The Role of Nanotechnology in Disinfection (Total)

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Agenda

- What is the problem?
- What is an ideal disinfectant?
- What is nanotechnology?
- Why nanotechnology in disinfection?
- What surfaces can it be used on?
- Evidence

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The Problem: Microbial Persistence

- Bacteria persist: few hours to 4+ years!
- Fungi persist: 1 day to 150+ days
- Viruses persist: few hours to 20+ weeks

Most **viruses from the respiratory tract, such as *corona***, *coxsackie*, *influenza*, *SARS* or *rhino* virus, can persist on surfaces for **a few days**.

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Persistence - Bacteria

Table 1: Persistence of clinically relevant bacteria on dry inanimate surfaces.

Type of bacterium	Duration of persistence (range)
Acinetobacter spp.	3 days to 5 months
Bordetella pertussis	3 – 5 days
Campylobacter jejuni	up to 6 days
Clostridium difficile (spores)	5 months
Chlamydia pneumoniae, C. trachomatis	≤ 30 hours
Chlamydia psittaci	15 days
Corynebacterium diphtheriae	7 days – 6 months
Corynebacterium pseudotuberculosis	1–8 days
Escherichia coli	1.5 hours – 16 months
Enterococcus spp. including VRE and VSE	5 days – 4 months
Haemophilus influenzae	12 days
Helicobacter pylori	≤ 90 minutes
Klebsiella spp.	2 hours to > 30 months
Listeria spp.	1 day – months
Mycobacterium bovis	> 2 months
Mycobacterium tuberculosis	1 day – 4 months
Neisseria gonorrhoeae	1 – 3 days
Proteus vulgaris	1 – 2 days
Pseudomonas aeruginosa	6 hours – 16 months; on dry floor: 5 weeks
Salmonella typhi	6 hours – 4 weeks
Salmonella typhimurium	10 days – 4.2 years
Salmonella spp.	1 day
Serratia marcescens	3 days – 2 months; on dry floor: 5 weeks
Shigella spp.	2 days – 5 months
Staphylococcus aureus, including MRSA	7 days – 7 months
Streptococcus pneumoniae	1 – 20 days
Streptococcus pyogenes	3 days – 6.5 months
Vibrio cholerae	1 – 7 days

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Persistence - Fungi

Table 2: Persistence of clinically relevant fungi on dry inanimate surfaces.

Type of fungus	Duration of persistence (range)	Reference(s)
Candida albicans	1 – 120 days	[31, 53, 99, 110]
Candida parapsilosis	14 days	[110]
Torulopsis glabrata	102 – 150 days	[31]

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Persistence - Viruses

Table 3: Persistence of clinically relevant viruses on dry inanimate surfaces.

Type of virus	Duration of persistence (range)
Adenovirus	7 days – 3 months
Astrovirus	7 – 90 days
Coronavirus	3 hours
SARS associated virus	72 – 96 hours
Coxsackie virus	> 2 weeks
Cytomegalovirus	8 hours
Echovirus	7 days
HAV	2 hours – 60 days
HBV	> 1 week
HIV	> 7 days
Herpes simplex virus, type 1 and 2	4.5 hours – 8 weeks
Influenza virus	1 – 2 days
Norovirus and feline calici virus (FCV)	8 hours – 7 days
Papillomavirus 16	> 7 days
Papovavirus	8 days
Parvovirus	> 1 year
Poliovirus type 1	4 hours – < 8 days
Poliovirus type 2	1 day – 8 weeks
Pseudorabies virus	≥ 7 days
Respiratory syncytial virus	up to 6 hours
Rhinovirus	2 hours – 7 days
Rotavirus	6 – 60 days
Vacciniavirus	3 weeks – > 20 weeks

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In General: Leaching vs. Non-Leaching

- **Leaching** = the ability of the anti-microbial to **affect the area around where it is applied**. Think of a raindrop creating ripples in a pail of water. Generally, unbound anti-microbials leach in order to be effective.

- **Non-Leaching** = affects only the area where it is applied. Binds to the surface and **does not dissipate**.

Think "rifle" versus "sword"

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There are a number of classes of compounds which can be used as sanitizers and disinfectants.

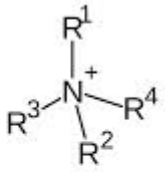
Leaching Chemistries:

The **efficacy** of these compounds **varies** depending upon the **environment** and **conditions** it is used in.

Different classes of disinfectants typically used:

Leaching:

- Halogens
  - Chlorine
  - Iodine
- Quaternary Ammonium Salts
- Phenols
- Alkylating Agents
  - formaldehyde
  - gluteraldehyde
- Oxidizing agents
  - ozone
  - hydrogen peroxide
  - Hypochlorites
- Creosols
- Dyes
  - gentian violet - blocks cell wall synthesis
- Heavy metals
  - silver - silver nitrate
  - copper - copper sulfate
- Alcohol



QUATS

Non-Leaching

- Silane QACs

- Certain nanometals and nanofibres

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Typical Disinfectant Technologies

Amphyl
Anti-microbial copper-alloy
Barbicide
Barium borate
BCDMH
Behentrimonium chloride
Benzalkonium chloride
Benzethonium chloride
Benzododecinium bromide
Bleach
Bromine monochloride
Calcium oxide
Calcium peroxide
Carbethopendecinium bromide
Carbol fuchsin
Carbolic soap
Chlorhexidine
Chlorine dioxide
2-Chlorophenol
Copper and its salts
Cresolene
Crystal violet
DBDMH
Diazolidinyl urea
Electrolysed water
Ethanol
Eucalyptus oil
Fuchsine
Glutaraldehyde
Hydrogen peroxide
Hypochlorous acid
Hypomide
Imidazolidinyl urea
Iodophor
Isopropyl alcohol
Lapyrium
Lithium hypochlorite
Lugol's iodine
Methyl violet
Milton sterilizing fluid
Nitromersol
Ozone
Peracetic acid
Phenols
Pine oil
Polyaminopropyl biguanide
Potassium permanganate
Povidone-iodine
Quaternary ammonium cation
Rideal-Walker coefficient
Silver salts
Sodium dichloroisocyanurate
Sodium hypochlorite
Sodium metabisulfite
Sodium permanganate
Tincture of iodine
Titanium dioxide
2,4,6-Trichlorophenol
UV lights
Vaporized hydrogen peroxide
Virkon

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Properties of disinfectants which need to be considered are:

- Efficacy
- Durability
- Toxicity and phytotoxicity
- Non-corrosive and non-staining
- How application is made
  - foam, soak, spray, aerosol, wipe…
- Mutagenicity

The selection of disinfectant should be done with care and matched for the job expected.

