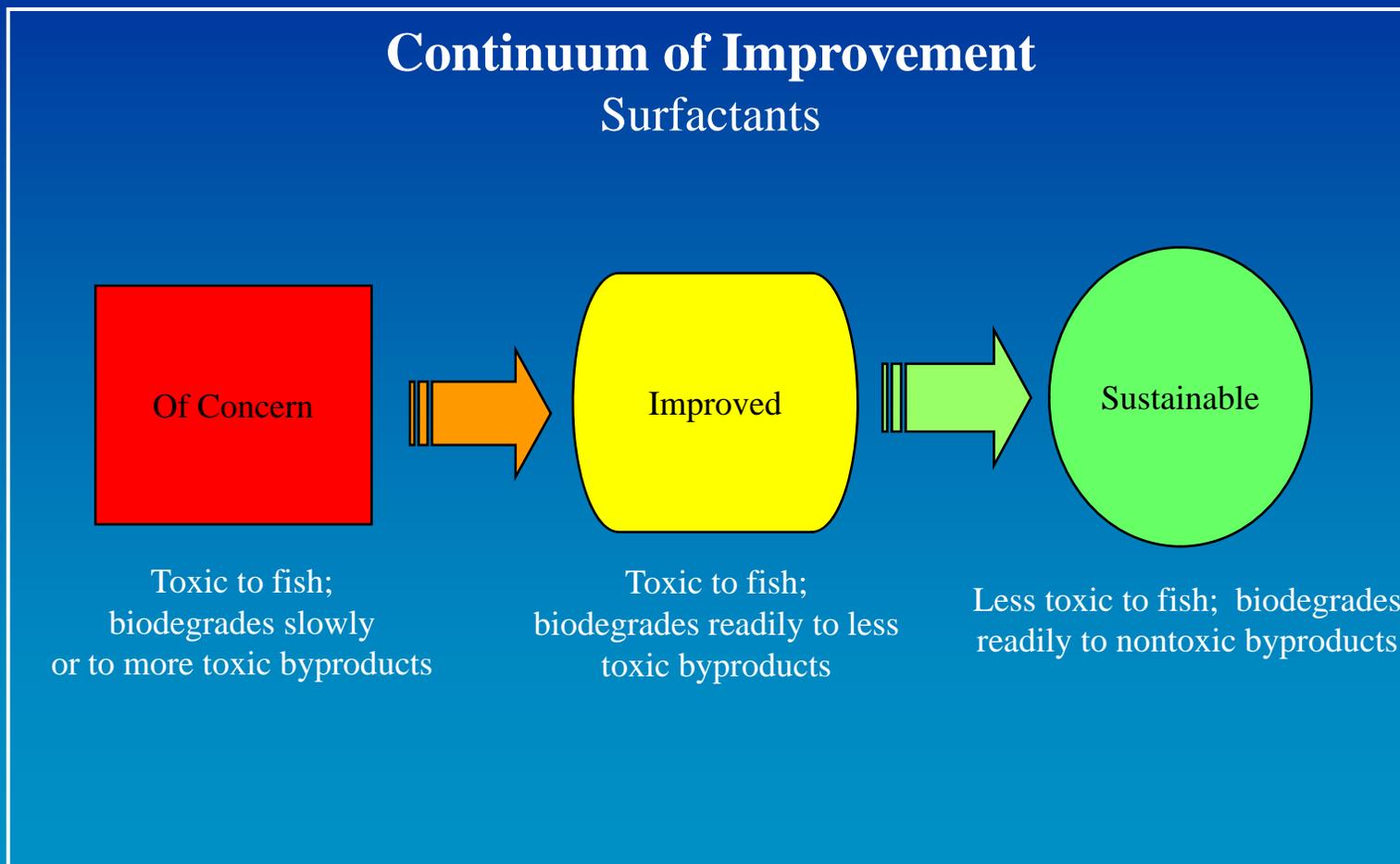
...Then Green Chemistry Principles



- Which Chemicals have the Lowest Hazard Potential in their Functional Class?



