SAFE Life Corp.

Triosyn Iodinated Resin Incorporated Into Disposable Respirators
Objective

- To increase awareness of the need for better respiratory protection against viral hazards relevant to potential Medical and Bio-weapon threats
Care Givers During SARS

- Healthcare providers acquired SARS despite masks and respirators

<table>
<thead>
<tr>
<th>City</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Toronto</td>
<td>51%</td>
</tr>
<tr>
<td>Hanoi</td>
<td>63%</td>
</tr>
<tr>
<td>Hong Kong</td>
<td>46%</td>
</tr>
</tbody>
</table>

Currently $600,000,000 Toronto law suits
### Exposure Potential

- **Inhalation:** Suck in air like a vacuum cleaner
  - 6 liters/min. (1 1/2 gallons)
  - 360 liters/hr. (90 gallons)
  - 2,880 liters/8hr shift (720 gallons)!

- 300 million alveoli (air sacs) in adult lung
  - Surface area if each opened = ~140 sq. yards = tennis court!

![Diagram of the lungs and alveoli](image-url)
Mission Critical:
Protect Vulnerable Respiratory Access Route

Protect Our Protectors
PAPRs, SCBA, Disposable Respirators, Masks
Balazy 2006

Penetration of virus at 85 LPM

If 10,000 viruses in inhaled air/4 hours

- 20.5% (A) Mask 2,050
- 84.5% (B) Mask 8,450
- 5.6% (D) Respirator 560

Balazy A., Amer Jour Infect Control 2006; 34: 52-57
<table>
<thead>
<tr>
<th>Potential Airborne Viral Threats</th>
<th>Infectious Dose</th>
<th>Associated Diseases</th>
<th>Size Comparison Representation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ebola &amp; Marburg; Crimean Congo Bolivian; Rift Valley Fever; New World Arenavirus; Hantavirus; Lassa; Yellow Fever;</td>
<td>1-100</td>
<td>Viral hemorrhagic fever (VHF) Infectious dose</td>
<td></td>
</tr>
<tr>
<td>Eastern, Western &amp; Venezuelan Equine Encephalomyelitis (EEE, WEE, and VEE) viruses</td>
<td>10-100</td>
<td>Viral encephalitis</td>
<td></td>
</tr>
<tr>
<td>Adenovirus</td>
<td>1-100</td>
<td>Respiratory infections, tumors</td>
<td></td>
</tr>
<tr>
<td>Influenza A virus; Avian flu H5N1, H2N2, H1N1, H3N2, etc.</td>
<td>1-740</td>
<td>Influenza</td>
<td></td>
</tr>
<tr>
<td>SARS Coronavirus</td>
<td>1-100</td>
<td>Sudden Acute Respiratory Syndrome (SARS)</td>
<td></td>
</tr>
<tr>
<td>Variola virus</td>
<td>10-100</td>
<td>Smallpox</td>
<td></td>
</tr>
<tr>
<td>Mycobacterium tuberculosis (TB)</td>
<td>1-10</td>
<td>Pulmonary tuberculosis First time N95s in healthcare</td>
<td></td>
</tr>
</tbody>
</table>
Technological Progress In Respiratory Protection

Disposable Respirators

Mask

Mechanical Capture

Mechanical + Electrical Charge
Mechanical + Electrostatic Charge

- Gravitation
- Impaction
- Diffusion

Electrical charge
The electrostatic charge degrades over time and with different contaminates decreasing efficacy.

Velocity of viral challenge: 85 LPM equivalent
Challenge: MS2 virus at approximately 1,000,000 pfu per hour
Duration: 8 hours
How Do You Ruin The Electret Charge On Filters?

