



NEWMAN CONSULTING GROUP

Profitable Ideas for High Performance Buildings Since 2002



HVAC Implications Since COVID-19: Protocols that Need to be Implemented

Webinar: ASHRAE COVID-19 Task Force – 08/11/2020

1

Content

- Background
- What do we think we know?
- What do we really know?
- Recommendations
- HVAC
 - Outside Air
 - Filtration
 - Humidity
 - Virus neutralization
- Concerns
- Old normal vs “new” normal

2

Liability/Litigation

Who is Blamed for Poor IAQ?

- Building Owners
- Architects & Engineers
- Building Contractors & Suppliers
- Building Management, Maintenance Personnel
- Real Estate Brokers
- Landlords & Tenants
- Employers

3

3

Poor IAQ

**Can Have Many Origins –
Some Indoor, Some Outdoor**



4

4

What Happens to HVAC Systems as Time Passes?

Green



Gray

5

IAQ Problems

- Humidity – too high/too low
- Mold or mildew growth due to condensation
 - Interior surfaces of walls near thermal bridges
 - Carpeting on cold floors
 - Locations where humidity promotes condensation
- Not enough outdoor/indoor air – or unhealthy OA
- Water intrusion – outdoor/indoor
- Bacteria/Viruses

6

6

IAQ Problems: HVAC *System*

- A source of biological contaminants
- Surface contamination by molds, bacteria, viruses
- Interior ductwork
- Odors

7

7

IAQ Problems: HVAC *Unit*

- Drain Pans
- Improper Damper Operation
- Surface Contamination
- Coils
- Air Filters

8

8

IAQ Problems – HVAC Filters



9

9

IAQ Problems: What Else?

- Mold spores on final filters
- Legionella from cooling towers
- Biofilm on heat transfer surfaces
- Bacteria
- Viruses

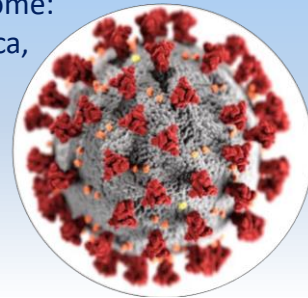


10

10

What Is COVID-19

- **The Disease:** CoronaVirus Disease, 2019 (COVID-19)
- **The Virus:** Severe Acute Respiratory Syndrome
CoronaVirus 2 (SARS-CoV-2)
- **Related to:**
SARS – China, 2003, Korea, Africa
MERS – Middle East Respiratory Syndrome:
Jordan, Saudi Arabia in 2012, then Africa,
Asia, Europe, Korea in 2015
- **Risks:**
 - Person-to-person transmission
 - Airborne spread
 - Contaminates surfaces



11

How COVID-19 Spreads

- Directly through aerosols
 - Infected people breathing, coughing, sneezing
 - Touching an infected person's hand or face
- Indirect Contact
 - Touching surfaces like doorknobs, elevator buttons, railings, handles, etc. then touching your eyes, nose or mouth



12

COVID-19 Concerns

What are the facts? We're still learning! And the "facts" are constantly changing.

- "Social" Distancing – Really "Physical" Distancing
 - 6' not enough
 - Aerosols, droplets, etc. – Breathe, Speak, Sing, Yell, Cough, Sneeze: 4' - 34'
- Face Masks
 - Yes? Why, When, What kind
 - No? Why, When
- Symptomatic vs. Asymptomatic
 - 14 days?
 - 28 days, or longer?
- Vaccine
 - If / When?



13

ASHRAE Position Paper

Summary / Highlights

- Change building operations, including HVAC systems, to reduce airborne exposures
- Increase Ventilation and Filtration
- Maintain humidity between 40 – 60% RH
- Use higher MERV rated filters
- Run Systems Longer
- Use UVGI, in any form (duct, in-room, portable)
- Bi-polar-ionization (not mentioned – not enough 3rd party data)



14

Requirements - HVAC

- Flush with Outside Air
 - 100%? Or less?
- Humidification
 - 40-60% Relative Humidity (RH)



- Biofilm

15

Requirements – HVAC (cont.)

- Filtration
 - MERV 13,14 Filters (Minimum Efficiency Reporting Value)
 - HEPA filters (High Efficiency Particulate Air)
 - Electrostatic filters
 - Carbon filters
 - Ultraviolet
 - UV-C / GUV (Germicidal Ultraviolet)
 - Ionization
 - Needle Point
 - PCO (Photo Catalytic Oxidation)
 - Bi-Polar (BPI)

16

What Is Biofilm?

- Aggregates of predominantly bacterial cells attach to and grow on a surface.

