Cutting-edge Sustainable Technologies for Cleaning

AWMA/NYWEA Conference
February 9, 2011

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Overview

- Green vs. sustainable products
- Chlorine dioxide (ClO_2)
- Enhance O_2
- Ozone (O_3)
- Solid chemicals
- Sustainable Green Housekeeping
- Discussion

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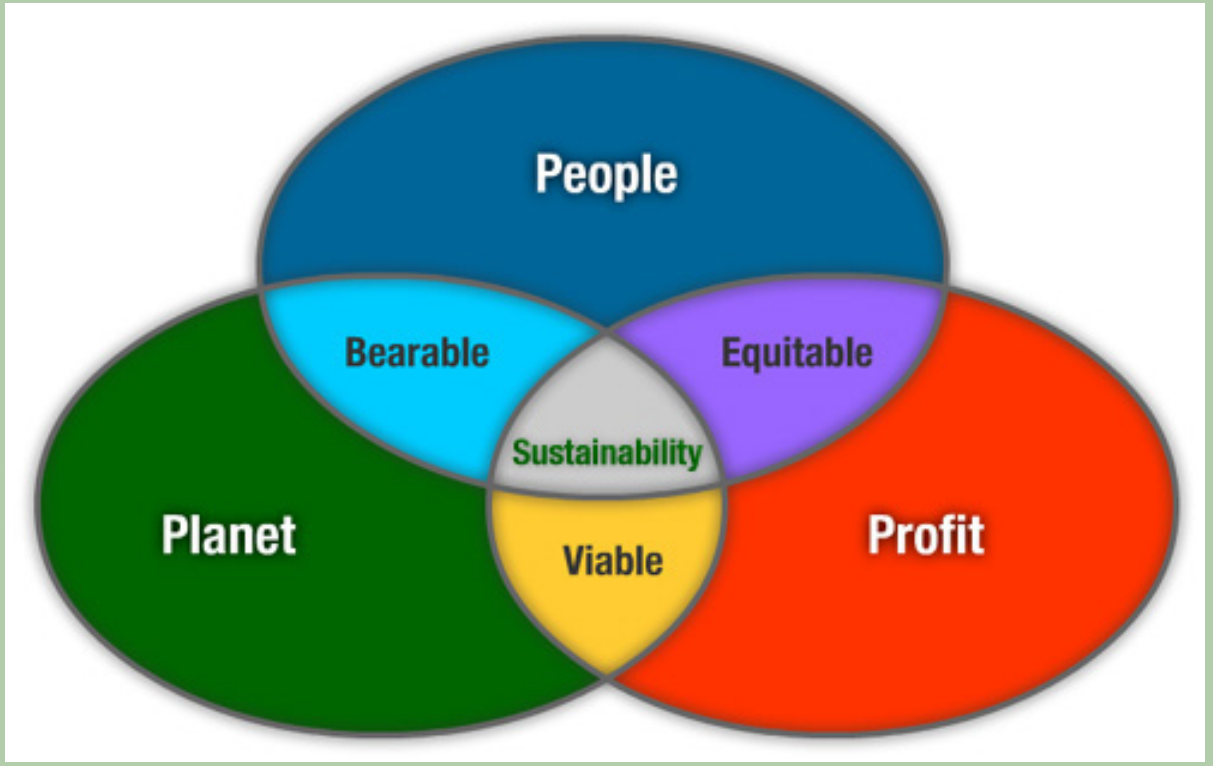
3 P's of Sustainability



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Green vs. Sustainable
What's the Difference?

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Green Product?

- Avoids production of CDs
- Avoids shipping of CDs
- Avoids manufacturing of plastic boxes and liner notes
- Above activities prevent pollution
- Product is green in its application

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Sustainable Product?

- Manufactured in filthy coal-burning plant in China that generates significant environmental pollution
- Plant employs low-wage workers living at poverty level
- Transported across Pacific Ocean
- iPod powered by oil-burning power plant in USA
- Discarded as e-waste that travels back to China, across the Pacific Ocean
- Disposed of in an unlined landfill next to a river that is the only water source for thousands of villagers

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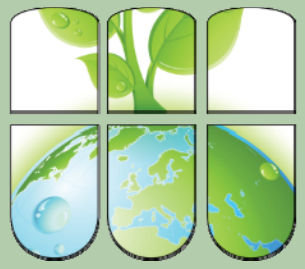

Green and Sustainable

- iPod is used in same manner as before
- Manufactured in local zero-discharge facility located in industrial park
- Profitable company pays its people well and has excellent benefit programs
- Product is remanufactured at end of life
- Product is used by consumer in a region with hydro power

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Can a Biocide and/or Disinfectant be both Green and Sustainable?

