Nitrogen Dioxide (NO$_2$)
Rapid, Room Temperature Sterilization
Noxilizer Organization Overview

- Formed in 2004
- 25 Associates Globally
- Offices in Baltimore, MD & Wakayama, Japan
- World Class Board and Leadership
- Facility Space:
  - BioPark: 3,596 sq ft office space, 13,039 sq ft lab and assembly space
  - Noxilizer Japan KK: 750m2 on 2 floors
Why NO₂ for Medical Device Sterilization?
Manufacturers and Providers under Cost and Productivity Pressure

The Infection Control Problem

- Difficult Challenges in Device Sterilization
  - Painfully slow cycle times (Hours vs. Days)
  - Noxious/dangerous materials
  - Expensive and time consuming logistics

- New Paradigm of NO₂ Sterilization
  - Shift Medical Device Sterilization to the Manufacturing Floor
  - True room temperature, uniquely suited to modern devices such as Pre filled Syringes, bioresorbables
  - Scalable, with the capacity of EtO
  - Cycle speed of H₂O₂ without moisture sensitivity
  - Typical 40%-60% annualized savings and 12-18 Mo. ROI

Throughput, Turnaround Time, Safety & Cost
# Medical Device Sterilization

## Establishing a New Player in Global Sterilization Solutions

### Technology Innovation Timeline

<table>
<thead>
<tr>
<th>Year</th>
<th>Technology</th>
</tr>
</thead>
<tbody>
<tr>
<td>1850</td>
<td>Steam</td>
</tr>
<tr>
<td>1950</td>
<td>Ethylene Oxide Gas (Industrial &amp; Hospital)</td>
</tr>
<tr>
<td>1990</td>
<td>Gamma Radiation (Industrial)</td>
</tr>
<tr>
<td>2012</td>
<td>Hydrogen Peroxide Gas Plasma (Hospital &amp; some Industrial)</td>
</tr>
<tr>
<td>2012</td>
<td>Nitrogen Dioxide (Enabling across All segments)</td>
</tr>
</tbody>
</table>

### Feature Parameter Range

<table>
<thead>
<tr>
<th>Feature</th>
<th>Parameter Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nitrogen dioxide gas sterilant</td>
<td>Boiling point 21°C</td>
</tr>
<tr>
<td>Low sterilant concentration</td>
<td>10 mg/L – 15 mg/L (less than 1%)</td>
</tr>
<tr>
<td>Room temperature process</td>
<td>Consistent results from 10°C to 65°C</td>
</tr>
<tr>
<td>Humidity reduces cycle time</td>
<td>70% - 80% RH provides rapid lethality, 0% RH requires longer exposure time</td>
</tr>
<tr>
<td>Fast cycle exposure times</td>
<td>Typically less than 20 minutes</td>
</tr>
<tr>
<td>Low sterilant residuals</td>
<td>Residuals often not measureable, no increase in cytotoxicity observed</td>
</tr>
</tbody>
</table>
Medical Device Sterilization
NO₂ Safety Profile (Safety Data Sheets)

- Smells like bleach & almonds
- Yellowish-brown or reddish-brown fumes
- NO₂ odor threshold is below the OSHA PEL

<table>
<thead>
<tr>
<th>Safety-related Properties</th>
<th>NO₂</th>
<th>Hydrogen Peroxide</th>
<th>Ethylene Oxide</th>
</tr>
</thead>
<tbody>
<tr>
<td>Color</td>
<td>Reddish-Brown</td>
<td>Colorless</td>
<td>Colorless</td>
</tr>
<tr>
<td>Odor Threshold</td>
<td>0.1 ppm</td>
<td>Odorless</td>
<td>200 – 400 ppm</td>
</tr>
<tr>
<td>OSHA PEL</td>
<td>5 ppm</td>
<td>1 ppm</td>
<td>1 ppm</td>
</tr>
<tr>
<td>NFPA: Health</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>NFPA: Flammability</td>
<td>0</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>NFPA: Instability</td>
<td>0</td>
<td>1</td>
<td>3</td>
</tr>
</tbody>
</table>

** PEL: Permissible Exposure Limits  
NFPA: Natl. Fire Protection Agency
The Opportunity in Medical Device Sterilization

Nitrogen Dioxide Sterilization

Benefits Multiple Markets

Pharmaceutical Isolator Disinfection

(VHP) \( H_2O_2 \)

\( NO_2 \) Decontamination System provides 70% faster aeration.

Industrial Batch Sterilization

EtO or Gamma

RTS-360 Industrial Sterilizer delivers 50% Cost savings, rapid aeration, much safer than Ethylene Oxide

Hospital Sterilization

Some EtO, \( H_2O_2 \)

\( NO_2 \) can provide 3x’s the capacity, 50% cost savings.
The Noxilizer EtO Alternative Industrial Opportunities

Value Proposition of Throughput & Cost Savings

**Industrial Batch**

Sterilization

**Contract Services**

& Systems

NO\textsubscript{2} Opportunities:

- **PFS Bioresorbables /Implants**
- “Bulk” EtO Contract Sterilization (25% Goal)
- Shifting sterilization in house
- Sterrad 200 Replacement (1100 Units Total, 250 in the industrial market)

