STOP THE SPREAD: IMPROVE IAQ & PROTECT BUILDING OCCUPANTS FROM AIRBORNE MICROBES USING UV AIR DISINFECTION

Heraeus Noblelight America LLC
AGENDA

› What is UV energy?
› History of UV for disinfection
› Science of UV disinfection
› Alternate technologies
› Technology examples and case studies
UV-C IS PART OF THE NATURAL LIGHT SPECTRUM

254 nm reliably kills viruses, bacteria and fungi

✓ 1877, British Physiologist Arthur Downes and scientist Thomas P. Blunt were the first to observe Sunlight inactivating pathogenic bacteria

✓ 1903, Niels Ryberg Finsen wins Nobel Prize for Medicine for use of UV energy to treat diseases
UV-C IS PART OF THE NATURAL LIGHT SPECTRUM

X-ray | Ultraviolet | Visible light | Infrared

- VUV
- UVC
- UVB
- UVA

254 nm reliably kills viruses, bacteria and fungi
>> effective for disinfection

✓ 1904, Heraeus invents the first quartz glass lamp, still the primary technology for generating UV energy today
UV-C IS PART OF THE NATURAL LIGHT SPECTRUM

- UV-C is part of the natural light spectrum.

- 254 nm reliably kills viruses, bacteria, and fungi.
  - Effective for disinfection.

- 1930’s, William F. Wells, a sanitary engineer from Harvard University utilizes upper air UV to prevent the spread of measles in classrooms. Rates drop from 53.6% infection rate to 13.3%.
APPLICATION AREAS OF UV-C DISINFECTION

- In healthcare settings for air and surface disinfection
- In the treatment of drinking water
- In air conditioning systems of large office spaces, airports, and other communal areas
- For the disinfection of food and food packaging
SENSITIVITY OF MICROORGANISMS TO UVC RADIATION

**Fungi**
- Penicillium roqueforti (green)
- Penicillium expansum (olive)
- Penicillium digitatum (olive)
- Aspergillus glaucus (blue-green)
- Aspergillus flavus (yellowish)
- Aspergillus niger (black)
- Rhisopus nigricans (black)
- Mucor racemosus A (light grey)
- Mucor racemosus B (light grey)
- Oospera lactis (white)

**Yeast**
- Saccharomyces ellipsoidens
- Saccharomyces sp.
- Saccharomyces cerevisiae
- Brewing yeast
- C. Albivans
- C. Tropicalis
- C. stellatoidea

**Viruses**
- Bacteriophage (E. coli)
- Influenza
- Adenoviridae family
- Retroviridae family
- Coronaviridae family

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**Dose ranges for 99.9% inactivation (Log 3)**

- **Viruses**: 2 – 16 mJ/cm²
- **Bacteria**: 4 – 60 mJ/cm²
- **Fungi**: 15 – 400 mJ/cm²

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**Bacteria**
- Bacillus anthracis
- B. Megatherium sp. (veg.)
- B. paratyphosus
- B. subtilis (spores)
- Corynebacterium diphteriae
- Clostridium tetani
- Dysentry bacilli
- Eberthella typosa
- Escherichia coli
- Micrococcus candidus
- Micrococcus sphaeroides
- Mycobacterium tuberculosiae
- Neisseria catarrhalis
- Phytomonas tumefaciens
- Proteus vulgaris
- Pseudomonas aeruginosa
- Pseudomonas fluorescens
- Salmonella
- S. typhimurium
- Sarema lutea
- Seratia marcescens
- Shigella paradyserteriae
- Spirillum rubrum
- Staphylococcus albus
- Staphylococcus aureus
- Staphylococcus hemolyticus
- Staphylococcus lactis
- Staphylococcus viridans
HIGHLY EFFECTIVE ON SARS-COV-2

Scientifically proven:

- **2021, Biotec:**
  Hygiene Institut biotec GmbH proves 99.91% virus reduction with the Soluva® Air V Universal

- **2020, Biotec:**
  99.99% reduction (log4) at 1100m3 air flow.

- **2020, Fraunhofer IBP:**
  Proven reduction of the virus load in the room by 99.9% through UV air disinfection devices (first proof worldwide)

- **2020, University Hospital Tübingen:**
  Rapid and efficient deactivation (99.99 %) of SARS-CoV-2 by UV-C irradiation of surfaces

- ... and many more

The virus is effectively destroyed!
THE GREATEST RISK OF INFECTION IS IN THE AIR

Aerosols

❯ 2021 CDC: The principal mode by which people are infected with SARS-CoV-2 (the virus that causes COVID-19) is through exposure to respiratory fluids carrying infectious virus.

