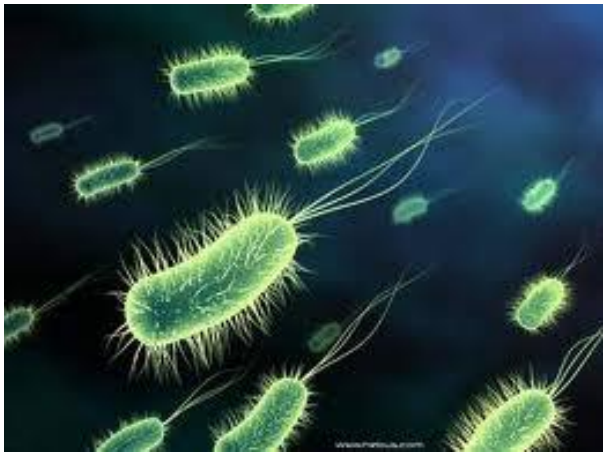
Safer Sanitizers and Disinfectants: A Look at San Francisco's Latest Alternatives Analysis



BizNGO Webinar, May 7, 2014

Chris Geiger, Ph.D.
Toxics Reduction Program
San Francisco Department of the Environment

SF Environment
Our home. Our city. Our planet.
A Department of the City and County of San Francisco

Topics

- The problem
- Definitions
- Methodology
- Recommendations
- Regulatory challenges