Key Advantages over EtO Sterilization

1. 90% improvement on aeration
2. Inventory Release in Hours versus Weeks
3. >50% sterilization cost savings
4. Non Carcinogenic out gassing
The Noxilizer Industrial Application Opportunity
New Sterilization Capabilities with Pre-Filled Syringes

- PFS market of $2.7b in 2010 to $3.9b in 2015, moving earlier into the drug development cycle
- Current sterilization penetrates syringes and contaminates contents.
- NO2 sterilization is a surface process, able to sterilize a pre-filled syringe after primary packaging stage. NO IMPACT TO PREFILLED CONTENTS..
- Cost of sterilization at 1.5% -2.5%, or a $50m – $100m savings opportunity
Reduce Sterilization Time from Days to Hours:
- No repackaging
- No shipping
- Partial Loads Possible

2.5 - 12 day turnaround reduction
The Noxilizer Industrial Application Opportunity

New Sterilization Capabilities with **Cost Reduction**

<table>
<thead>
<tr>
<th></th>
<th>EtO</th>
<th>In House Noxilizer</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sterilization Cost per $000/Vials</strong></td>
<td>$3.96</td>
<td>$5.67*</td>
</tr>
<tr>
<td><strong>Inventory Carrying Cost per $000/Vials</strong></td>
<td>$3.27</td>
<td>$0.00</td>
</tr>
<tr>
<td><strong>Transportation Cost per $000/Vials</strong></td>
<td>$3.02</td>
<td>$0.00</td>
</tr>
<tr>
<td><strong>Total Cost per $000/Vials</strong></td>
<td>$10.25</td>
<td>$5.67</td>
</tr>
<tr>
<td><strong>Annual Sterilization Cost</strong></td>
<td>$583,873</td>
<td>$324,573</td>
</tr>
<tr>
<td><strong>Potential Savings</strong></td>
<td></td>
<td>$259,300</td>
</tr>
</tbody>
</table>

- **Provides 44% savings**
- **Investment payback in ~16 months.** Includes validation, installation, etc.
- In-house sterilization eliminates Inventory Carrying Cost and Transportation expense.
- Eliminates concern about EO residuals on vials.
- No investment in explosion proof facilities and associated compliance expense.

*Quoted cost per vial includes: depreciated equipment, consumables, maintenance and...
Medical Device Package Sterilization
Growing Customer Relationships, Feasibility Studies
Noxilizer’s RTS 360 Sterilization System
Expanded Product & Service Offering for Industrial, Pharmaceutical & Hospital Customers

RTS-360 Sterilizer

Recurring, Cycle Driven:
- \(\text{NO}_2\) Liquid
- Biological Indicators
- Chemical Indicators
- Process Challenge Devices
- Scrubber Material
- \(\text{NO}_2\) Sensors
- Service Contracts

Sterilization Services:
- Feasibility, Cycle Optimization
- Contract Sterilization
Simple, effective and economical in-house sterilization

- Operates at Room Temperature
- Maintains Material Properties
- No Residuals
- No Aeration Required *(Avoids Out-Gassing)*
- Shorter Cycle Time *(Inventory release in hours versus weeks)*
- Free Standing/Non Hazardous Bi Product
- Safer than Ethylene Oxide *(Known EPA Carcinogen)*
- Fully Scalable *(Larger Chamber & In line Potential)*
- Permits partial Pallet Loads
- No need for Safety Reinforced Facilities
- >50% sterilization cost savings
Noxilizer RTS 360 NO₂ Sterilization System

Differentiation versus Hydrogen Peroxide (Sterrad 200)

1. Rapid Cycle times
   COMBINED with capacity
   - Capacity 2.5x greater than 200NX,
   - 10% less cycle time

2. No moisture or weight/load aborts – leads to flashing

3. No package residuals

4. 50% less expensive to operate
   - Less cycles, comparable consumables

5. REAL ambient temperature
   - 70 degrees versus 115 degree temperature

Replacing Discontinued ASP 200 Systems with RTS360 units:

- Large Loads, overnight
- Batteries, scope sets, implants
- 60 minute cycle
- Research/Animal work
RTS-360 Roadmap of Global Commercial Traction
Moving to the Hospital

Global Medical Device Package Sterilization

Hospital Sterilization
**Europe & China**

Hospital Sterilization
United States

- Released RTS360
- Available
- Available
- Late 2013 Submission

RTS 360 passed UL, IEC testing, Masterfile submitted to FDA

ISO 13485 – scope includes design and manufacturing of sterilization equipment
ISO 14937 – scope includes cycle development, validation, consulting on sterilization and contract sterilization

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Hospital Sterilization in the US
Initial Relationships and “Seeding” Plans

FDA Submission Target 2013/2014
Next Steps for Noxilizer
Accelerate Value Creation in 2013 ….

2012
Series C Raise – July 1
Expanded Patent
AOAC MRO
Saian Acquisition
Move to BioPark & Wakayama Shi
Securing NO₂ supply Globally
EPA Submission
Contract Sterilization BSI Certification

2013
Submitting RTS360 FDA

1. Customer Deliveries & Support:
   - Weiler & CRI
2. Complete Regulatory Agenda
   - Blue Torch & CRI 510k
   - CE Marking
3. Drive Orders & Sales
4. Build First lot Units
5. Complete the C Round
Nitrogen Dioxide ($\text{NO}_2$)
Rapid, Room Temperature Sterilization