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Sustainable Elements of Cleaning

- Technologies (Product) - ClO_2, O_3, Enhance O_2, green products, solid systems
- Applications (Process) – Innovative methods for using old and new products leading to sustainable results, i.e. ROI
- Supporting Measures (Packaging, Certifications)

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Sustainable Results from Improved Products and Processes Food Manufacturing

People

- Training
- Automation
- Risk management
- Testing

Planet

- Energy savings
- Reduced water use
- Less hazardous chemistry
- Lower discharge

Profit

- Brand protection
- Reduced water use
- Reduced energy use
- Increased efficiency
- Re-allocation of labor

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Chlorine Dioxide (ClO_2)

- Powerful disinfectant of water
- First used at a spa in Ostend, Belgium
- Neutral compound of chlorine
- Disinfects by oxidation but does not chlorinate

$$ClO_2\,(\mathrm{aq}) + e\text{-} = ClO_2\text{-}$$

- 900 public water systems use ClO_2 to treat potable water
- Ten times more soluble in water than chlorine

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Chlorine Dioxide (ClO_2)

- ClO_2 gas is explosive under pressure; must be generated on site
- For food applications, can be created from the reaction of sodium chlorite and phosphoric and/or citric acid
- Metering pump in AANE unit at right delivers aqueous concentration of ClO_2 at 3800 ppm
- Does not impart flavor to foods being treated

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Enhance O_2

- Patented technology developed by RMC
- Used for cleaning food processing equipment surfaces heavily soiled with grease, starch, and proteinaceous materials
- Aqueous oxidizing agent is mixed with aqueous hydroxide ions and applied to soiled surfaces
- Generates perhydroxyl ions (HOO-) and other active oxygen species; creates synergistic cleaning effect

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Case Study - Enhance O_2 Tortilla Supplier

Problem

- Deep fat fryers used in tortilla production become caked with cottenseed oil
- Cleaning required 4 hours of scraping and 2 hours of boil-out to remove residue
- After boil-out, surfaces are sticky, and even caustic soda (NaOH) did not remove all residues

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Case Study - Enhance O_2 Tortilla Supplier

Solution and Results

- Pre-rinse and scrape fryers and treat with alkaline cleaner mixed with cold water for 20 minutes
- Add 4 gallons of Enhance O_2 and bring up to boil for one hour
- Sticky feel of surfaces was **completely eliminated**
- Alternative cleaning process resulted in **annual savings of $6,000 per year, 67% reduction in labor, reduced energy costs, and decreased water use**

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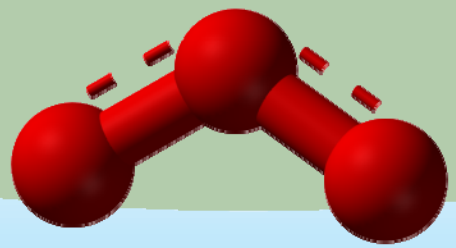
Ozone (O_3)

- Very strong oxidant and virucide
- Created from dissociation of molecular oxygen (O_2) via electrical discharges that form atomic oxygen, which subsequently combines with molecular oxygen to form O_3
- Must be generated onsite; decomposes quickly to elemental oxygen shortly after generation
- After decomposing in water, O_3 forms the free radicals perhydroxyl (HOO-) and hydroxyl (OH-) that have great oxidizing capacity, and hence disinfect the water