Problems with disinfectants

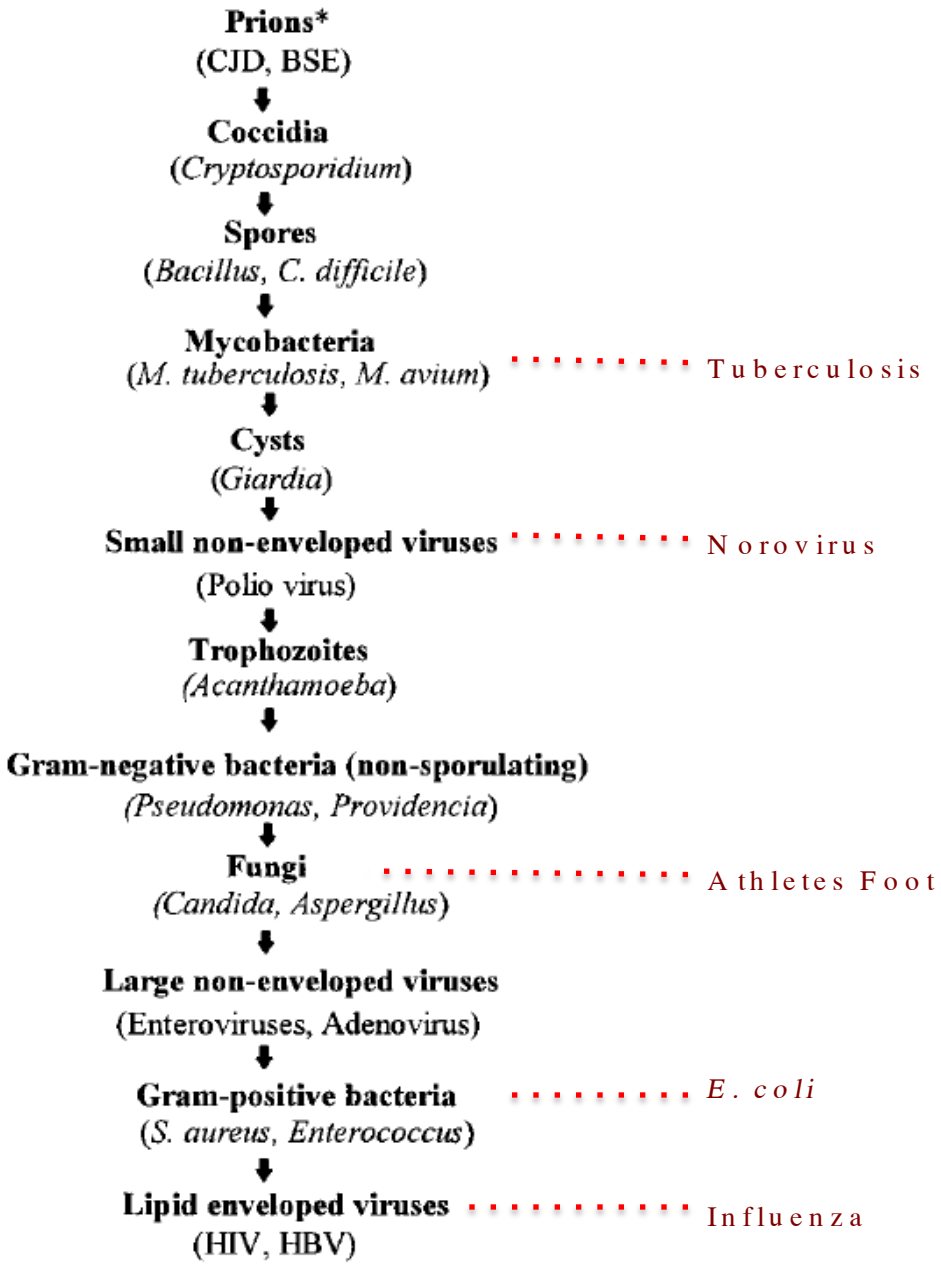
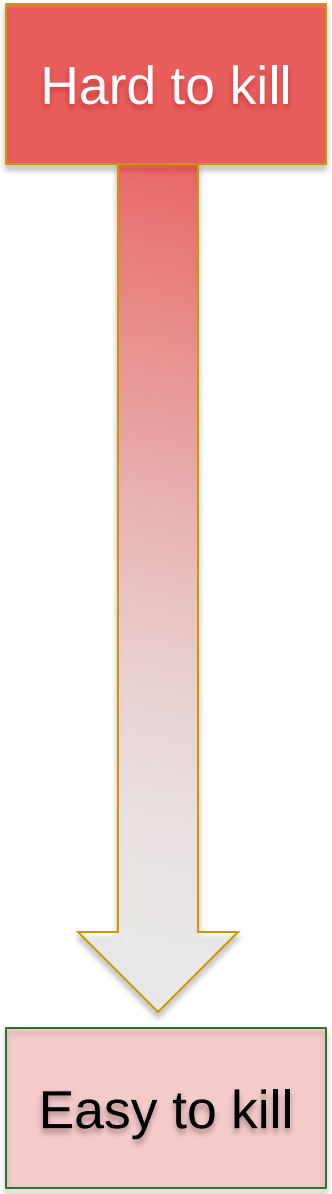
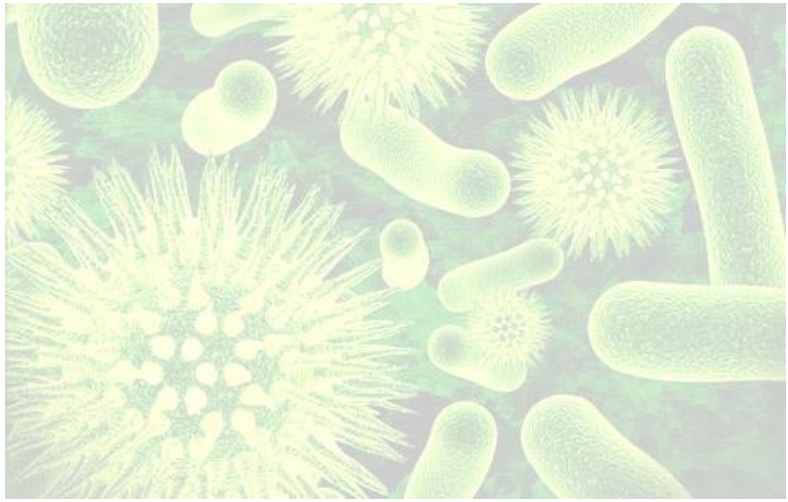


FIG. 1. Descending order of resistance to antiseptics and disinfectants. The asterisk indicates that the conclusions are not yet universally agreed upon.



