Alternatives Assessment: Searching for Safer Alternatives to Perfluorinated Chemicals

Biz-NGO – December 6, 2017
Facilitated by: Joel A. Tickner, ScD
Lowell Center for Sustainable Production
UMass Lowell
What is alternatives assessment?

“A process for identifying, comparing, and selecting safer alternatives to chemicals of concern on the basis of their hazards, comparative exposure, performance, and economic viability”

• GOAL: To facilitate an informed consideration of the advantages and disadvantages of alternatives to a chemical of concern in order to guide substitution and product design decisions

https://www.nap.edu/catalog/18872/a-framework-to-guide-selection-of-chemical-alternatives
Focus of Alternatives Assessment

• Alternatives assessment is a step-defined, action-oriented process
• Focus on function not the particular chemical
  – Focus on “intrinsic impact reduction”
  – Considers the “necessariness” of a chemical
• Finding a safer alternative and getting industry to adopt the use of it are not the same thing.
• In some cases, safer, feasible alternatives may not exist and need to be developed
Table 1. Functional Substitution for Chemicals in Products, Chemicals in Processes

<table>
<thead>
<tr>
<th>Functional Substitution Level</th>
<th>Chemical in Product Bisphenol-a in Thermal Paper</th>
<th>Chemical in Process Methylene Chloride in Degreasing Metal Parts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemical Function (Chemical Change)</td>
<td>Is there a functionally equivalent chemical substitute (i.e., chemical developer)?</td>
<td>Is there a functionally equivalent chemical substitute (i.e., chlorinated solvent degreaser)?</td>
</tr>
<tr>
<td></td>
<td>Result: Drop-in chemical replacement</td>
<td>Result: Drop-in chemical replacement</td>
</tr>
<tr>
<td>End Use Function (Material, Product, Process Change)</td>
<td>Is there another means to achieve the function of the chemical in the product (i.e., creation of printed image)?</td>
<td>Is there another means to achieve the function of the process (i.e., degreasing)?</td>
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<tr>
<td></td>
<td>Result: Redesign of thermal paper, material changes</td>
<td>Result: Redesign of the process (e.g., ultrasonic, aqueous)</td>
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<tr>
<td>Function As Service (System Change)</td>
<td>Are cash register receipts necessary? Are there alternatives that could achieve the same purpose (i.e., providing a record of sale to a consumer)?</td>
<td>Is degreasing metal parts necessary? Are there other alternatives that could achieve the same purpose (i.e., providing metal parts free of contaminants for other end uses)?</td>
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<tr>
<td></td>
<td>Result: Alternative printing systems (e.g., electronic receipts)</td>
<td>Result: Alternative metal cutting methods</td>
</tr>
</tbody>
</table>

Tickner, et al, Environmental Science and Technology, 2014
Challenge for Perfluorinated Compounds

- A unique and very functional chemistry/set of materials used in a range of applications
- Substitutes may not have equivalent functionality and may impact other sustainability criteria
- Structurally similar substitutes may present similar or different hazards
- Rethinking functional needs/requirements and chemistry/material choices for different applications necessary.
- It will require new supply chain collaborations
GC3: Bridging the Supply Chain to Advance Green Chemistry Innovation

Green chemistry ideas & technology options

* Established companies & startups

Green chemistry market requirements & desires

* FEEDSTOCK  CHEMICAL SUPPLIERS  FORMULATORS  RETAIL CHANNEL  END USERS
What is the Green Chemistry and Commerce Council (GC3)?

- A cross-sectoral, business-to-business network
- Work collaboratively to accelerate the application of green chemistry across industry sectors and supply chains

Mission: To make green chemistry standard practice – **Mainstream** - in industry, for innovation, public health, and environmental protection

Started in 2005
120 members across sectors and value chain