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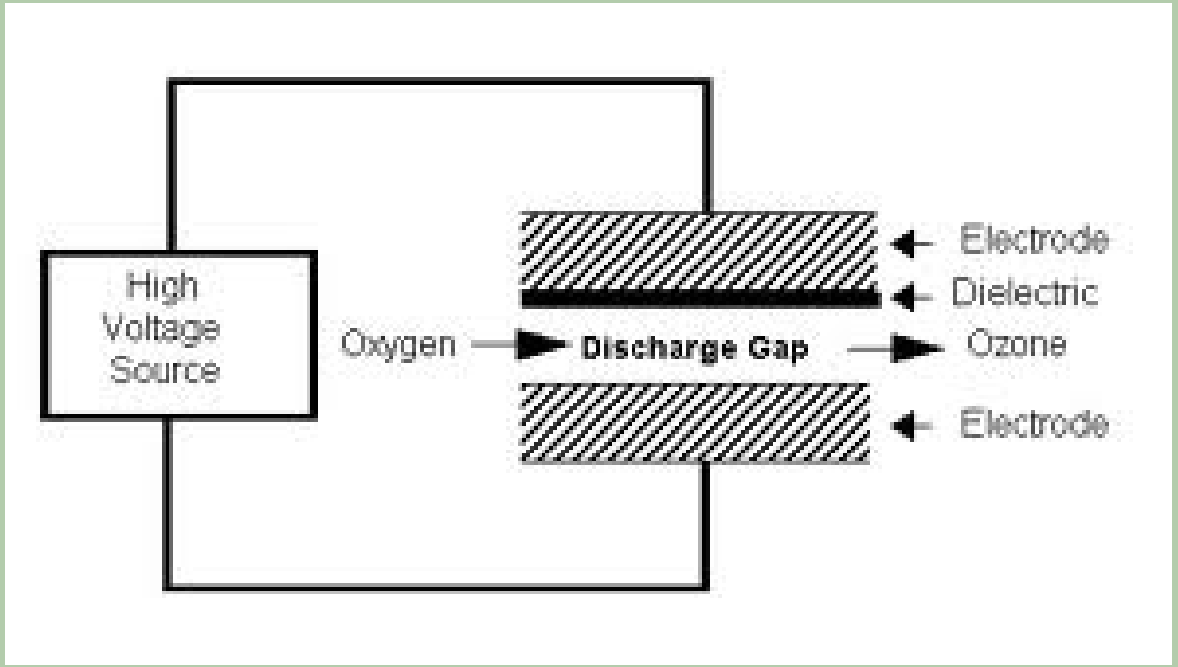
Ozone (O_3) Schematic Diagram of Generator



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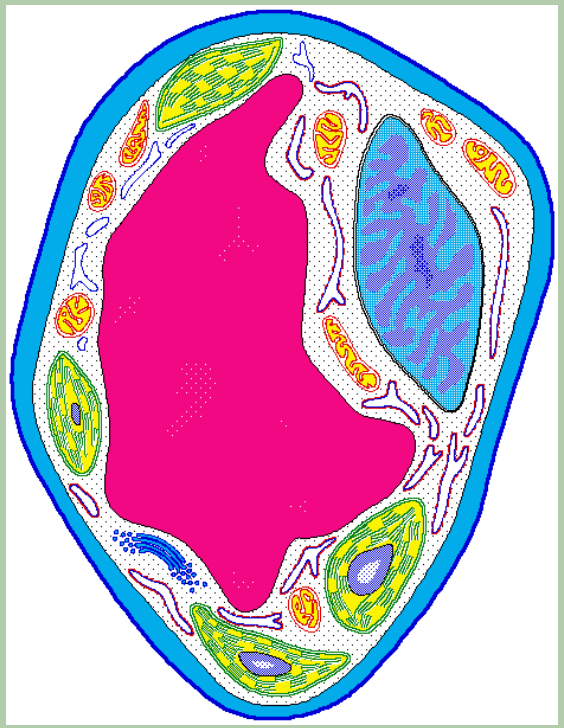
Ozone (O_3) Mechanisms of Disinfection

- Direct oxidation and destruction of cell wall, causing leakage of cellular constituents outside the cell
- Reactions with radical by-products of ozone decomposition
- Damage to constituents of nucleic acids (purines and pyrimidines)
- Breakage of carbon-nitrogen bonds leading to depolymerization



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Ozone (O_3)
Top 10 Reasons to Use

1. Most powerful broad-spectrum microbiological control agent available
2. 51% more powerful than chlorine on bacterial cell walls; kills bacteria 3100 times faster
3. Viritually eliminates all chemical usage; produces no toxic by-products
4. Clean and environmentally friendly (ozone is added to water, not to air; eliminates air emissions of ozone)
5. Safer for employees than conventional disinfectants when used properly

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Ozone (O_3)
Top 10 Reasons to Use

6. Has full FDA approval for direct-food contact application
7. Extremely effective as a disinfectant at relatively low concentrations
8. Generated onsite, thereby eliminating transport, storage, and handling of hazardous materials
9. Extends shelf life of food products
10. Permits recycling of wastewater; no biocide in discharge