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The effectiveness of the disinfectant/sanitizer is dependent upon a number of factors:

- **Absence** of organic matter from the area to be sanitized or **not be affected** by organic matter
- The **Concentration** of the active ingredient available (ppm)
- The **type of surface** being treated (surface porosity)
- The **diluent** (hard water?) properties
- The **length of time** the disinfectant/sanitizer is in contact with the surface to be sanitized
- The **temperature** of the disinfectant solution and surface to be cleaned **pH**, whether high or low, can increase or decrease potency. The optimal pH increases the degree of ionization of the chemical agent which will affect its ability to penetrate the cell
- **Compatibility** between the cleaners and the disinfectants which are use

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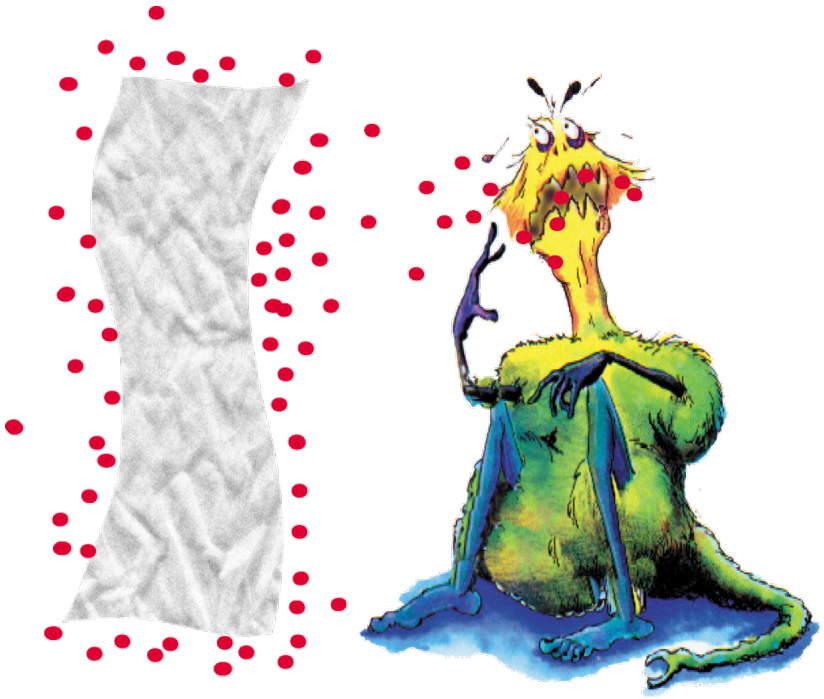
The effectiveness of the disinfectant/sanitizer is dependent upon a number of factors:

	Nanopolymers	Traditional QUATS	Hypochlorites	Peroxides
Organic Matter Present	**Unaffected**	Strongly affected	Mildly affected	Mildly affected
Concentration	**independent**	Strongly affected	Strongly affected	Strongly affected
Surface Type	**Wide range**	Wide range	Corrosive & bleaching	Corrosive & bleaching
Water Hardness	**Very mild effect**	affected	Mild effect	Mild effect
Temperature	**independent**	Strongly affected	Strongly affected	Strongly affected
pH	**independent**	Strongly affected	affected	affected
Compatibility	**broad**	medium	broad	broad

Leaching Anti-Microbials

Common anti-microbials on the market leach off the surface to form a *Zone of Inhibition.*

This *Zone of Inhibition* affects the cells but may not kill the cells.



These affected microbes **adapt** to the anti-microbial treatment and form ***super bugs***.

These super bugs are no longer killed by the anti-microbial and continue to multiply, and present a new generation of challenges

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Pros & Cons of Leaching

Pros:

Kills large area of microbes

Cons:

Can create mutations or resistant super bugs

Only works at the moment applied

No staying power

Ideal Disinfectant

- **Long-lasting**
- **Non-mutagenic**
- Ultra-low toxicity
- Broad-spectrum
- Eco-responsible
- Water-based
- Cost-effective

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Pros & Cons of Non-Leaching

Pros:

Has staying power. Works until removed from surface

Doesn't create mutations or resistant super bugs

Cons:

Only affects where applied

To Kill Microorganisms, Traditional (*Leaching*) Disinfectants Require:

- Concentration
- Time
- Temperature
  - generally higher
  - Ionic activity increases with temperature
- pH - degree of ionization
- Diluent (water) properties – Ca^{2+} or Mg^{2+} (hardness)
- Compatibility of cleaner and disinfectant

(Non-*Leaching*) Disinfectants remove these concerns

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What is Nanotechnology as Applied to Disinfection?

A mono-molecular, nano-scale, durable polymerized coating that provides long-lasting anti-microbial protection without affecting the look, feel and properties of the substrate

Think of it as an "*invisible paint*"

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Not ALL Nanotechnologies are Equal !!!

- Nanometals
- Nanocarbons
- Nanofibres
- **Nanopolymers**

Differs in:

- ***Safety & toxicity***
- ***Durability***
- ***Eco-impact***
- ***Cost***
- ***Effect on Surfaces***

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Not ALL Nanotechnologies are Equal !!!