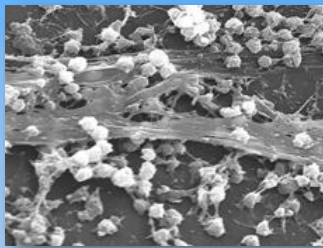
(Costerton J.W. and Stewart, P.S., 2001 Battling Biofilms. Sci. Am., 285:74-81.)

- Bacteria excrete slimy, sticky substance that allows them to adhere to surfaces.
- Extracellular polymeric substance (EPS) increases resistance to antimicrobial agents, heat/cold, cleaners.

17

17

Biofilm Effects



- Bacteria - in/on coils and fins – and other surfaces
- Lowers HVAC system efficiency
- Irritating odors – health issues

18

Solution to Bio-Film

Step 1: Proper Cleaning

- Use environmentally-friendly surfactants
 - Enzymes
 - Environmentally Friendly Microorganisms (EFM)
 - Break down biofilm and release trapped dirt
- Clean at the microscopic level

Step 2: Proper Disinfecting

19

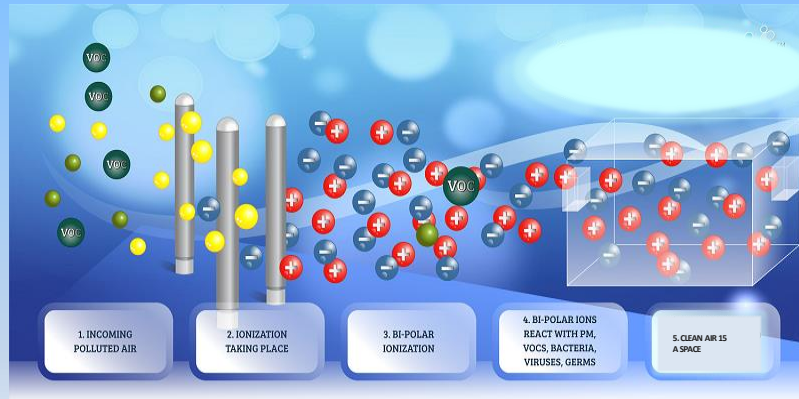
19

Comparing IAQ Systems – Rev. 08/14/20

	Bi-Polar Ionization	Needlepoint Ionization	PCO	UV	Media Filtration	Chemical Filter	Electronic Air Cleaner	Scent Generator
Reduces Contaminants "in the Space"	Yes	No	Yes	Yes ¹	No	No	No	No
Reduces Odors	Yes	Yes	Yes ³	No	No	Yes	No	Yes
Reduces VOCs	Yes	Yes	Yes ³	No	No	Yes	No	No
Reduces Particles	Yes	Yes ³	No	No	Yes	Yes	Yes	No
Effective on Bacteria and Germs	Yes	Yes	Yes	Yes	No	No	No	No
Effective on Viruses	Yes	Yes	Yes	Yes	No	No	No	No
Produces Ozone	No ³	No ³	No ³	No ²	No	No	Yes	No
Low Pressure Drop	Yes	Yes	Yes	Yes	No	No	Yes	Yes
Maintenance Requirements	Every two years	When needles wear out	Yearly ³	Yearly	Quarterly	Monthly	Monthly	Monthly
Requires Re-engineering of HVAC system	No	No	Maybe	No	Maybe	Yes	Yes	No
Reduces Energy Costs	Yes	Yes	Yes	Yes	No	No	Yes	No
Contaminants Must Travel Through Filtration System	No	No	No	Yes	Yes	Yes	Yes	N/A
Produces Chemicals or Byproducts	No	No	Yes	No	No	Yes	No	Yes
Tested Contaminant Reductions in Occupied Space	Yes ³	No ³	No ³	Yes ³	No	No	No	N/A
1 - When used in the space.								
2 - UVV (Vacuum UV), UV-A and UV-B typically produce ozone. Properly designed UV-C does not.								
3 - Depends on Manufacturer / Application								

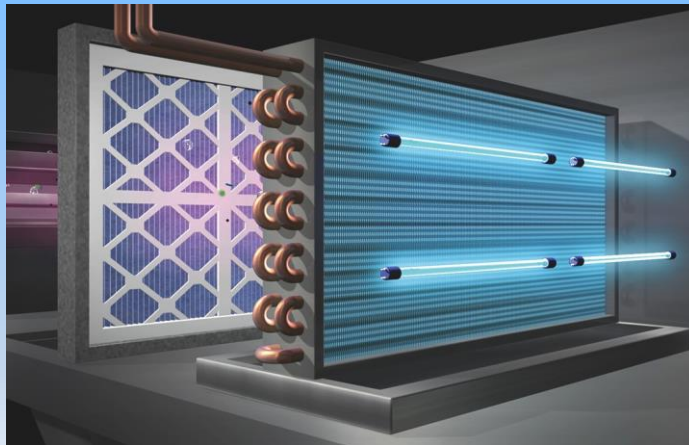
20

Bi-Polar Ionization (BPI)



