

Presenting Today



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ARORA Rethinking Infrastruct

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Introduction: Our current world

By July 2, 2020, there have been:

2.74 million confirmed cases of COVID-19 in the United States

130,000 US deaths due to COVID-19

10.7 million confirmed cases of COVID-19 worldwide

516,000+ worldwide deaths due to COVID-19

Arora has received inquires from two different airports about recommended upgrades to their ventilation systems to mitigate disease spread.

Solutions will vary from place to place, but many of the technologies discussed may be implemented in most commercial buildings.



Presentation Summary

- Electrostatic Air Filters
- Bipolar Ionization Technology
- UV-C Light Purification Systems
- Hydrogen Peroxide Disinfection Technology
- Standalone Air Purification Technology
- Conclusion and Questions







- Uses static electricity to capture airborne particles
 - The filter creates an electric charge, and the ionizers in the filter emits ions.
 - Ions attach themselves to particulates, causing the particles to become attracted to an oppositely charged collector
 - A carbon filter removes remaining odors including ozone
 - Must be incorporated into new design due to filter array depth, not ideal for retrofit
- Reusable and washable = first-cost effective to be weighed vs. cleaning labor.
- Effective at capturing small particles such as bacteria and viruses
- Larger particles like mold and spores may not be captured
- Regular maintenance and cleaning is mandatory for effective performance





Bipolar Ionization Technology

- Alternating voltage source introduced to ionization tubes producing positive and negative ions hydrogen (H2) and oxygen (O2).
- Ions enter the space and attach themselves to airborne particulates and cause oppositely charge particles to stick together ("agglomeration")
- Particles are then more likely to be captured by filters in HVAC systems.
- Particles may become weighted down enough to fall out of the breathing zone.
- Disrupts the reproductive ability of viruses and bacteria
- Integrated in supply ductwork or as a standalone unit





Safety Concerns

Bipolar Ionization

- Ions created are predominantly charged particles of hydrogen (H2) and oxygen (O2) in this case.
- Not regarded as harmful.
- Not unlike the naturally occurring ions present after a thunderstorm or at the seashore.
- Ions have relatively short active lifespans. Typically are neutralized within 60 seconds of creation. Will likely react with airborne contaminants long before inhaled or otherwise coming into human contact.
- Does not create harmful levels of ozone. Tested in accordance with UL 2998, which limits ozone to 0.005 parts per million by volume.

Light Spectrum / Effect of UV Light on DNA



Credit: https://www.evoqua.com/en/brands/delta-uv/Pages/How-It-Works.aspx



UV-C Light Purification System

- UV-C lights integrated into an HVAC system are typically installed inside an air handling unit near the cooling coil to effectively prevent biological growth (mold, bacteria) on the coil, drip pan, and interior surfaces
- UV-C lights are not as effective at killing airborne pathogens within air handling systems
- 3 factors to UV-C effectiveness:
 - Contact Time
 - Distance From Light
 - Intensity of Light
 - A stationary particle 6" from a UV-C light emitting an 800 ma frequency will be killed in 10 seconds. A particle traveling 500 FPM will only be within a UV-C light's area of influence 0.18 sec.



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UV-C Light Purification: High Wall Units

 UV-C lights may be mounted high on walls or on ceilings to "wash" upper air with UV-C radiation

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- Commonly used in hospital rooms to continuously disinfect air near the ceiling
- More study is required to determine effectiveness on coronaviruses, but shows promise
- May cause eye damage with prolonged exposure to light







Safety Concerns

UV Light (UV-C) vs. (UV-A&B)

 UV-A (Lower-frequency: 315 to 400 nm) is about 90% of what the earth sees naturally.

UV-B (Medium-frequency: 280 to 315 nm) is



about 10% of what the earth sees naturally. Is a greater contributor to sunburn than UV-A; We are most-familiar with UV-A & B. Sunscreen, sunglasses are normal protectives.

- UV-C (Higher-frequency: 100-280 nm) is almost entirely blocked by the atmosphere and is the most effective against pathogens vs UV-A & B.
 Direct line of sight to occupants and service personnel is to be avoided.
- The absorption length of UV-C radiation in human skin is extremely short so that almost no UV-C radiation can reach the living cells in the skin; all the absorption occurs in the dead cell layers.



Safety Concerns - Continued





Hydrogen Peroxide Disinfection

- MacArthur Airport on Long Island became first to implement a continuous hydrogen peroxide disinfection system at an airport
- Installed in supply ductwork, system creates hydrogen peroxide from the oxygen and water molecules in the air
- Molecules are dispensed into the space to coat and disinfect stationary surfaces
- Molecules decompose back into oxygen and water molecules
- Typically implemented in hospital settings
- Very effective at surface disinfection, but need more evidence for airborne disinfection and more information on safe breathing levels







Safety Concerns

Hydrogen Peroxide

- Hydrogen Peroxide is commonly used in medicinal applications.
- Sometimes used to bleach hair.
- NIOSH considers hydrogen peroxide safe depending upon dosage and duration of exposure.
- System only provides trace levels of H202 deemed by OSHA to be safe to people, pets, plants, and equipment.





Standalone Air Purification Systems



- Wide variety of solutions for different space requirements
- Commonly available as portable units or wall/ceiling mounted units
- Operates independently of HVAC system
- Most effective at serving relatively small spaces (offices, waiting rooms, conference rooms)



Conclusions

Electrostatic Air filters save money, but may not be the most effective at capturing larger particles.

Hydrogen Peroxide Disinfection may have merit, but more research is necessary. Bipolar Ionization seems to be the most effective at reducing airborne pathogens.

Standalone Air Purification Systems are common and offer many solutions depending on space type and requirements. UV-C lights in HVAC systems are effective at preventing biological growth on stationary surfaces but have little effect on airborne pathogens.

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Next Steps / Implementation

 Each potential application will be Unique, so a proper Assessment of the facility, taking into account the specific utilization, occupancy, architecture, systems and desired goals/outcomes would be essential.



- The proposed solution could be very different in otherwise identical applications if new construction versus existing. Legacy HVAC and other systems could dictate a different approach to minimize cost and disruption while achieving the intended goal.
- One approach might be to implement a *Pilot Program* in one facility or portion thereof to serve as a *Test Case* to evaluate effectiveness.
- Include in facility design and construction standards for all new projects, perhaps based upon results of pilot program.