	Nanopolymers	Nanometals	Nanofibres	Nanocarbons
Safety & toxicity	Excellent	Poor - medium	Poor	Varied
Durability	Excellent	variable	good	good
Eco-impact	Excellent	Not understood	poor	Not understood
Cost-Effective	low	high	medium	Medium -high
Effect on Surfaces	innocuous	Colour changes	Change in physical properties	Change in physical properties
Availability	Global	Regional	Global	Regional

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S.P.A.D.A. Technology Videos

- SPADA animation
- What is SPADA nanotechnology

- https://www.youtube.com/watch?v=Ua_LLGQkZGM&list=PLRpYwEJf1AGsr1SzQU6DE6030CzeMtrbM

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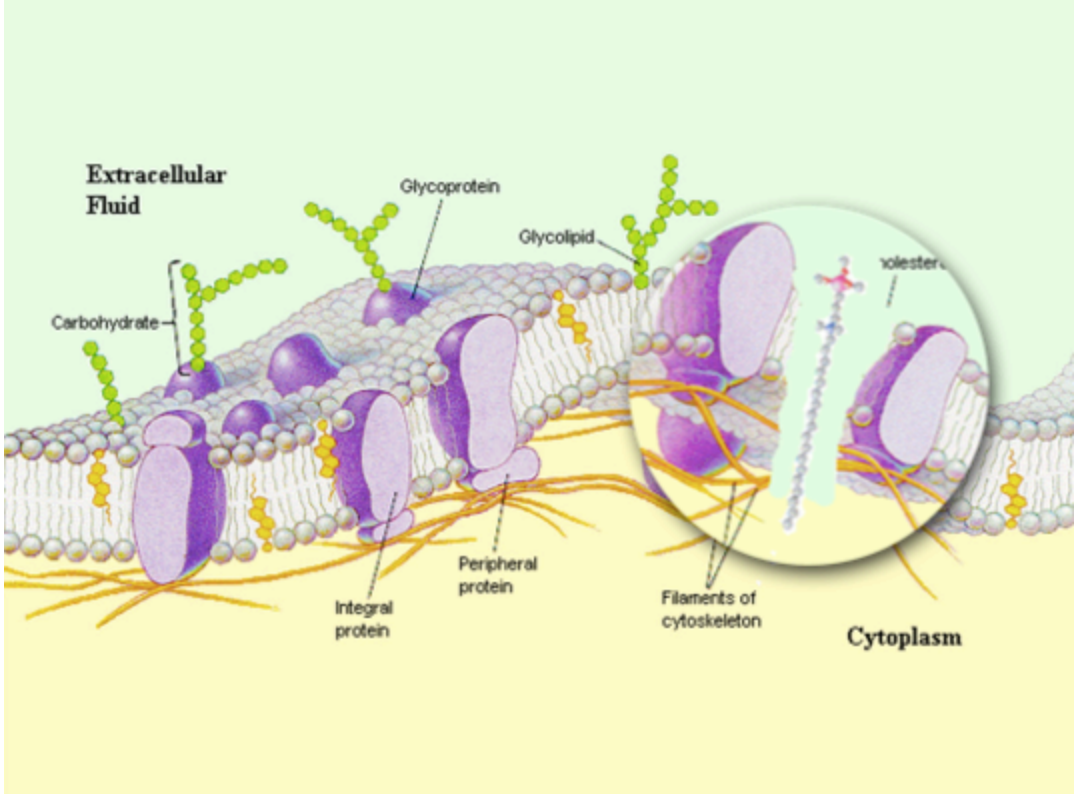
The SiQAC Non-Leaching Anti-Microbial Molecule



Negatively charged microbes are electromagnetically attracted to SiQAC's positively charged molecule; stabbing, electrocuting & killing the microbe.

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Technology Comparison

TECHNOLOGY	SiQUATS	BZK, NATURAL ACIDS, DFE	SILVER SALTS, NANO - SILVER	MICRO - COPPER	HEAVY METALS	TRICLOSAN	PHENOLS	ALCOHOL	BLEACH	OXIDIZING AGENTS
toxicity rating	very mild	mild	mild	mild	high	growning concerns	high	medium	medium	varies
odour reduction	yes	no	yes	yes	yes	yes	yes	no	yes*	yes
durability	essentially permanent	no	up to 24 hours	durable	varies	no	no	no	no	no
green	yes	yes	yes	yes	no	no	no	no	no	no
prevents super bugs	yes	no	no	no	no	no	no	no	no	no
prevent cross contamination	yes	no	unlike	unlike	unlike	unlike	unlike	unlike	unlike	no
water based	yes	yes	yes	no	no	no	no	yes	yes	varies

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Silane QAC's Durability

- **Surface bonding:**
  - Covalent bonding
  - Ionic bonding
  - Surface entanglement
  - Mono-molecular film thickness
  - Continues to act because it is not consumed