❯ 2021 Cambridge: In healthcare setting, mask wearing reduced covid cases from 14.3 to 4.3 cases per week
FUNCTIONALITY OF AIR DISINFECTION WITH UV-C TECHNOLOGY

High-energy UV-C light destroys viruses

Clean air
## SYSTEM COMPARISON AIR PURIFIERS - UV LIGHT VS. ALT TECHNOLOGIES

<table>
<thead>
<tr>
<th></th>
<th>UVGI (UVC Light)</th>
<th>Filters (HEPA or &gt;13 MERV)</th>
<th>In-duct Ionization (must be used with collection media/filter)</th>
<th>Increased Outside Air Ventilation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Elimination of Infectious Aerosols</strong></td>
<td>In-duct</td>
<td>In-room</td>
<td>In-duct</td>
<td>In-room</td>
</tr>
<tr>
<td><strong>HVAC Costs (cooling &amp; heating)</strong></td>
<td>No Impact</td>
<td>No impact</td>
<td>Increases fan use</td>
<td>No impact</td>
</tr>
<tr>
<td><strong>Operating Cost (electricity)</strong></td>
<td>Higher</td>
<td>Medium</td>
<td>Medium</td>
<td>Low</td>
</tr>
<tr>
<td><strong>Maintenance Cost</strong></td>
<td>Low</td>
<td>Low</td>
<td>Medium</td>
<td>High</td>
</tr>
<tr>
<td><strong>Installation Costs</strong></td>
<td>Medium</td>
<td>Low</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td><strong>Occupant Comfort</strong></td>
<td>Excellent</td>
<td>Very good (check noise levels)</td>
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</tr>
<tr>
<td><strong>Ozone Hazard</strong></td>
<td>Choose systems like Soluva to ensure <strong>no</strong> ozone is produced</td>
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<td>No</td>
<td>No</td>
</tr>
<tr>
<td><strong>Scientific Studies Prove Effectiveness Against Viruses</strong></td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
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</table>
SOLUVA AIR W AS A UNIVERSAL AIR PURIFIER

› For wall mounting or mobile use with stand
› Best in smaller and medium-sized rooms such as offices, reception areas, meeting rooms, breakrooms...
› Proven to be highly effective by independent testing labs
THE FIRST EFFICACY STUDY UNDER REAL CONDITIONS

✓ Room volume of 4500 cubic ft (127 m³) disinfected using Soluva W
✓ Aerosolized surrogate virus tested (enveloped Phi6 bacteriophage with a structure, particle size and environmental stability comparable to SARS-CoV-2)
✓ Virus emitted for 150 min, UV system activated after 75 min

<table>
<thead>
<tr>
<th>UV System Active</th>
<th>Measured Reduction</th>
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<tbody>
<tr>
<td>46 min</td>
<td>53.73%</td>
</tr>
<tr>
<td>105 min</td>
<td>98.00%</td>
</tr>
<tr>
<td>116 min</td>
<td>99.68%</td>
</tr>
</tbody>
</table>
Many English-speaking schools have air purifiers - French-speaking schools do not

https://montreal.ctvnews.ca/quebec-schools-without-air-purifiers-have-3-to-4-times-more-covid-19-cases-says-dad-running-citizen-count-1.5400739

Samples from 677 schools in Canada showed:

Ø 6.8 Covid Infections per school WITHOUT air purifier

Ø 1.8 Covid Infections per school WITH air purifier

"I can measure that."
Olivier Drouin, operator of the website COVID Ecoles Quebec (overview of all COVID case numbers)
SOLUVA AIR D FOR INTEGRATION INTO VENTILATION SYSTEMS

- For installation or retrofit into existing building ventilation systems
- Utilize existing infrastructure to disinfect recirculated air
- Available in multiple sizes for different duct designs, and fully stackable to treat any air volume
SUPER SPREADER EVENT BUS

China, January 2020

- On a 50-minute bus ride, 35% of all passengers became infected with SARS-CoV-2.
- The air conditioning system may have aided in the distribution of the viruses.

Quelle: https://www.aerzteblatt.de/nachrichten/118191/SARS-CoV-2-Super-Spreader-steckt-ein-Drittel-aller-Buspassagiere-an
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SOLUVA PRODUCT FAMILY – NEW INNOVATIONS

Soluva V
› Mounted to the ceiling of vehicles
› Can be integrated into trains, busses, vans, corporate shuttles, RV’s, etc.
› Reduces risk for both driver and passengers

Soluva T
› Desktop device - small, compact, mobile
› For flexible use on conference tables, in offices, meeting rooms, reception areas, and much more
UV BENEFITS - SUMMARY

✓ Scalable technology for many different spaces and applications

✓ Treats the air without the use of chemicals or filters

✓ Fully inactivates all known viruses, doesn’t just capture them

✓ Complete systems are easy to install and operate with low maintenance costs
QUESTIONS?

Email me: Eric.Nelson@heraeus.com
Visit us: Soluva.com