Example: Surfactants





DfE Screen for Surfactants

- Safer surfactants degrade quickly to low toxicity degradates.

| Acute Aquatic Toxicity (L/E/IC50 Value) | Rate of Biodegradation |
|--|--|
| ≤ 1 ppm | May be acceptable if biodegradation ¹ occurs within a 10-day window |
| >1 ppm and ≤ 10 ppm | Biodegradation ¹ occurs within a 10-day window |
| >10 ppm | Biodegradation ¹ occurs within 28 days without products of concern ² |

¹ Generally, $>60\%$ mineralization (to CO₂ and water) in 28 days.

² Products of concern are compounds with high acute aquatic toxicity ($L/E/IC50 \leq 10$ ppm) and a slow rate of biodegradation (greater than 28 days).



DfE Screen for Solvents (draft)

- Safer solvents demonstrate low impacts to human health and the environment.

| | |
|---|--|
| General Attributes of Concern for All Solvents | Carcinogenicity Reproductive and Developmental Toxicity Persistence, Bioaccumulation and Aquatic Toxicity (PBaT) Acute Mammalian Toxicity |
| Key Attributes of Concern for 4 Solvent Classes* | Repeated-Dose Toxicity <i>Reproductive and Developmental Toxicity (covered above)</i> Neurotoxicity |

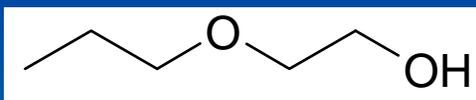
* Ethylene Glycol Ethers (EGEs), Propylene Glycol Ethers (PGEs), Alcohols, Esters



DfE Screen for Fragrances (draft)

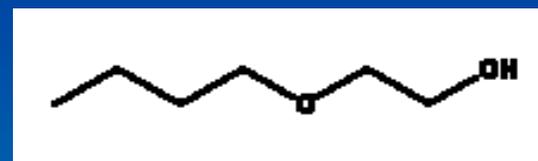
- **Human Health and Safety**
 - Carcinogenicity
 - Reproductive/Developmental Toxicity
 - Fertility
 - Developmental Effects
 - Endocrine Disruption
 - Acute mammalian toxicity (oral, dermal, inhalation)
 - Mutagenicity
 - Systemic Toxicity (Target Organ Effects and Neurotoxicity)
 - Sensitization (Dermal, Respiratory)
- **Environmental Fate & Toxicity**
 - Persistence/Biodegradation
 - Degradation Products/Metabolites of Concern
 - Bioaccumulation
 - Aquatic toxicity (fish, crustacea, and/or algae)
- Note: DfE Fragrance Screen criteria apply to aroma chemicals and fragrant extracts (essential oils) only

Structure-Activity Relationships (SARs)



n-Propoxyethanol

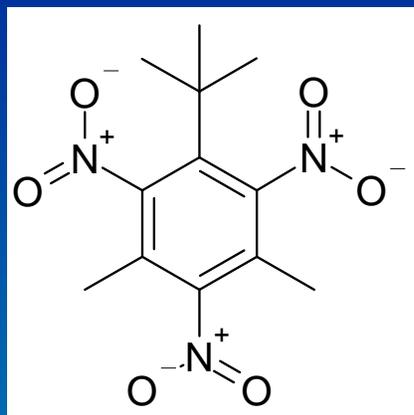
- Similar human health concerns including hemolysis leading to toxicity in kidney, spleen and liver.
- LOAEL (rat, oral, 6 wks): 195 mg/kg/d
- LOAEL (rat, inhalation, 14 wks): 200 ppm (0.85 mg/L)



2-Butoxyethanol

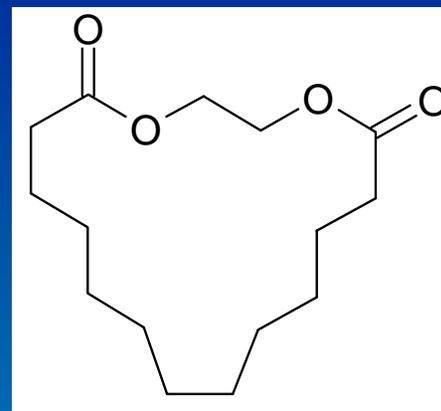
- Human health concerns include hemolysis leading to toxicity in kidney, spleen and liver.
- LOAEL (rat, oral, 6 wks): 222 mg/kg/d
- LOAEL (rat, inhalation, 13 wks): 77 ppm (0.37 mg/L)

