



# Greening the Supply Chain to Develop More Sustainable Formulations

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Annual Scientific Seminar  
Society of Cosmetic Chemists

Tom Burns<sup>1</sup>, Mike Buczynski<sup>2</sup>, David Long<sup>3</sup>, Julie Manley<sup>3</sup>, Suhail Massad<sup>4</sup>,  
Schubert Pereira<sup>5</sup>, Robert Predale<sup>6</sup>, Phil Sliva<sup>7</sup>, Herb VanderBilt<sup>8</sup>, Stanley Weller<sup>4</sup>

<sup>1</sup>Novozymes, <sup>2</sup>Church & Dwight, <sup>3</sup>ACS GCI Formulators' Roundtable, <sup>4</sup>Zep, <sup>5</sup>Rug  
Doctor, <sup>6</sup>Johnson & Johnson Consumer Products, <sup>7</sup>Amway, <sup>8</sup>Bissell Homecare, Inc.



# Objective

- Cosmetic chemists and formulators rely heavily on their supply chain in order to develop more sustainable products while meeting the needs of their customers.
  - The components of existing formulated products are considered safe and effective; however, the development of innovative greener components will enhance the overall sustainable profile of formulated products.
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# Overview


- The ACS GCI Formulator's Roundtable
    - *Who we are*
  - What are the needs and opportunities?
    - *Call for better & more-sustainable ingredients*
  - Open for collaboration
    - *Activities, and how you can play a role in the ACS GCIFR*
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# Mission

To be a **driving force** in the **formulated products** industry, **promoting** use of **Green Chemistry** in **creating innovative products** that are **environmentally sustainable** throughout their **product life cycle** and **safer to make and use**.

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# ACS GCI Formulators' Roundtable Membership Definition

**Any corporation, or subsidiary, division or unit thereof, significantly engaged in the formulation of soap, detergents and cleaning preparations and/or perfumes, cosmetics, and other toilet preparations under its own brand names.**

**This includes all corporations identifying with SIC Industry Group 284.**

Annual membership contributions = \$1,000 - \$10,000  
(according to annual sales volume)

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# ACS GCI Formulators' Roundtable

## Current Membership



Superior Solutions





# Strategic Priorities

- Promote transparency and consistency through a set of green chemistry principles for formulated products.
  - Drive good science in the development of environmentally-preferred products standard/ certification.
  - Inform and influence suppliers and academia to develop greener alternatives.
  - Be recognized leaders in Green Chemistry formulations.
  - Incorporate risk-based decision-making into green chemistry.
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# “Green Chemistry” is a Continuous Endeavor

## 12 Principles of Green Chemistry

1. Prevention
2. Atom Economy
3. Less Hazardous Chemical Syntheses
4. Designing Safer Chemicals
5. Safer Solvents and Auxiliaries
6. Design for Energy Efficiency
7. Use of Renewable Feedstock
8. Reduce Derivatives
9. Catalysis
10. Design for Degradation
11. Real-time analysis for Pollution Prevention
12. Inherently Safer Chemistry for Accident Prevention

“Green” definition will continuously evolve - is not a destination

Anastas, P. T.; Warner, J. C.; *Green Chemistry: Theory and Practice*, Oxford University Press: New York, 1998, p.30.

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# Opportunities for Greener Alternatives

- Antimicrobials
- Solvents
- Small Amines
- Chelants & Sequestrants
- Boron Replacements
- Fragrance Raw Materials
- Corrosion Inhibitors
- Alkanolamide Replacements
- Surfactants
- UV Absorbers

*All about the  
INGREDIENTS!*

Key ingredient categories in formulations  
identified for improvement



# General “Greener” Criteria

- Increased sustainability
  - Reduced toxicity
  - Increased biodegradability
  - No bioaccumulation
  - Cost-Effective
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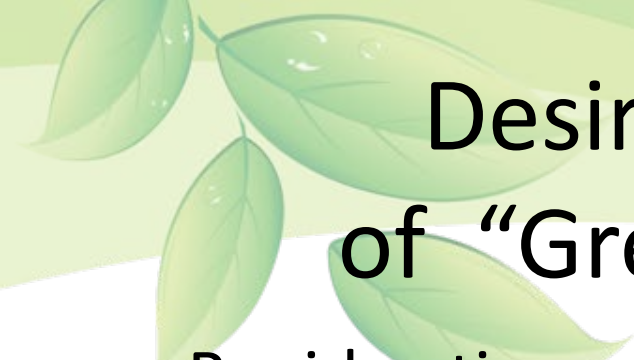