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Case Study – Ozone Brewery/Beverage Plant

Problem

- Brewery was contracted to make a private label for a flavored malt beverage manufacturer, which required substantial treatment of incoming city water
- Specification required a maximum bacteria count of 1 colony per 100 mL, which the brewery was exceeding
- Treated water cannot contain any ozone, as this could compromise the taste of the beverage

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Case Study – Ozone Brewery/Beverage Plant

Solution and Results

- Brewery sterilized storage tank with periacetic acid
- Incoming city water was treated with ozone in an RMC C 5000 generator prior to entering a storage tank
- Carbon dioxide was added to the storage tank to **eliminate residual ozone**
- Treated water exhibited **zero bacteria counts** and **zero ozone residuals**, **meeting contract specifications**
- **Retention of contract** and **several $000 of savings**

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Solid Chemicals

- Existing technology in hard paste form
- 100% combination of raw materials blended in such a way to ensure same ratios of raw materials are present every time a solution is made up
- Just add water on-site with a dissolution feeder
- Sustainable

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Solid Chemicals

- Reduces spilling, handling and lifting risk, particularly high elevations
- 1 case (48 lbs) is equivalent to 1 drum of liquid (55 gallons)
- Safe vs. corrosive
- Excellent results
- Sustainable

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Sustainable Results
Solid Chemicals

People

- No liquids to spill – reduces the risk of slips and falls
- No powders to irritate
- No offensive odors
- No heavy drums to handle – reduces the risk of injury and worker's compensation claims
- No caustics – reduces employee chemical exposure

Planet

- Reduced weight equals reduced fuel usage
- Reduces water usage – use what you need when you need it
- Fully recyclable packaging
- Less hazardous discharge
- Recyclable as non-hazardous with triple rinse

Profit

- Reduced weight equals reduced shipping costs
- No drum disposal costs
- Frees up floor space
- Reduces caustic discharges to sewer and reduces surcharges
- May be used to qualify for LEED certification
- Reduces scale deposits for better heat transfer – saves on fuel usage
- Better corrosion control extends equipment life

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Before and After

Cooling tower installation using traditional liquids.

Cooling tower installation using solid Chemical Treatment.

NOTE: Three cooling tower systems are being treated in these applications.

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Sustainable Green Housekeeping – Why?

- 90% of our time is spent indoors
- 30% of buildings worldwide generate excessive IAQ complaints (Source: World Health Organization)
- 78% of asthmatic patients become worse when exposed to the fumes from cleaning products (Source: American Medical Association)
- 20 million Americans (including 6.3 million children) have asthma; 1 out of 6 people have asthma or allergies
- Approximately 14 million school days and equivalent work days are lost due to allergies and asthma

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State and City Environmentally Preferable Purchasing Programs

- Massachusetts Environmentally Preferable Products Procurement
- Minnesota Environmental Responsible Purchasing
- City of Santa Monica Sustainable City Program
- Seattle, WA Environmental Purchasing Program
- New York E.O. 134 - Green Cleaning for State Buildings, Healthy Schools
- New York City, E.O.1
- New Jersey E.O. 76 - Purchase & Use of Environmental Cleaning Products
- Connecticut E.O. 14 - Utilizing Cleaning Products that Minimize Impacts on Human Health & the Environment
- Illinois – August 2007 Green Cleaning Schools Act
- Florida – E.O. 07-126

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What Sustainable Green Housekeeping Means

- Health impact
- Environmentally preferable
- Renewable
- Recyclable
- Reduction
- Sustainable
- Bio-based
- Indoor air quality
- Energy savings
- Water usage reduction

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People, Planet, Profit

- **Products**
  - Bio-based and renewable cleaning technologies
  - Attributes and product selection criteria
- **Dispensing systems**
  - Usage reduction and selection criteria
  - Safety & cross-contamination
- **Training & certification**
  - Third-party certifications
  - Certified Green Housekeeping Professional
- **Developing and implementing the program**
  - The 7-step process
  - Controlling the 3 major pollutants
  - Core elements of a green program

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Problems with Traditional Housekeeping Products

- Petroleum distillates – crude oil feedstocks
- VOCs (Volatile Organic Compounds) – solvents
- Carcinogens
- Reactive – dangerous when mixed with other products ("yellow plus red means dead")
- Toxic – harmful to skin, eyes, and internal organs
- Corrosive – can burn skin and eyes
- Flammable
- Adverse environmental impacts