- Water
- Moisture
- Time
- Heat
- Oil based products, diesel mist, vaporized fatty tissue
- Alcohol
- Most disinfectants
- Overwhelm with captured particles; stuff

Myers DL. Electret Media for HVAC Filtration Applications. INJ Winter 2003; 43-54
- Fibers adsorb exhaled moisture
- Moisture accumulates to form minute droplets on fibers
- Fiber’s electrostatic charge begins to decay and with it
  - Decrease in capture efficiency
  - Decrease in microbe retention

Exhalation Moisture
An Arctic Visual
A Journey Begins

Microorganisms Are Captured, But Alive On the Fibers
Accumulation

- The droplets continue to expand soaking off more and more virus and bacteria already retained on the fibers
- Remember, they are still alive
Growing droplets reach critical mass and are pulled into the air stream, where they may be:
- impaled onto another fiber (droplet break apart)
- pushed back out into the environment (exhalation)
- inhaled by the wearer (inhalation)
Mechanical + Electrostatic Charge + Antimicrobial

Most penetrating aerosol size: 0.3 microns

Gravitation

Impaction

Diffusion

Triosyn treated fibers

Electrical charge
Technological Progress In Respiratory Protection

Respirators

Mechanical + Electrical Charge

Mask

Mechanical Capture

Mechanical + Electrical Charge + Antimicrobial

Triosyn Respirators all three mechanisms
Antimicrobial Preserves Efficacy

- Counteracts the degradation affect – preserves the respirator
- Preserves higher microbial capture efficiency and prevents migration

8 hours
85 LPM when
Challenged with 1,000,000 viruses per hour
Iodine ($I_2$) is a fast acting, broad spectrum antimicrobial utilized for wound treatment and infection prevention since the 1800s.

Historically unable to keep iodine stable over time.

Tri-iodide is thermal-fused into unique polymeric resin particles: polystyrene-4-methyltrimethylammonium-triiodide.

Triosyn Antimicrobial Technology

[Chemical structure diagram]
Triosyn Antimicrobial Resin On Fibers

Triosyn iodinated polymeric resin

Respirator Filtration Fiber
Electrochemical bond maintains $I_3^-$ integrity and sets up a demand–release mechanism. $I_2$ is released from the $I_3^-$ in the presence of microorganisms (direct contact not necessary).
- Drawn to the surface of the microorganism

- Iodine ($I_2$) **oxidizes** surface and key external and internal components of the cell

- Affective against viruses, bacteria, fungi, protozoa
Triosyn Iodinated Resin: Addresses Both Passing Air and “Migration and Dump”

- Triosyn technology
- Captured organisms on fibers

Fiber
Flow Rate: 85 LPM for 6 hours
Virus: MS2 (as per Governmental agencies protocols)
Air Force Research Laboratory (AFRL), Panama City, Florida
### Efficacy Comparisons

**Airborne Viral Exposure**

<table>
<thead>
<tr>
<th>Filtration Efficiency</th>
<th>100</th>
<th>1,000</th>
<th>10,000</th>
<th>100,000</th>
</tr>
</thead>
<tbody>
<tr>
<td>99.999%</td>
<td>0.001*</td>
<td>0.01</td>
<td>0.1</td>
<td>1</td>
</tr>
<tr>
<td>99.90 %</td>
<td>0.1</td>
<td>1</td>
<td>10</td>
<td>100</td>
</tr>
<tr>
<td>99.00 %</td>
<td>1</td>
<td>10</td>
<td>100</td>
<td>1,000</td>
</tr>
<tr>
<td>95.00 %</td>
<td>5</td>
<td>50</td>
<td>500</td>
<td>5,000</td>
</tr>
<tr>
<td>90.00 %</td>
<td>10</td>
<td>100</td>
<td>1,000</td>
<td>10,000</td>
</tr>
<tr>
<td>20.00%**</td>
<td>80</td>
<td>800</td>
<td>8,000</td>
<td>80,000</td>
</tr>
</tbody>
</table>