# Greener Antimicrobials

- Cleaning and personal care products are constantly challenged by microbes
- Contaminated products can become off odor, lose functionality, and potentially pose a risk to the user
- Solutions are sought for both preservative and disinfectant purposes.

Antimicrobials are designed to kill, so a “Greener Alternative” is challenging.

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# Desirable Characteristics of “Greener” Antimicrobials

- Rapid-acting
- Broad Spectrum (gram positive and gram negative bacteria, yeasts and molds)
- Compatible with a wide range of ingredients
- Stable and active over a wide pH - 2.5 to 11.5
- Acceptable odor
- Acceptable color; will not react with colors
- Soluble in product base, water or oil
- Cost effective

Difficult criteria, but certainly a green opportunity

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# Greener Solvents

- Crucial to formulating
  - Unique performance attributes
  - Potential environmental concerns (VOC, GWP)
  - Adverse health concerns
  - Bio-based solvents can reduce bio-diversity
  - Bio-based can negatively impact food supplies
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# Characteristics of Greener Solvents

- Performance to meet current materials
  - Renewable source - preferably based on non-food supply
  - Reduce carbon footprint and VOC emissions
  - Low toxicity; high biodegradability
  - Less resource-intensive production
  - Minimal odor and color
  - Meet US EPA Design for the Environment criteria
  - Cost-effective
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# Greener Amine Replacement

Small amines (MEA, DEA, TEA) are used by Home and Personal Care formulators for key benefits:

- Source of alkalinity for low pH formulations.
- Superior stability in high concentration formulas.
- Improved grease removal, corrosion inhibition and film and streak prevention.

Secondary amines can form nitrosamines so a greener alternative is needed.

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# Characteristics of a “Greener” Small Amine Replacement

- “Organic” alkalinity requiring less water than inorganic counter ions.
- Neutralize anionic surfactants & relatively low pH fatty acids.
- Compatible with a wide range of ingredients.
- Acceptable/minimal odor and color.
- Positive impact on finished product physical properties (reduced viscosity, improved freeze-thaw recovery, freeze point depression) over inorganic alkalinity sources.
- Corrosion protection, grease removal, film prevention.
- Cost effective

Uncompromising formulating chemists – challenging demands!

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# Greener Surfactants

- Large Market Potential
  - >\$20 Billion Market (Home, Personal and I&I) SRI Consulting
- Renewable Sourcing is a Growing Marketing Desire

Watch for negative impact of biodiversity reduction.

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# Characteristics of Greener Surfactants

- Biodegradability (readily biodegradable).
- Aquatic toxicity ( $LC_{50} > 10\text{mg/l}$ ).
- Preferably feedstock has no adverse impact on food supply.
- Prefer feedstock will not have a negative impact on eco-diversity.
- Manufacturing processes should be designed considering the 12 Principles of Green Chemistry.

Standard setting bodies such as US EPA Design for Environment Program (with CleanGredients List) have established good criteria.

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# Characteristics of a Greener Chelating Agent

- Reduced toxicity
- Increased biodegradability
- Chelating capacity over a broad pH range
- Reasonable cost

Metal	Preferred Metal Chelation Capacity
	Part chelant per parts metal (w/w)
Ca	16-20
Mg	25-35
Fe	10-20
Cu	10-15
Mn	10-15

L-glutamic acid, MGDA acid and IDS are examples of promising green chelants.

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# Characteristics of a Greener UV Screens

A desirable alternative would be well-characterized as readily biodegradable, of low toxicity to aquatic organisms, and not endocrine active.