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Ethylene Glycol Ethers

- Also known as “Butyl”, 2-BE (2-butoxy ethanol)
- Can cause anemia, irritation, intoxication, adverse reproductive effects, birth defects in animals
- Banned in Europe and Canada

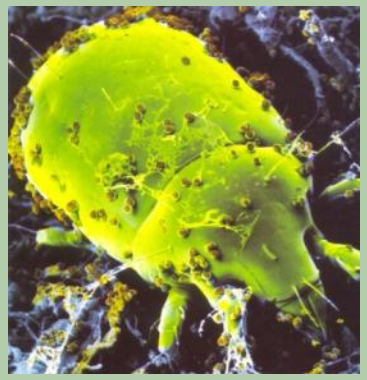
APE, NPE

(Alkyl Phenol & Nonyl Phenol Ethoxylate)

- Effective surfactants
- Inexpensive replacement for Butyl
- Suspected endocrine (hormone) disruptor
- Slow to biodegrade; have greater aquatic toxicity
- Restricted in Europe and soon to be banned in Canada

The 3 Major Pollutants

- Particulates
- Volatile Organic Compounds (VOCs)
- Biological – bio-contaminants



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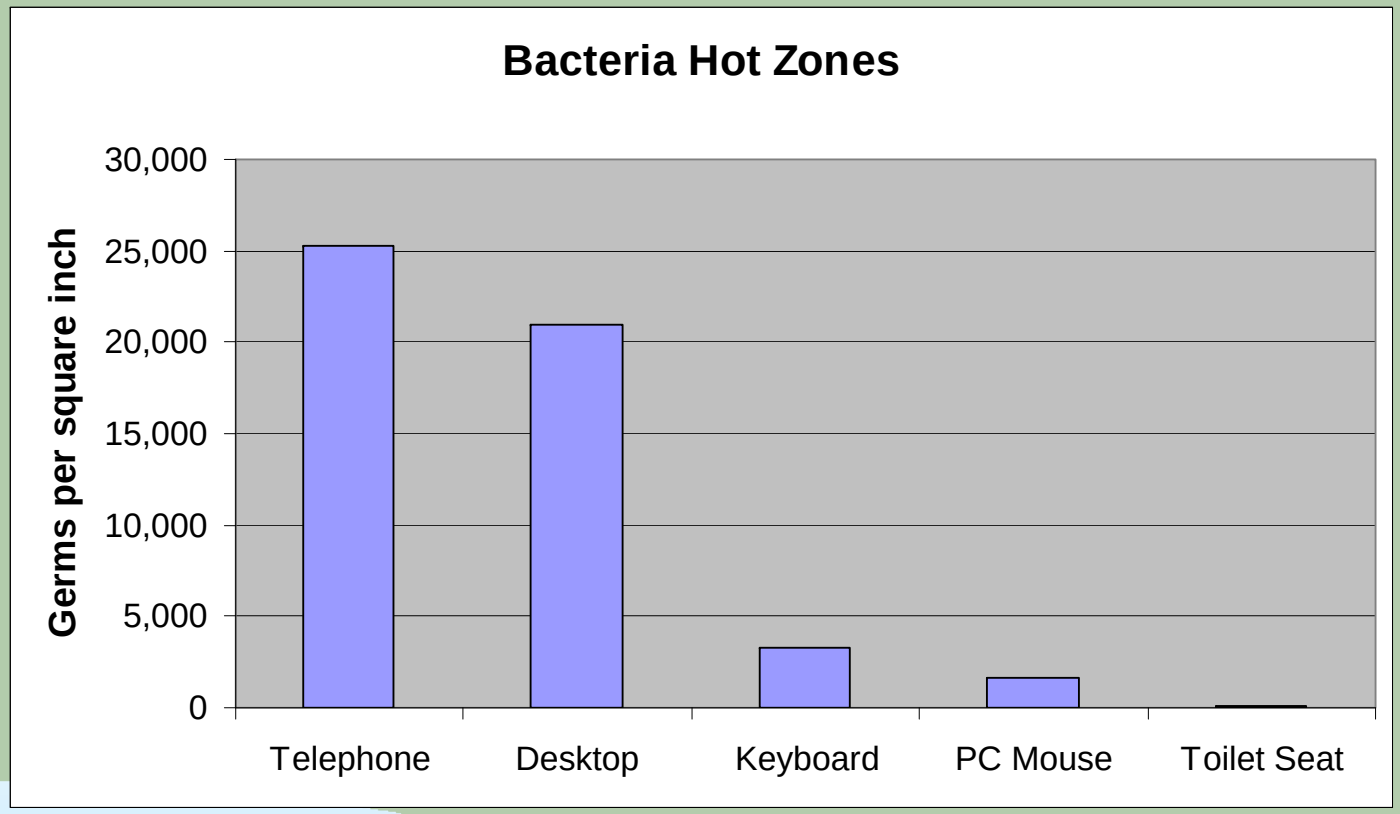
Contamination of Various Surfaces