Suggesting Safer Substitutes - Fragrances



Musk xylol

- Appears designed for maximum environmental persistence—nitro and t-butyl groups
- May bioaccumulate
- Potentially toxic to aquatic organisms
- May be an indirect toxicant, inhibiting the ability of cells to excrete harmful chemicals



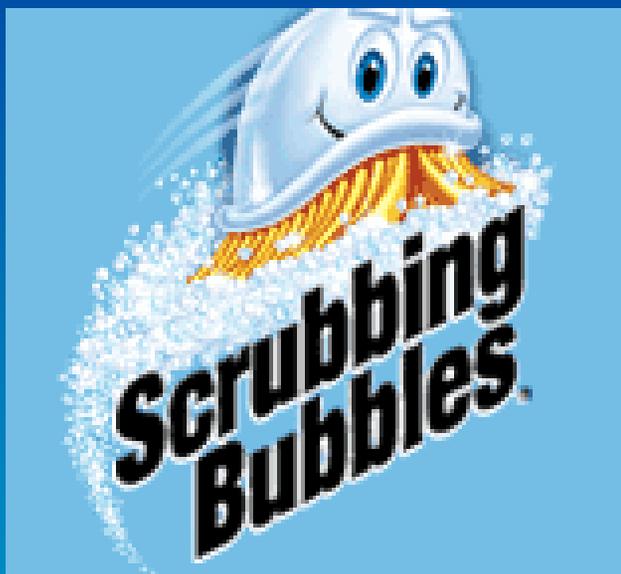
Ethylene brassylate

- Faster biodegradation—ester linkages
- Fragrance houses have worked with EPA's Design for the Environment Formulator Program to replace musk xylol with ethylene brassylate

Scrubbing Bubbles[®], A Safer Cleaning Product



Ingredients



Surfactant

Solvent

Chelating Agent

Preservative

When you see the DfE logo on a product, what does it mean?



It means that the DfE technical workgroup has screened each ingredient in the product for potential human health and environmental effects and that – based on currently available information, predictive models, and expert judgment – **the product contains only those ingredients that pose the least concern among chemicals in their class.**





Sampling of DfE Partners

DfE has more than 80 Partners representing nearly 500 recognized products (for a complete list go to: www.epa.gov/dfe)





CleanGradients™

U.S. Environmental Protection Agency

CleanGredients™ and the DfE Screens are Defining Safer Chemistry



- CleanGredients™ is a marketplace...
 - for suppliers to showcase safer chemical ingredients for cleaning products, and
 - for formulators to find those ingredients.
- CleanGredients™ is at the intersection of safer chemistry and high performance ingredients (resource for informed substitution)
- DfE Screens for Safer Chemical Ingredients
 - Defined for functional classes of ingredients (e.g. surfactants, solvents)
 - Chemicals that are acceptable under the DfE Product Recognition Program.

Search by Performance/Physical Properties



https://db.cleangredients.org - CleanGredients™ » Surfactant Search - Mozilla Firefox

Logged in as **Topher Buck** from **TestCorp.** [Log out](#)