- **Removal:**
  - Abrasion
  - Will not re-dissolve in water, alcohol, solvents

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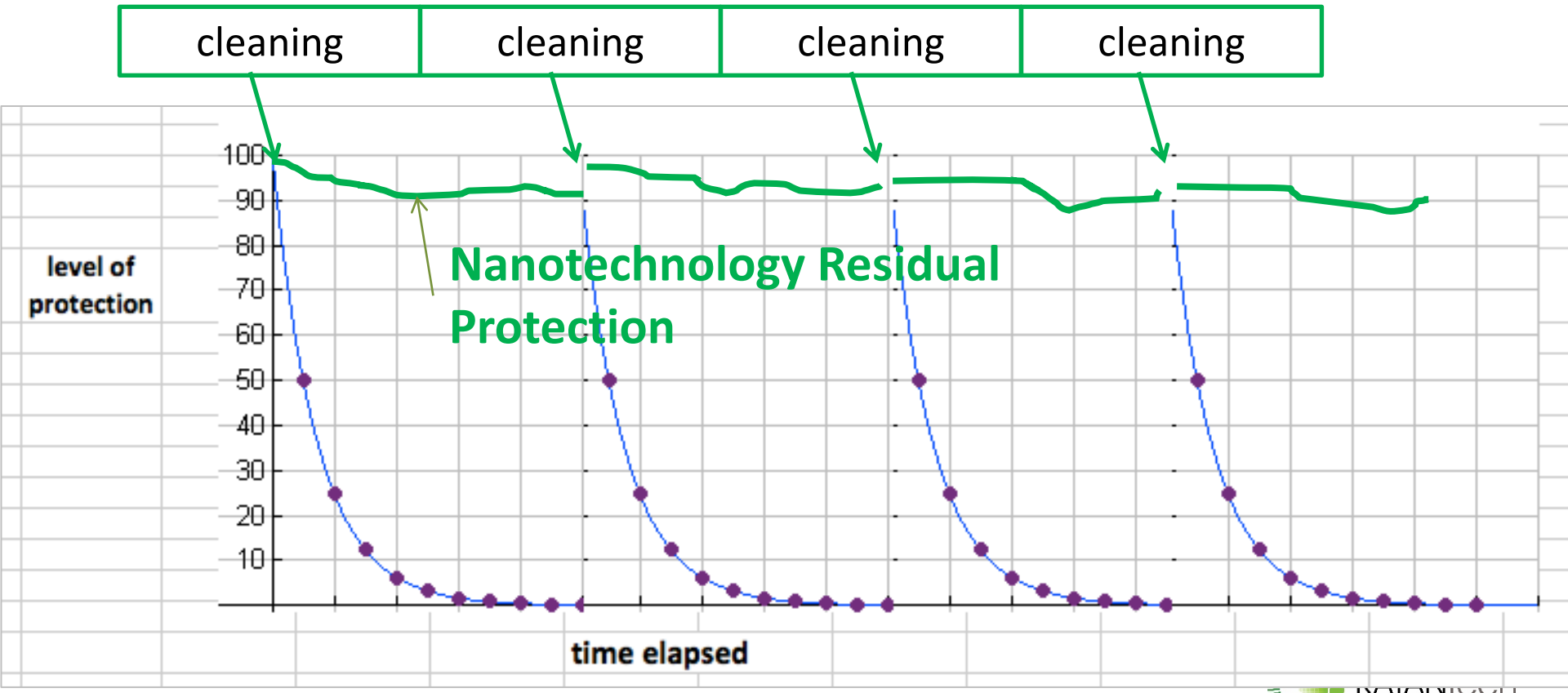
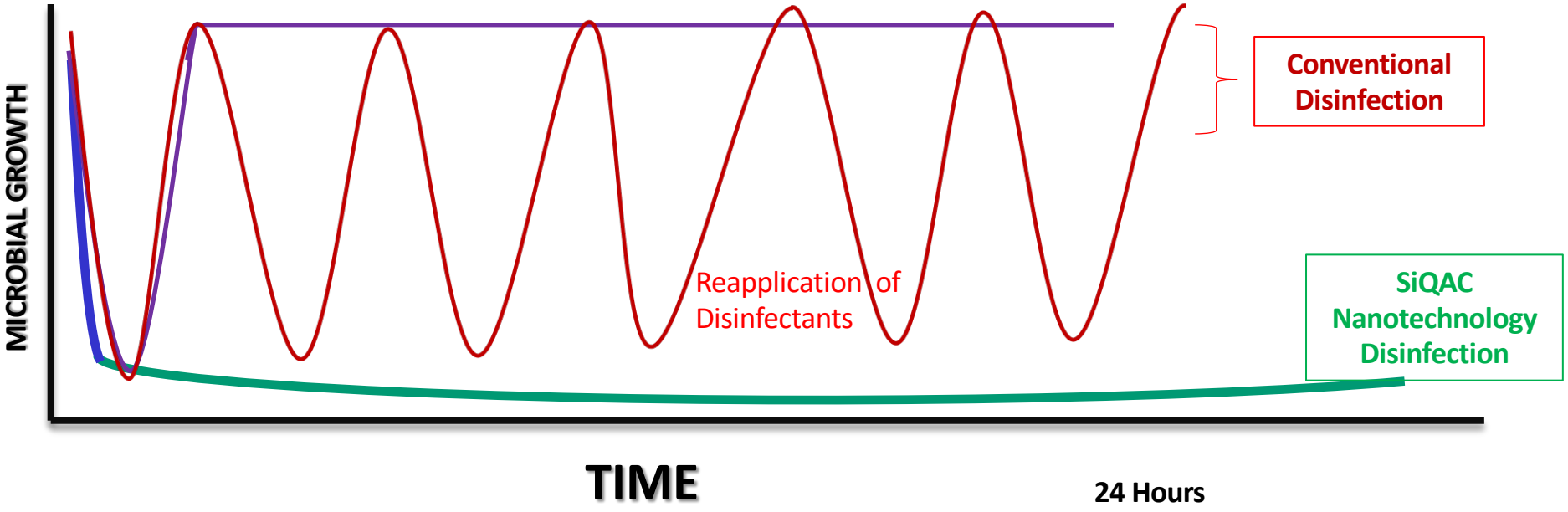
What Keeps You Safer Between Cleanings?



Nanotechnology Durable Disinfection Benefits



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Silane QAC's PPM's

- Monomolecular film formation, attached to surface, means that the finished film is NOT affected by concentrations in solution
- This essentially makes SiQAC ppm independent
- This technology does NOT benefit from "more is better"

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Silane QAC's

- This nanotechnology makes surfaces

  "bio-active"

  to make them inhospitable to microbes of all types

- This minimizes the persistence of microbes on surfaces – the PROBLEM we are trying to solve