*Viruses penetrating through respirator/mask

* *20% represents the results of a face mask
## Aerosolized SARS Coronavirus

<table>
<thead>
<tr>
<th>Sampling Time (min)</th>
<th>Positive Control</th>
<th>Total TCID$_{50}$ Units</th>
<th>Sample 1 (Total TCID$_{50}$ Units)</th>
<th>Sample 2 (Total TCID$_{50}$ Units)</th>
<th>Sample 3 (Total TCID$_{50}$ Units)</th>
<th>Sample 4 (Total TCID$_{50}$ Units)</th>
<th>Sample 5 (Total TCID$_{50}$ Units)</th>
<th>Sample 6 (Total TCID$_{50}$ Units)</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td></td>
<td>3,000</td>
<td>No Virus Detected</td>
<td>No Virus Detected</td>
<td>No Virus Detected</td>
<td>No Virus Detected</td>
<td>No Virus Detected</td>
<td>No Virus Detected</td>
</tr>
<tr>
<td>60</td>
<td></td>
<td>30,000</td>
<td>No Virus Detected</td>
<td>No Virus Detected</td>
<td>No Virus Detected</td>
<td>No Virus Detected</td>
<td>No Virus Detected</td>
<td>No Virus Detected</td>
</tr>
<tr>
<td>120</td>
<td></td>
<td>150,000</td>
<td>No Virus Detected</td>
<td>No Virus Detected</td>
<td>No Virus Detected</td>
<td>No Virus Detected</td>
<td>No Virus Detected</td>
<td>No Virus Detected</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>183,000</strong></td>
<td><strong>No Virus Detected</strong></td>
<td><strong>No Virus Detected</strong></td>
<td><strong>No Virus Detected</strong></td>
<td><strong>No Virus Detected</strong></td>
<td><strong>No Virus Detected</strong></td>
<td><strong>No Virus Detected</strong></td>
</tr>
</tbody>
</table>

- 85 LPM for two hours with increasing level of SARS Coronavirus challenge
- No viruses detected during continuous collection of the air after passage through Triosyn Respirators (6 respirators tested).
Influenza penetration levels through Triosyn P95 and Commercial N95 Respirators tested 85 LPM

Influenza A

Detection Level
Triosyn below detection level

M06-0246; July 5th 2006
Activated Carbon absorbs odors and nuisance organic vapors

Fluid resistant to protect from splashes and sprays of blood and other bodily fluids

Prevents oil penetration for those with “P” designation

SAFE Life
NIOSH testing determines Particle Filtration Efficiency of the Respirator fabric, not the finished product.
Appropriate Parameters For Testing Barrier Effectiveness Against Viruses

- Appropriate preconditioning
- 0.05 to 0.1 micron inert particle challenge
- 0.05 to 0.1 micron viral aerosol challenge (virus in aerosol will be smaller, e.g. MS2)
- High humidity to reflect exhalation moisture
- 85 LPM (NIOSH) equivalent face velocity
- 3 to 24 hour test duration
Triosyn Antimicrobial Technology

- Broad spectrum: bacteria, fungi, viruses and protozoa
- Rapid activity able to interact with microorganisms in air stream passing at 85 LPM
- Biocidal (kills microorganisms) - not, just static (putting germ into hibernation)
- Bio-compatible at extended-use exposure levels
- An antimicrobial with long term use-history and expectations in a harnessed format
- Not known to instigate antibiotic resistance
Triosyn Antimicrobial Technology

- No development of microbial-resistance to the antimicrobial has occurred to Triosyn iodinated resin
- Stable in expected manufacturing, shipping, storage, environmental and use conditions
- Effective for entire duration of use of the respirator with negligible efficacy degradation and acceptable ease of breathing – can be adjusted depending on product
- Antimicrobial not a constant leach out, but is instead delivered as needed
Reasons for Having Triosyn Disposable Respirators Available

- Exposure to serious natural or manmade airborne infectious microorganisms or infected individuals
- Threat of airborne bioterrorist attack
- Working with symptomatic poultry or other animal vectors
Reasons for Having Triosyn Disposable Respirators Available

- Cleaning up after natural disasters
  - Floods
  - Hurricanes
  - Earthquakes

- Cleanup after manmade disasters
  - Explosions
  - Bioterrorism

- When faced with odor and nuisance fumes
  - Cleanup
  - CSI
  - Mortuary
  - 1st responders

- Stock to ensure access when (not if) pandemic strikes or bioterrorist attack occurs
Safe Life and Triosyn Research

Innovative Product Development for the 21st Century
Various stages of product development and commercialization