- Readily biodegradable
  - Low octanol-water partition coefficient ( $K_{ow}$ ) (*e.g.*,  $\log K_{ow}$  less than 3.5)
  - Low acute toxicity to aquatic organisms (*e.g.*, lethal and adverse effects concentrations to 50% of a test population – LC50 and EC50 values – greater than 100 mg/L)
  - Does not elicit a positive response in endocrine disruption screening tests (*e.g.*, estrogen receptor binding assay)
  - Non-sensitizing
  - Non-toxic and non-irritating to humans
  - Minimal odor and white in color, thus minimal impact on the finished product aesthetics
  - Safe handling and shipping as raw material
  - Sourced from renewable raw materials
  - Meet the US Environmental Protection Agency Design for the Environment criteria for acceptable
  - Cost effective
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# Other Green Ingredient Opportunities

- Boron (builder, buffer & deodorizer)
  - Fragrance Raw Materials
  - Corrosion Inhibitors
  - Alkanolamide (viscosity & foam modifier)
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# Current Initiatives & Activities

- Encourage development of greener alternatives
    - Facilitate communication: P2 Science with C-Glycosides
    - Support development: InnoCentive project with US EPA
  - Improve transparency of non-proprietary green assessment information
    - ACS GCIFR Chemical Ingredient Database
    - Evaluations from EPA Design for Environment, Green Seal, EcoLogo, etc.
  - Demonstrate leadership & encourage membership via presentations/papers/sponsorship
  - Collaborate with other Roundtables
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# Opportunity for Collaboration

- **Industry**

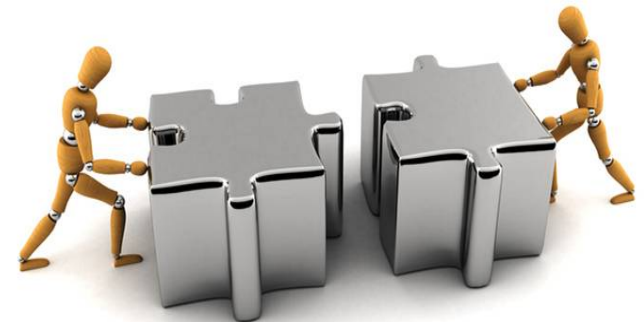
- Formulators' Roundtable
- Chemical Manufacturer's Roundtable
- Pharmaceutical Roundtable
- Trade Organizations

- **Academia**

- Research Funding

- **Government & NGO**

- Cooperate & Communicate Good Science
- Advise on Eco-Label Criteria





# Roundtable Collaboration

- Supporting Yale University in a National Science Foundation proposal related to designing safer chemicals

*“Rational Molecular Design of Commercial Chemicals for Minimal Unintended Biological Activity”*

- Outreach to peer Roundtables on projects of mutual interest (i.e., greener solvents)
- Sharing information via quarterly newsletter
- Annual ACS GCI Roundtable Poster Reception

**2011 ACS GCI  
Roundtable  
Reception:**

100% of poster presenters and attendees responding to a survey would recommend the event to others.

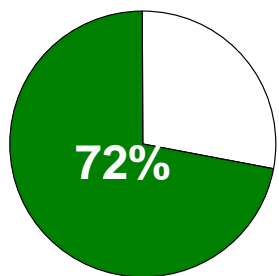
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# 2<sup>nd</sup> Annual ACS GCI Roundtables

## *Poster Reception*

### *Greening the Supply Chain: Near-Term Solutions for Sustainable Products and Manufacturing*



#### **2011 ACS GCI Roundtable Reception:**

Learned about a greener technology, material, market need, or research idea that may be applicable to their organization.

An evening networking event designed to encourage research, development, and marketing of industrially relevant greener alternatives.

**Tuesday, June 19**

**7 – 9 PM**

**Marriott Wardman Park Hotel**

**Washington, DC**

**Advance registration required.**

*Attendance is complimentary.*

For registration and more information:

Email [gcifr@acs.org](mailto:gcifr@acs.org)



# Contact Information

ACS GCI Formulators' Roundtable

**Website: [www.acs.org/gciformulators](http://www.acs.org/gciformulators)**

**Email: [gcifr@acs.org](mailto:gcifr@acs.org)**

Ideas, suggestions, collaborations are  
encouraged...

Please get in touch whenever you feel inspired!