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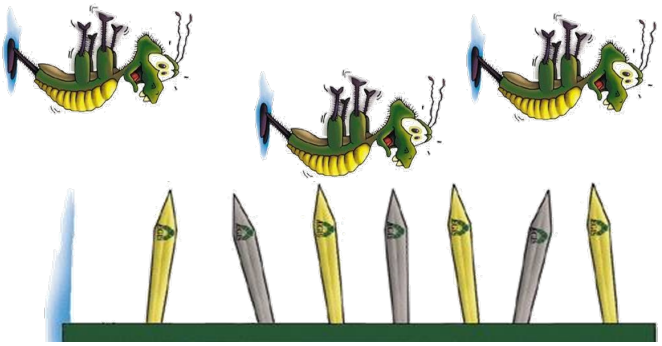
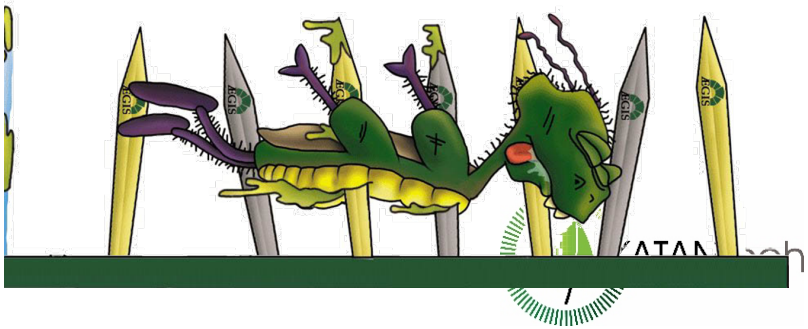
Silane QAC's Non-Mutagenicity

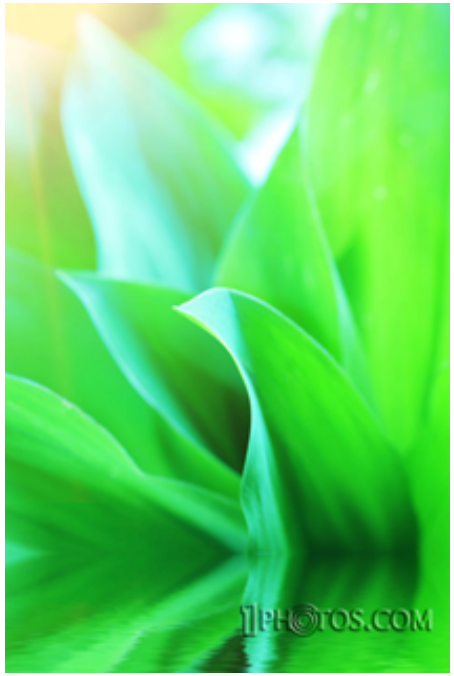
- Surface bonding:
  - Action is through physical intrusion of cell wall or cleavage of lipid layer
  - Immunity is not generated because there is no selection for chemical susceptibility





Non-leaching Silane QAC's

- **Features**
  - Long-lasting effects
  - Non-mutagenic
  - Broad spectrum
  - Eco-responsible
  - Ultra-low toxicity
  - Fast-acting
  - Effective in presence of organic matter
  - Decomposes to non-hazardous compounds
  - Solution or vapor phase effective



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Silane QAC Example: Broad-Spectrum

Microbes Controlled:

Bacteria Controlled

- *Acinetobacter calcoaceticus*
- *Aeromonas hydrophilia*
- *Bacillus cereus*
- *Bacillus subtilis*
- *Bacillus typhimurium*
- *Brucella abortus*
- *Brucella canis*
- *Brucella suis*
- *Burkholderia cepacia*
- *Citrobacter diversus*
- *Citrobacter freundii*
- *Clostridium difficile (non-spore form)*
- *Clostridium perfringens*
- *Corynebacterium bovis*
- *Corynebacterium diptheriae*
- *Enterobacter aerogenes*
- *Enterobacter agglomerans (I, II)*
- *Enterobacter cloacae*
- *Enterococcus*
- *Enterococcus faecalis*
- *Escherichia coli*
- *Haemophilus influenzae*
- *Haemophilus suis*
- *Klebs-Löffler bacillus*
- *Klebsiella oxytoca*
- *Klebsiella pneumoniae*
- *Klebsiella terrigena*
- *Lactobacillus acidopholus*
- *Lactobacillus casei*
- *Legionella pneumophila*
- *Leuconostoc lactis*
- *Listeria monocytogenes*
- *Micrococcus species*
- *Micrococcus lutea*
- *Morganella morganii*
- *MRSA, CA-MRSA*
- *Mycobacterium smegmatis*
- *Mycobacterium tuberculosis*
- *Propionibacterium acnes*
- *Proteus mirabilis*
- *Proteus vulgaris*
- *Pseudomonas aeruginosa*
- *Pseudomonas cepacia*
- *Pseudomonas fluorescens*
- *Salmonella choleraesuis*
- *Salmonella enterica*
- *Salmonella typhi*
- *Salmonella typhimurium*
- *Serratia liquefaciens*
- *Serratia marcescens*
- *Stachybotrys chartarum*
- *Staphylococcus aureus*
- *Staphylococcus epidermidis*
- *Streptococcus faecalis*
- *Streptococcus mutans*
- *Streptococcus pneumonia*
- *Streptococcus pyrogenes*
- *Vancomycin-resistant enterococci*
- *Xanthomonas campestris*

Fungi Controlled

- *Alternaria alternata*
- *Aspergillus flavus*
- *Aspergillus fumigatus*
- *Aspergillus niger*
- *Aspergillus terreus*
- *Aspergillus versicolor*
- *Aureobasidium pullulans*
- *Bipolaris australiensis*
- *Candida albicans*
- *Candida parapsilosis*
- *Cephaldascus fragans*
- *Chaetomium globosum*
- *Cladosporium herbarum*
- *Clonostachys rosea*
- *Cryptococcus humicola*
- *Cryptococcus laurentii*
- *Dreschslera australiensis*
- *Epidermophyton floccosum*
- *Fusarium nigrum*
- *Fusarium solani*
- *Geotrichum candidum*
- *Gliocladium roseum*
- *Gliomastix cerealis*
- *Iternaris species*
- *Mariannaea elegans*
- *Microsporum audouinii*
- *Monilia grisea*
- *Mucor sp.*
- *Oospora lactis*
- *Penicillium albicans*
- *Penicillium chrysogenum*
- *Penicillium citrinum*
- *Penicilliumn notatum*
- *Penicillium elegans*
- *Penicillium funiculosum*
- *Penicillium humicola*
- *Penicillium notatum*
- *Penicillium variabile*
- *Pullularia pullulans*
- *Rhizopus nigricans*
- *Ricoderm species*
- *Stachybotrys atra*
- *Saccharomyces cerevisiae*
- *Trichoderma flavus*
- *Trichosporon mucoides*
- *Trichophyton interdigitale*
- *Trichophyton mentagrophytes*
- *Trichophyton mentagrophytes*