- Defense / Military
  - Troop shelters
  - Patient transports
  - Body bags
  - Canteen filters
  - Shoe innersoles

- Air Filtration
  - Respirators
  - Gas Mask Canisters
  - HVAC Systems

- Industrial
  - Lubricant Filters
  - Paints & Coatings
  - Decontamination
  - Barriers & Textiles

- Medical-Hemo
  - Treatment
  - Transfusion

- Medical-Topical
  - Wound Management
  - Wound Dressings & Burn Wraps
  - Topical Preparations
Microbiological Performance

Microorganisms tested against Triosyn Air Filtration or Antimicrobial Finishes

<table>
<thead>
<tr>
<th>Viruses</th>
<th>Bacteria</th>
<th>Bacterial spores</th>
<th>Fungi</th>
</tr>
</thead>
<tbody>
<tr>
<td>Φx174 Coliphage</td>
<td>Erwinia herbicola</td>
<td>Bacillus atrophaeus (BG)</td>
<td>Aspergillus niger</td>
</tr>
<tr>
<td>MS2 Coliphage</td>
<td>Escherichia coli</td>
<td>Bacillus subtilis</td>
<td>Candida albicans</td>
</tr>
<tr>
<td>Newcastle Disease Virus</td>
<td>Klebsiella pneumoniae</td>
<td></td>
<td>Cladosporium herbarum</td>
</tr>
<tr>
<td>SARS coronavirus</td>
<td>Klebsiella terrigena</td>
<td></td>
<td>Rhodotorula rubra</td>
</tr>
<tr>
<td>Avian &amp; Human Influenza</td>
<td>Micrococcus luteus</td>
<td></td>
<td>Trichophyton mentagrophytes</td>
</tr>
<tr>
<td></td>
<td>Staphylococcus aureus</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Staphylococcus epidermidis</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Microorganisms tested against Triosyn Products

<table>
<thead>
<tr>
<th>Viruses</th>
<th>Bacteria</th>
<th>Bacterial Spores</th>
<th>Fungi</th>
<th>Protozoa</th>
</tr>
</thead>
<tbody>
<tr>
<td>Φx174 Coliphage</td>
<td>Brucella abortus</td>
<td>Bacillus anthracis</td>
<td>Aureobasidium pullulans</td>
<td>Cryptosporidium parvum</td>
</tr>
<tr>
<td>Human Immuno.</td>
<td>Enterobacter aerogenes</td>
<td>Bacillus atrophaeus (BG)</td>
<td>Aspergillus niger</td>
<td>Giardia lamblia</td>
</tr>
<tr>
<td>Virus (HIV)</td>
<td>Enterococcus faecalis</td>
<td>Bacillus subtilis</td>
<td>Candida albicans</td>
<td>Giardia muris</td>
</tr>
<tr>
<td>MS2 Coliphage</td>
<td>Erwinia herbicola</td>
<td></td>
<td>Cladosporium herbarum</td>
<td></td>
</tr>
<tr>
<td>Newcastle</td>
<td>Francisella tularensis</td>
<td></td>
<td>Penicillium citrinum</td>
<td></td>
</tr>
<tr>
<td>Disease Virus</td>
<td>Klebsiella pneumoniae</td>
<td></td>
<td>Penicillium sp.</td>
<td></td>
</tr>
<tr>
<td>Poliovirus Type</td>
<td>Klebsiella terrigena</td>
<td></td>
<td>Rhodotorula rubra</td>
<td></td>
</tr>
<tr>
<td>1 Rotavirus SA-11</td>
<td>Legionella sp.</td>
<td></td>
<td>Trichophyton mentagrophytes</td>
<td></td>
</tr>
<tr>
<td>SARS coronavirus</td>
<td>Micrococcus luteus</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Drug-Res. Staphy. aureus (MRSA)</td>
<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td>Proteus mirabilis</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Pseudomonas aeruginosa</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pseudomonas pseudomallei</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Salmonella sp.</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Serratia marcescens</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>Shigella flexneri</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>Staphylococcus aureus</td>
<td></td>
<td></td>
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