Source: McDonnell & Russell, 1999

Definitions



- Non food contact sanitizers
  - *Staph*
    AND
    Klebsiella pneumoniae OR *Enterobacter aerogenes*
    99.9% in 5 minutes

Definitions

- Disinfectants
  - High-Grade, or Hospital-Grade
    - *Staph, Salmonella*, and *Pseudomonas*
      99.9999% in 10 minutes
  - General
    - *Staph* AND *Salmonella*
      99.999% kill in 10 minutes
  - Limited
    - *Salmonella* OR *Staph*
      99.999% kill in 10 minutes.

Attributes assessed in this AA

- ✓ Hazard*
- ✓ Fate
- Physical-chemical properties
- ✓ Functional use
- ✓ Product performance*
- Technical feasibility
- ✓ Exposure potential*
- ✓ Cost and availability*
- Life-cycle impacts
- Social impacts
- Stakeholder input
- ✓ Comparison of materials and/or processes.

(OECD, 2013. Current landscape of alternatives assessment practice: A meta-review. Series on Risk Management #26. www.oecd.org/chemicalsafety/)

Assessment factors: Active ingredients

- Cancer
- Reproductive toxicity
- Respiratory sensitization
- Skin sensitization
- Aquatic toxicity
- Persistence

Assessment factors: Products

All of the above, and…

- Dwell time
- Efficacy for various microorganisms
- Acute toxicity
  - Skin
  - Eye
  - Respiratory
- Eutrophication potential
- Surface compatibilities
- Availability as a concentrate (carbon impacts)
- Potential for exposure reduction (dispensing systems)

Active ingredients considered

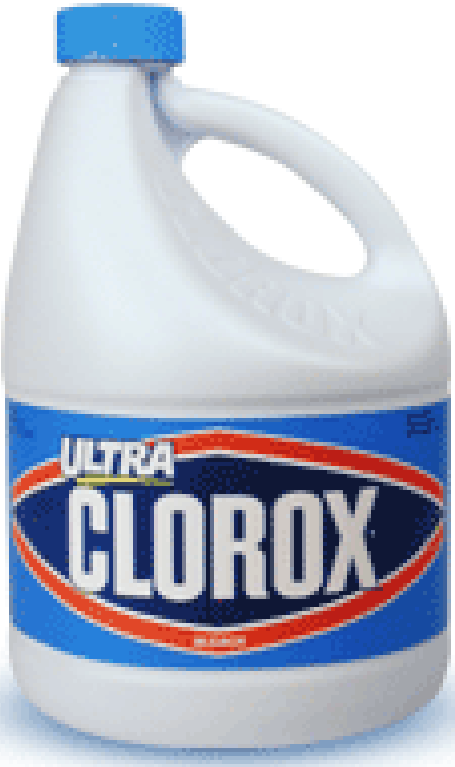
- Chlorine “bleach” (sodium hypochlorite)
- Hydrogen peroxide (regular and AHP)
- Organic acids (citric/lactic/caprylic)
- Ortho-phenylphenol
- Pine oil
- “Quats”
- Silver + citric acid
- Thymol

Other alternatives

- Electrolyzed water
- Microfiber cloth
- Soap and water
- Steam

Sodium hypochlorite (bleach)

PROS	CONS
CHEAP, widely available	pH 11.5 = severe eye damage
Kills wide variety of microbes, versatile; some products kill Tb and/or NoroVirus	Respiratory irritant; Cl_2 and HCl are Asthmagens (AOEC)
Leaves no residue	Reacts with organic molecules – environmental hazards
	Corrodes metals and floor polish
	Not stable – loses potency
	Reacts with other chemicals to form toxic gas



$1.79 (60 oz)