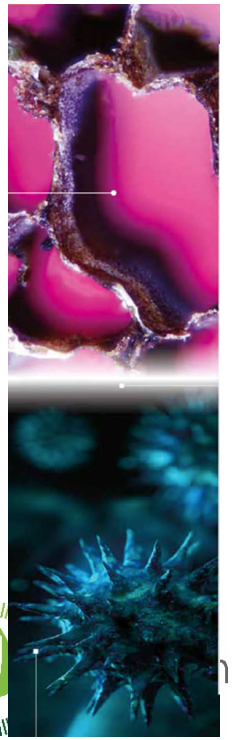
Algae Controlled

- *Anabaena cylindrica*
- *Chlorella vulgaris*
- *Chlorophyta (green)*
- *Chrysophyta (brown)*
- *Cyanophyta (blue-green)*
- *Gonium species*
- *Oscillatoria borneti*
- *Pleurococcus*
- *Protococcus*
- *Scenedesmus quadricauda*
- *Selenastrum gracile*
- *Volvox species*

Viruses Controlled

- *Adenovirus Type II*
- *Adenovirus Type IV*
- *Bovine Adenovirus Type I*
- *Bovine Adenovirus Type IV*
- *Feline pneumonitis*
- *H1N1*
- *H3N2*
- *Herpes Simplex Type I*
- *Herpes Simplex Type II*
- *HIV B*
- *HIV-1 (AIDS)*
- *Influenza A (Japan)*
- *Influenza A2 (Aichi)*
- *Influenza A2 (Hong Kong)*
- *Influenza B*
- *Parinfluenza (Sendai)*
- *Poliovirus*
- *Reovirus Type I*
- *SARS*
- *Simian Virus 40*
- *Vaccinia*

Note: The laboratory tests may not be representative of the conditions of the real world. This information is an aid in the understanding of the technology. We do not guarantee the elimination, control, or minimization of specific organisms.



Silane QAC Example: **Very low toxicity**

*A 10 kg child would need to eat **11,200** apples sprayed with a SiQAC in **one sitting** to reach the lower toxicity level!*

Substance	**Animal, Route**	**LD_{50}**
Sucrose (table sugar)	rat, oral	29,700 mg/kg
Silane QUATS	**rat, oral**	**12,270 mg/kg**
Vitamin C (ascorbic acid)	rat, oral	11,900 mg/kg
Cadmium sulfide	rat, oral	7,080 mg/kg
Grain alcohol (ethanol)	rat, oral	7,060 mg/kg
Sodium molybdate	rat, oral	4,000 mg/kg
Table Salt	rat, oral	3,000 mg/kg
Paracetamol (acetaminophen)	rat, oral	1,944 mg/kg
THC (main psychoactive substance in Cannabis)	rat, oral	1,270 mg/kg males; 730 mg/kg females
Metallic Arsenic	rat, oral	763 mg/kg
Coumarin (benzopyrone, from Cinnamomum aromaticum and other plants)	rat, oral	293 mg/kg
Aspirin (acetylsalicylic acid)	rat, oral	200 mg/kg
Caffeine	rat, oral	192 mg/kg
Arsenic trisulfide	rat, oral	185 mg/kg - 6400 mg/kg
Sodium nitrite	rat, oral	180 mg/kg
Cobalt(II) chloride	rat, oral	80 mg/kg
Cadmium oxide	rat, oral	72 mg/kg
Nicotine	rat, oral	50 mg/kg
Strychnine	rat, oral	16 mg/kg
Arsenic trioxide	rat, oral	14 mg/kg
Sodium cyanide	rat, oral	6.4 mg/kg
White phosphorus	rat, oral	3.03 mg/kg
Mercury(II) chloride	rat, oral	1 mg/kg
Beryllium oxide	rat, oral	0.5 mg/kg
Aflatoxin B1 (from Aspergillus flavus)	rat, oral	0.48 mg/kg
Venom of the Inland Taipan (Australian snake)	rat, subcutaneous	0.025 mg/kg
Dioxin (TCDD)	rat, oral	0.020 mg/kg

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Silane QAC Example: Durable Effects