Source – Dr. C, Gerba, University of Arizona

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How Biological Cleaners Work

- Spores (dormant bacteria)
- Bacteria (non pathogenic)
- Enzymes (protein catalyst/physical)
- Organic matter (fats, oils, and grease)
- Digests (metabolizes)
- Decomposes into H_20 and CO_2
- Replicates rapidly, continues to work after application
  1 = 1 Billion to 5 Billion (10-24 hours)

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Glass Cleaners

Conventional

- Alcohols
- Butyl cellosolve
- Ammonia
- Flash point <100°
- Human toxin
- Petrochemical
- Aquatic toxin

Enviro Care®

- None
- None
- None
- No flash point
- Non-toxic
- 99.7% bio-based
- Aquatic safe
- Equally effective

Pick up samples of our cleaners at our booth!

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Dispensing Systems Source Reduction

- Reduces packaging
- Reduces transport
- Reduces consumption
- Improves productivity

- No contact with concentrate
- Insures product performance
- Easier training
- Security

Side benefit - "30 percent or more savings"

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3rd Party Certification

- **Products**
  - EcoLogo
  - Green Seal
  - EPA DfE
- **People**

  Certified Green Housekeeper by Franken Ledrew Consulting
  - Contractors
  - Custodians
- **Facility**
  - USGBC – U.S. Green Building Council
  - L.E.E.D. certification (Leaders in Energy & Environmental Design)

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Sustainable Green Housekeeping 7-Step Process

1. Set building policy and goals
2. Management commitment
3. Baseline study
4. Identify opportunities and options
5. Rank options and prioritize
6. Implement and evaluate
7. Set new goals

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Core Elements of Effective Sustainable Green Housekeeping

1. Use bio-based & environmentally preferable cleaning products
2. Use proper air flow control
3. Maximize matting
4. Vacuum with HEPA micro-filter
5. Eliminate aerosols with high VOCs
6. Implement low-impact floor care program
7. Identify bio-contamination points
8. Maintain effective use of disinfectants
9. Maintain HVAC filter media
10. Implement moisture/odor control

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Results and Benefits Case Study

- Frank Porter Child Development Center University of North Carolina, Chapel Hill
  - Baseline – 5 months of routine housekeeping followed by 7 months Green Housekeeping
- Association for Children with Down Syndrome School in Bellmore, New York
  - Baseline – 12 months

Results and Benefits
Case Study

- 52% reduction in airborne dust
- 49% reduction in total VOCs
- 40% reduction in total bacteria
- 61% reduction in total fungi

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Results and Benefits Case Study

Illness*	Baseline Year	Intervention Year	% Change	Most Probable Contribution To Improvements
Total Illnesses -- Respiratory -- Gastrointestinal -- Otitis media -- Sinusitis	**0.70** 0.67 0.08 0.08 0.00	**0.53** 0.42 0.00 0.08 0.00	**-24%** -37% # 0 0	[illegible] proper use and dilution of cleaning products Cleaning procedures were modified -- Sequence of rooms to clean was modified -- Frequency for changing mop bucket water was increased -- Mops were disinfected routinely
Number of Visits to Doctor*	**0.50**	**0.33**	**-34%**	[illegible] hand washing procedures
Courses of Antibiotics*	**0.33**	**0.25**	**-24%**	[illegible] staff and parents about infection control -- Procedural posters strategically placed in classrooms -- Special attention paid to toys
Days Absent from School*	**0.75**	**0.40**	**-46%**	-- [illegible] houses were cleaned
* Per Child/Month # Incident rate declined to zero!				

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Summary

- The world is changing - our responsibility is to the future.
- How we clean makes a big difference
- Sustainability is more than green products, it's being green to the core

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Discussion

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