$2.00 (10.1 oz)

Quaternary ammonium compounds

PROS	CONS
Widely available, inexpensive	Found in sewage outfalls
More stable than bleach	High aquatic toxicity, “persistent*
Broader efficacy claims than most other products	Asthmagens; concentrates corrosive
Not as sensitive to organics as bleach	Forms toxic chloramine gas when mixed with bleach
Surfactant – cleans also	Dev & repro toxicity observed (but not weight of evidence)
Available in neutral pH formulations	Requires rinsing – leaves residues

Thymol

PROS	CONS
Low environmental hazard	Strong smell
Rapidly breaks down	Skin sensitizer
Long shelf life	Possible repro effects ('weak' studies)
Not an asthmagen	

Peroxide compounds

PROS	CONS
Low human toxicity	Eye hazard from concentrates - corrosive
Low environmental hazard	Irritating vapors from concentrates
Rapidly decomposes to $O_2 + H_2O$	Animal carcinogen & mutagen?
No residues	
Effective on full range of microbes	
Shorter dwell time than quats, pine oil	
Whitens grout; removes stains	

Active ingredient review

ACTIVE INGREDIENT	CANCER	REPRO TOX	ASTHMA	SKIN SENS	AQUATIC TOX	PERSIST
Caprylic Acid	No	No	No	No	Med acute	Low
Citric Acid	No	No	No	No	None	Low
Hydrogen Peroxide	No[1]	No	No	No	High acute	Low
Lactic Acid	No	No	No	No	None	Low
Ortho-Phenylphenoll	Known	Suspected	No	No	Very high acute	Low
Peroxyacetic Acid	No	No	Yes	No	Very high acute	Low
Pine Oil	No[2]	No	No[3]	Yes	None	Low
Quats	No	Suspected	Yes	One compound[4]	High acute, med chronic	Very High
Silver	No	No	No	No	High acute	Very High
Chlorine Bleach	No	No	Yes	No	Very high acute	Low
Thymol	No	No[5]	No	Yes	High acute	Low

Recommendations-ingredients

- Hydrogen peroxide
- Citric acid
- Lactic acid
- Caprylic acid
- (Silver/citric acid)

Sample product review

Active Ing.	Dwell	Efficacy	(Bact, Virus, Fungi)		Health	Env
H2O2 ----------	1	BB	VVV	FF	L	L
CAPRYLIC ACID ---	10	BBB	VVV	F	L	L
CITRIC ACID -------	10	BB	V	0	L	L
SILVER/CITRIC --	1	BBB	VVV	F	L	H
LACTIC ACID ------	10	BB	V	0	L	L
THYMOL ----------	10	BB	V V	F	H	L
QUATS ----------	10	BBB	VVV	FFF	H	M
CHLORINE ---------	1-10	BBB	VVV	FFF	H	L
PINE OIL ----------	10	BB	0	F	M	H
H2O2 + PAA [ ] ---	10	BBB	V	FF	H	L
OPP ----------	10	BBB	VVV	F	H	H

Recommendations-disinfectants

(for complete list, see report)

Hydrogen Peroxide

- **Accel** (Concentrate: 1:128, 3-minute dwell time)
- **Alpha HP** (Concentrate, 1:128 dilution, 3-minute dwell time)
- **Alpha-HP Multi-Surface Disinfectant Cleaner** (Concentrate, 1:128 dilution, 3-minute dwell time)
- **Carpe Diem Concentrate Five 16** (Concentrate: 1:128, 3-minute dwell time)
- **Envirox Concentrate 118/H2Orange2 117*** (Concentrate, 5-minute dwell time)
- **Envirox H2Orange2 Superconcentrate 112** (Concentrate: 5:23 dilution, 5-minute dwell time)
- **G-Force H2O2 Bathroom Cleaner Disinfectant** (Concentrate, 1:128 dilution, 3-minute dwell time)
- **Oxivir Five 16** (Concentrate, 1:128 dilution, 3-minute dwell time)
- **Ramsey Bathroom Cleaner Disinfectant** (Concentrate, 1:128 dilution, 3-minute dwell time).