Laboratory Testing on Katan Technologies Products

Organism	Initial	Product	Efficacy	Test Method	Testing Lab
Acid tolerant bacteria	>99%	Biospada Plus	>99%	UNE 1276	I. Bernier
Aspergillus niger	>99%	Biospada	>90% (>21 days)	Modified ASTM G-21	Microstar
Aureobasidium pullulans	>99%	Biospada	>90% (>21 days)	Modified ASTM G-21	Microstar
Avian Influenza A (H3N2) virus (Avian Reassortant)	>99%	Biospada Plus	>99% (7 days)	5 min, 10 min exposures	Ryscor Science
Avian Influenza virus H5N1	>99%	Biospada Plus	>99% (7 days)	5 min, 10 min exposures	Ryscor Science
B. cereus ATCC 11778	>99%	Biospada Plus	>99%	UNE 1276	I. Bernier
C. albicans ATCC 10231	>99%	Biospada Plus	>99%	UNE 1276	I. Bernier
Candida para psilosis	>99%	Biospada Plus	>99%	UNE 1276	I. Bernier
Cryptococcus laurentii	>99%	Biospada Plus	>99%	UNE 1276	I. Bernier
E.coli ATCC 25922	>99%	Biospada Plus	>99%	UNE 1276	I. Bernier
E.coli ATCC# 25922	>99%	Biospada	>99% (7 days)	ASTM E2149	Microstar
E.coli ATCC# 25922	>99%	Biospada, Biospada Plus	>99% (3200 feet of dragged abrasion)	ASTM E2149	Microstar
E.coli ATCC# 25922	>99%	Biospada	>88% (3200 feet of dragged abrasion)	ASTM E2149	Microstar
Gliocladium virens aka *(Trichoderma virens)*	>99%	Biospada	>90% (>21 days)	Modified ASTM G-21	Microstar
Influenza A H1N1	>99%	Biospada	>91%	MDCK ATCC #CCL-34	Biosciences
Klebsiella pneumoniae	>99%	Biospada	>99%	ASTM E2149	KT R&D
Klebsiella pneumoniae	>99%	Biospada	>90% (after 50, 75 and 100 commercial launderings on assorted textiles treated with Biospada)	ASTM E2149	I. Bernier
Klebsiella pneumoniae	>99%	Biospada	>99% (after 5,20, 30 commercial launderings on assorted textiles treated with Biospada)	ASTM E2149	I. Bernier
L. monocytogenes 27853	>99%	Biospada Plus	>99%	UNE 1276	I. Bernier
P. aeruginosa ATCC	>99%	Biospada Plus	>99%	UNE 1276	I. Bernier
Penicillium funiculosum aka P. pinophilium	>99%	Biospada	>90% (>21 days)	Modified ASTM G-21	Microstar
S. aureus ATCC 25923	>99%	Biospada Plus	>99%	UNE 1276	I. Bernier
S. typhimurium	>99%	Biospada Plus	>99%	UNE 1276	I. Bernier
Saccharomyces cerevisiae	>99%	Biospada Plus	>99%	UNE 1276	I. Bernier
Shigella sp	>99%	Biospada Plus	>99%	UNE 1276	I. Bernier
Trichosporon mucoides	>99%	Biospada Plus	>99%	UNE 1276	I. Bernier
Z. E.coli, Klebsiella pneumoniae	>99%	Biospada	>95% on: Acetate, Acrylic, Concrete, Cotton, Cotton Blends, Drywall, Elastane, Emery Boards, Fiberglass, Foam, Laminate, Non-Wovens, Nylon, Poly Blends, Polyester, Polypropylene, & Stainless Steel	ASTM E2149	KT R&D

To obtain copies or further details of independent tests and studies, please contact your local KATANTECH office, or ask for them via e-mail at info@katantech.com.

- Hands : Up to **6 hours**

- Surfaces & Environment : Up to **30 days**

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SiQAC Durability

Aspergillus	>31 days
E.Coli	>31 days
Klebsiella	5,10,30,50 75, 100 commercial launderings
Listeria	>14 days
Penicillium	>14 days
SARS	>14 days

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Silane QAC Example: Cost-effective

- Durable attachment to the surface means:
  - Less material usage
  - Fewer applications
  - Fewer incidences of cross-contamination
  - Reduced absenteeism
  - Reduced medical and liability costs
  - Essentially a silent, vigilant, anti-microbial “insurance” policy

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Surfaces to Which SiQAC's can be Applied

- Acetate
- Acrylic
- Cardboard/Paper
- Ceramics
- Ceramics
- Concrete
- Concrete
- Cotton
- Cotton Blends
- Drywall
- Elastane
- Emory Boards
- Fibreglass
- Foam
- Foams
- Glass
- Laminate
- Metal
- Non-wovens
- Nylon
- Paints
- Paper
- Plastic
- Poly Blends
- Polyester
- Polypropylen
- PVC
- Rubber
- Skin
- Stainless Steel
- Textiles
- Wood

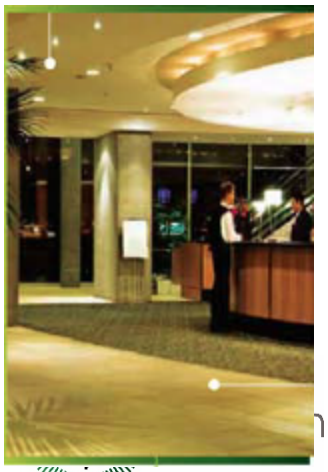
Industries to Which SiQAC's can be Applied









Testing Results

Laboratory Testing on Katan Technologies Products					
Organism	**Initial**	**Product**	**Efficacy**	**Test Method**	**Testing Lab**
Acid tolerant bacteria	>99%	Biospada Plus	>99%	UNE 1276	I. Bernier
Aspergillus niger	>99%	Biospada	>90% (>21 days)	Modified ASTM G-21	Microstar
Aureobasidium pullulans	>99%	Biospada	>90% (>21 days)	Modified ASTM G-21	Microstar
Avian Influenza A (H3N2) virus (Avian Reassortant)	>99%	Biospada Plus	>99% (7 days)	5 min, 10 min exposures	Ryscor Science
Avian Influenza virus H5N1	>99%	Biospada Plus	>99% (7 days)	5 min, 10 min exposures	Ryscor Science
B. cereus ATCC 11778	>99%	Biospada Plus	>99%	UNE 1276	I. Bernier
C. albicans ATCC 10231	>99%	Biospada Plus	>99%	UNE 1276	I. Bernier
Candida para psilosis	>99%	Biospada Plus	>99%	UNE 1276	I. Bernier
Cryptococcus laurentii	>99%	Biospada Plus	>99%	UNE 1276	I. Bernier
E.coli ATCC 25922	>99%	Biospada Plus	>99%	UNE 1276	I. Bernier
E.coli ATCC# 25922	>99%	Biospada	>99% (7 days)	ASTM E2149	Microstar
E.coli ATCC# 25922	>99%	Biospada, Biospada Plus	>99% (3200 feet of dragged abrasion)	ASTM E2149	Microstar
E.coli ATCC# 25922	>99%	Biospada,	>88% (3200 feet of dragged abrasion)	ASTM E2149	Microstar
E.coli ATCC# 25922					
E.coli ATCC# 25922					