cleangredients™

search your account

| Charge Class ⁱ | Application ⁱ | Supplier ⁱ | Text ⁱ |
|---|---|---|--|
| All <input type="button" value="v"/> | <input type="checkbox"/> Hard Surface Cleaner <input type="checkbox"/> Hand Dish Soap <input type="checkbox"/> Carpet <input type="checkbox"/> Laundry | All <input type="button" value="v"/> | <input type="text"/> |
| Chemical Class ⁱ | CAS # ⁱ | Biodegradability ⁱ | Aquatic Toxicity ⁱ |
| All <input type="button" value="v"/> | All <input type="button" value="v"/> | All <input type="button" value="v"/> | All <input type="button" value="v"/> |
| HLB ⁱ | Physical Form ⁱ | Flash Point ⁱ | CMC ⁱ |
| Min: <input type="text"/> Max: <input type="text"/> | All <input type="button" value="v"/> | Min: <input type="text"/> Max: <input type="text"/> °C <input type="button" value="v"/> | Min: <input type="text"/> Max: <input type="text"/> |
| % Active Surfactant ⁱ | Sp. Gr. ⁱ or Density ⁱ | Cloud Point ⁱ | pH ⁱ |
| Min: <input type="text"/> Max: <input type="text"/> | Min: <input type="text"/> Max: <input type="text"/> Sp Gr <input type="button" value="v"/> | Min: <input type="text"/> Max: <input type="text"/> °C <input type="button" value="v"/> | Min: <input type="text"/> Max: <input type="text"/> |

Disclaimer: Only data on acute aquatic toxicity, biodegradability, and degradation products are reviewed by a designated third party for purposes of listing in the CleanGredients(tm) database. All other data and product information are provided by ingredient suppliers who are individually responsible for the accuracy of the information. All TestCorp and GreenBlue Ingredients are fictional and are provided for demonstration purposes only.

If you experience technical difficulties or have any suggestions or comments, please let us know at info@cleangredients.org

Search Results



https://db.cleangredients.org - CleanGredients™ » Surfactant Search - Mozilla Firefox

| Supplier | Product Name ID | Charge Class | | | | Biodegradability ⓘ | Acute Aquatic Toxicity ⓘ L/VEC ₅₀ ⓘ [mg/L] | DfE Screen ⓘ |
|---|---|---|------|-------|-----|--------------------|---|------------------|
| | | Chemical Class | | | | | | |
| | | HLB | Form | Flash | CMC | | | |
| %Act | Sp. Gr. | Cloud | pH | | | | | |
| Uniqema | Monatropo 1620 | Nonionic Alkyl Polysaccharide | | | | Ready | >10 and ≤100 | Meets DfE Screen |
| Air Products & Chemicals (Tomah Products) | Tomadol 400 | - | | | | Ready | ≤1 | Meets DfE Screen |
| Cognis Corporation | Glucopon 625 UP | Nonionic Alkyl glucosides | | | | Ready | >1 and ≤10 | Meets DfE Screen |
| | Magnesium lauryl sulfate 3097-08-3 (CAS #) | Anionic Linear alkyl sulfate | | | | Ready | >10 and ≤100 | Meets DfE Screen |
| Stepan Company | BIO-SOFT® N1-5 PF696 | Nonionic Alcohol Ethoxylates | | | | Ready | >1 and ≤10 | Meets DfE Screen |
| CLER | LAS CLER Standard | Anionic Linear alkylbenzene sulfonate, sodium salt | | | | Ready | >1 and ≤10 | Meets DfE Screen |

Detailed Ingredient View



https://db.cleangredients.org - CleanGredients™ » View Ingredient - Mozilla Firefox

uniqema **Monatropo 1620**
[Company Website](#)

General Ingredient Information

| | |
|--|--|
| <i>Charge Class</i> | Nonionic |
| <i>Chemical Class</i> | Alkyl Polysaccharide |
| <i>Product Description</i> | Monatropo 1620 is a bio-based natural renewable alkyl polysaccharide surfactant with a range of properties required in an increasing number of formulations. |
| <i>Applications</i> | Hard Surface Cleaner Hand Dish Soap Carpet Laundry |
| <i>Suggested Uses</i> | Ready biodegradable High electrolyte stable Non-gelling super concentrates Excellent hydrotrope Soluble in high alkaline solutions Good wetter and detergent base |
| <i>EU Detergent Directive Compliance</i> | Yes |
| <i>EU Detergent Directive Reference</i> | StatementDetRegUpdateUS82006.pdf - 25.75 KB |
| <i>MSDS File</i> | MSDS16209-2006.pdf - 23.81 KB |
| <i>Technical Data File</i> | Monatropo 1620.pdf - 1.44 MB |