Recommendations-disinfectants

(for complete list, see report)

Citric Acid

- **Comet Disinfecting Bathroom Cleaner** (Concentrate, 1:4 dilution, 5-minute dwell time)

Caprylic/Octanoic Acid

- **Ecolab 65 Disinfecting Heavy-Duty Acid Bathroom Cleaner** (Concentrate, 1:40 dilution, 5-minute dwell time)

Recommendations-specialized

- Bloodborne pathogens HIV + HBV

  - RTU
    - 30 sec: Clorox Healthcare Peroxide Cleaner (1.4% H_2O_2)
    - 1 min: Oxivir Tb (0.5% AHP)
    - 1 min: Pure Hard Surface (Silver + Citric Acid)

  - Concentrate
    - 5 min: Oxivir Five 16 (4.25% AHP; 1:16)

Recommendations-specialized

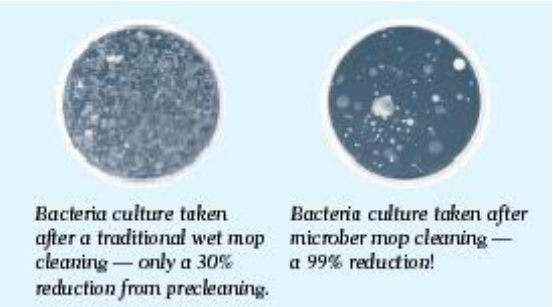
- Locker Rooms (Athletes Foot Fungus)
  - RTU
    - 5 min: H2Orange 120 One (1% H202)
    - 3 min: Clorox Healthcare Peroxide Cleaner (1.4% H_2O_2)
    - 10 min: Oxivir Tb (0.5% AHP)
    - 10 min: Clean-Cide (0.6% Citric acid)
    - 10 min: Quantum Tb (0.138% Caprylic acid)
    - 5 min: Limited: Pure Hard Surface (Silver + CitAcid)
  - Concentrate
    - 5 min: Oxivir Five 16 (4.25% AHP; 1:16) 5 min.

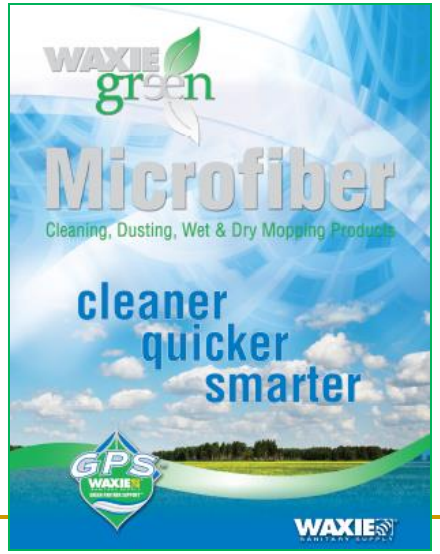
Recommendations-specialized

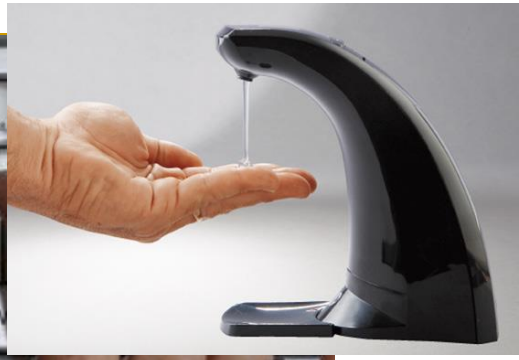
- Norovirus
  - RTU
    - 1 min: Oxivir Tb (0.5% AHP)
    - 1 min: Clorox Healthcare Peroxide Cleaner (1.4% H_2O_2)
    - 5 min: Clean-Cide (0.6% Citric acid)
    - 1 min: Pure Hard Surface (Silver + Citric Acid) 24-hr residual efficacy
  - Concentrate
    - 5 min: Oxivir Five 16 (4.25% AHP @1:16)