Testing Results

Gliocladium virens aka *(Trichoderma virens)*	>99%	Biospada	>90% (>21 days)	Modified ASTM G-21	Microstar
Influenza A H1N1	>99%	Biospada	>91%	MDCK ATCC #CCL-34	Biosciences
Klebsiella pneumoniae	>99%	Biospada	>99%	ASTM E2149	KT R&D
Klebsiella pneumoniae	>99%	Biospada	>90% (after 50, 75 and 100 commercial launderings on assorted textiles treated with Biospada)	ASTM E2149	I. Bernier
Klebsiella pneumoniae	>99%	Biospada	>99% (after 5,20, 30 commercial launderings on assorted textiles treated with Biospada)	ASTM E2149	I. Bernier
L. monocytogenes	>99%	Biospada Plus	>99%	UNE 1276	I. Bernier
P. aeruginosa ATCC 27853	>99%	Biospada Plus	>99%	UNE 1276	I. Bernier
Penicillium funiculosum aka ***P. pinophilium***	>99%	Biospada	>90% (>21 days)	Modified ASTM G-21	Microstar
S. aureus ATCC 25923	>99%	Biospada Plus	>99%	UNE 1276	I. Bernier
S. typhimurium	>99%	Biospada Plus	>99%	UNE 1276	I. Bernier
Saccharomyces cerevisiae	>99%	Biospada Plus	>99%	UNE 1276	I. Bernier
Shigella sp	>99%	Biospada Plus	>99%	UNE 1276	I. Bernier
Trichosporon mucoides	>99%	Biospada Plus	>99%	UNE 1276	I. Bernier

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Testing Results

Z. E.coli, Klebsiella *pneumoniae*	>99%	Biospada	>95% on: Acetate Acrylic Concrete Cotton Cotton Blends Drywall Elastane Emory Boards Fibreglass Foam Laminate Non-wovens Nylon Poly Blends Polyester Polypropylene Stainless Steel	ASTM E2149	KT R&D

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Registrations

- INVIMA Registration # 2010024280
- New Zealand Food Safety approvals
- European registry
- Australian TGA 2 registry
- INCI approval
- Malaysia MOH NPCB approval
- Singapore HSA
- EPA approvals
- India FDA approval
- EU PT2 , PT 7, PT9

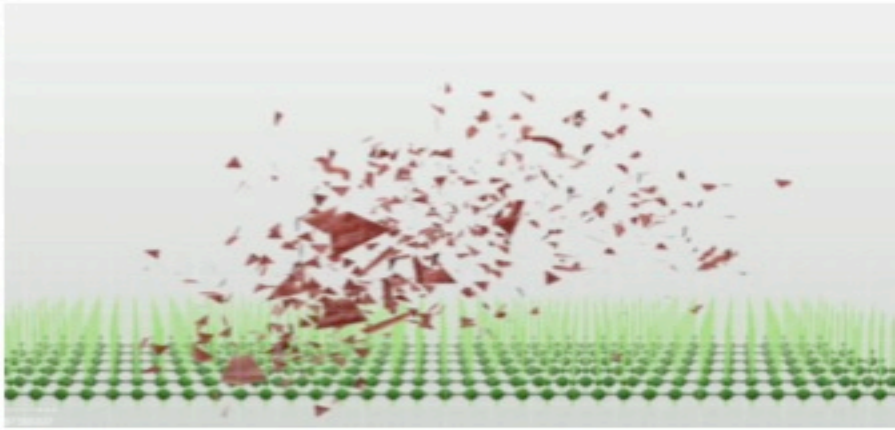
National Pharmaceutical
Control Bureau (NPCB)
Ministry of Health
MALAYSIA

Cambio de paradigma No. 1

No envenenar con químicos:

ELIMINACIÓN FÍSICA

de toda clase de microbios



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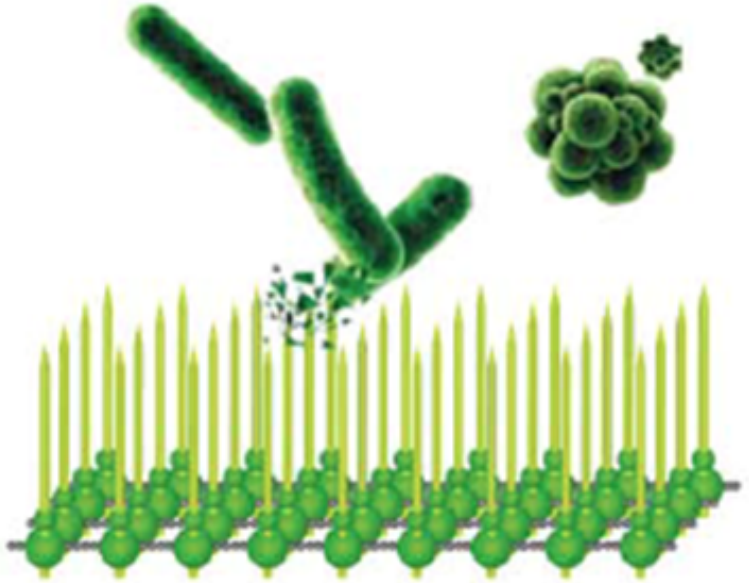
Cambio de paradigma No. 2

No basta limpiar y desinfectar:

PROTECCIÓN CONTINUA

más eficaz y más durable



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¿Porqué ésta nanotecnología es diferente?

- **Elimina física** (mecánicamente) no por envenenamiento
- No genera resistencia
- Durabilidad – **Acción desinfectante Continua**
- No tóxico
- Inoloro e incoloro

ica · INVIMA · United States Environmental Protection Agency · ANLA Autoridad Nacional de Licencias Ambientales · FDA Approved · INCI International Nomenclature of Cosmetic Ingredients · New Zealand Food Safety Authority · ECHA European Chemicals Agency

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People + Planet
Providing global solutions that clean, protect and prevent disease and create healthy environments.

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