Detailed Ingredient View (continued)



https://db.cleangredients.org - CleanGredients™ » View Ingredient - Mozilla Firefox

Environmental Summary (Ingredient-Level)

| | |
|-------------------|-----|
| <i>DfE Screen</i> | Yes |
|-------------------|-----|

Tier I ⓘ

Tier I Ingredient Attributes require the submission of test data and third party review. [More Info.](#)

Acute Aquatic Toxicity ⓘ [Show Details](#)

| | |
|--------------------------------|-------------------|
| <i>Reviewed Category</i> | >10 and ≤100 mg/L |
| <i>Fish LC₅₀</i> | >100 mg/L |
| <i>Daphnia EC₅₀</i> | 10-100 mg/L |
| <i>Algae IC₅₀</i> | 10-100 mg/L |

Biodegradability ⓘ [Show Details](#)

| | |
|--|-----------------------|
| <i>Reviewed Category</i> | Readily Biodegradable |
| <i>Percent Degraded</i> | ≥60% |
| <i>Duration</i> | 28 days |
| | Meets 10-day window |
| <i>Toxic / Persistent Degradation Products</i> | No |



Environmentally Preferable Purchasing

Environmentally Preferable Purchasing



- Several states and municipalities include DfE recognition in their procurement standards
 - State of New Jersey
 - State of Oregon
 - State of Colorado
 - State of Washington
 - State of Utah
 - State of Hawaii
 - State of Illinois (in draft)
- Additional states and entities are considering DfE recognition for inclusion in their purchasing programs
- North American Green Purchasing Initiative's Fact Sheet on Green Cleaners
- Executive Order 13101: Greening the Government
 - DfE recognition will be part of EPA's goals under this EO
 - Implemented internally through the EPA's Environmental Management System
- Home Depot Eco Options



Summary and Conclusions

- DfE recognition is a leadership standard – only the safest possible ingredients can be used. Its continuous improvement approach promotes innovation.
- Value-added through DfE's approach
 - Informed substitution complements formulators' own approach to product development
 - Consider all ingredients regardless of percentage
 - Engage in life-cycle thinking (green-chemistry chemicals protect throughout the life cycle, from chemical production, to transportation, to disposal)
- DfE (as part of EPA) has a unique role in providing expert advice, advancing green chemistry, and meeting ever-evolving demands of sustainable product design.



Thank you.

Questions?

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www.epa.gov/dfe
www.cleangredients.org

U.S. Environmental Protection Agency



Backpocket Slides

What's Unique About the DfE Formulator Product Review



- DfE considers chemicals of concern that can be masked by raw material blends or by dilution in water.
 - E.g.: Acute aquatic toxins.
- DfE spots negative synergies between product components.
 - E.g.: Reaction between nitrosating agents and amines to create carcinogenic nitrosamines.
- DfE uses EPA's expert knowledge and predictive tools.
 - E.g.: Structural similarities between chemicals and predictive models used to flag product components with similar potential effects including mutagenicity, developmental toxicity, carcinogenicity, etc.
- DfE screens all fragrances and dyes for chemicals that may pose health or environmental effects of concern.



Testimonials for DfE

- “One of the reasons we are so excited about working with DfE is that we can get explanations and recommendations from you and the organization on ways to continually improve our products, both from a performance AND an environmental standpoint.”
– Joel Sugarman, Saric Solutions, Inc.
- “We are delighted to continue to partner with the EPA. Design for the Environment Program supports SC Johnson’s commitment to put the environment and human health at the center of product development and formulation. Companies can and should continue to look closely at making investments that are about doing what’s right for the business and the environment.”
– Fisk Johnson, SC Johnson
- “I personally want to thank you and commend your group and the efforts you are putting into this program. It is refreshing to see this type of work between the government and business. It also is refreshing to see the government offer a program that literally saves us thousands of dollars...”
– Scott Jarden, President, The Bullen Companies