Electrolyzed water devices

Microfiber
(an important part of an effective disinfection program)





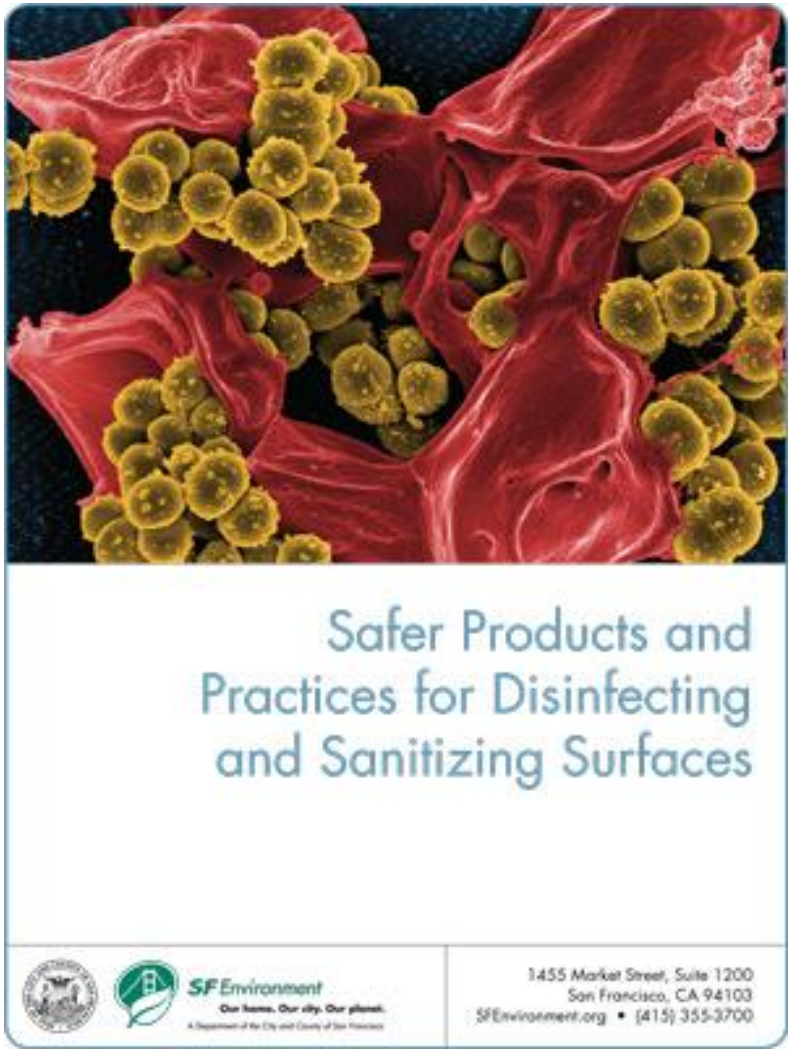



JohnsonDiversey
FIVE 16 CONCENTRATE
CAUTION


Twist 'n Fill Application Chart
Cuadro de Aplicación Twist 'n Fill
Administrative Services
Custodial Department
Do you Have the
Right Gear
For the Job?

Regulatory challenges

- Meaningful registration of devices
- Full ingredient disclosure
- Verifying manufacturers' claims
- Confusion over market claims vs. label claims



http://www.sfapproved.org/

Acknowledgements

- Susan Kegley – Pesticide Research Institute
- Kelly Moran – TDI Consulting
- Ann Blake – Ann Blake Consulting
- Justine Weinberg – Calif Dept. of Public Health
- Luz Agana – SF Dept. of Public Health
- Karen Cohn – SF Dept. of Public Health
- Bridget Williams - USEPA DfE
- Cal Baier-Anderson - USEPA DfE