21

Germicidal UltraViolet (GUV)



22

Pathogen Transmission

Pathogen infectivity is high when $RH < 40\%$



Greater
aerosol
transmission



Evasion from
surface cleaning
through
resuspension

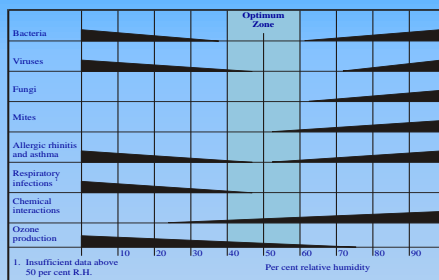


Increased
survival and
virulence of
pathogens

From Dr. Stephanie Taylor, M.D., M. Arch., CIC

23

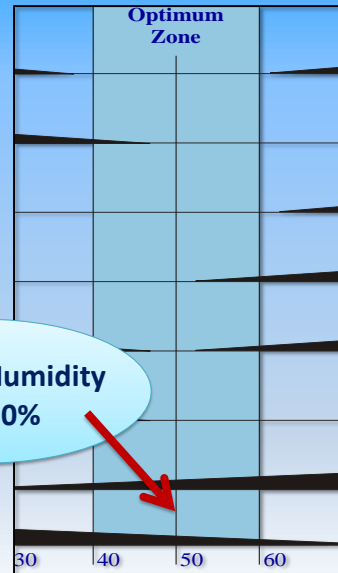
Optimum Relative Humidity for Health



E.M. Sterlino, Criteria for Human Exposure to Humidity in Occupied Buildings, 1985 ASHRAE

- Bacteria
- Viruses
- Fungi
- Mites
- Allergic Rhinitis and Asthma
- Respiratory Infections

**Optimum Humidity
is 40-60%**

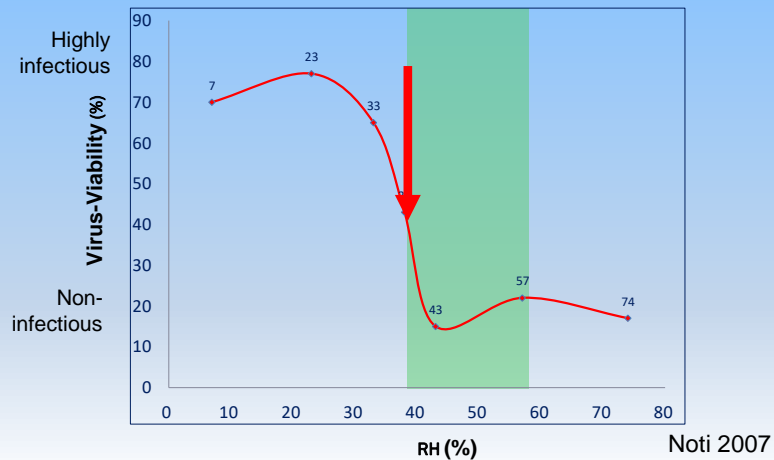


24

24

Role of Relative Humidity

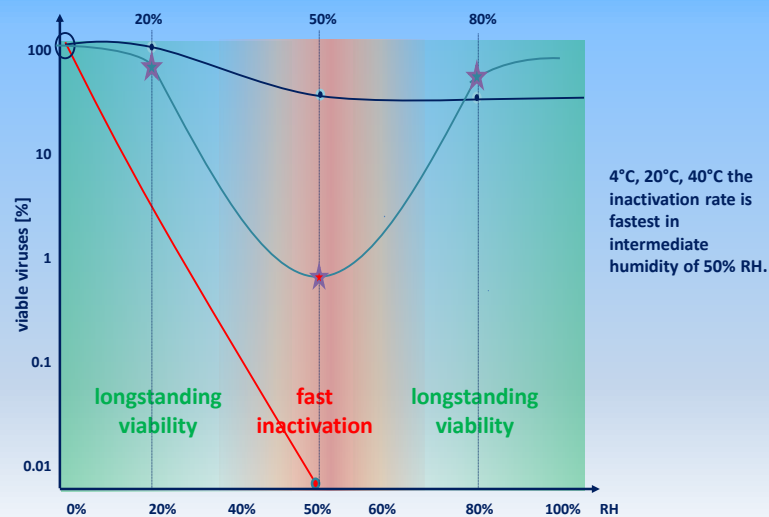
Influenza A virus is more infectious when RH is below 40% (Taylor)



25

Pathogen Transmission

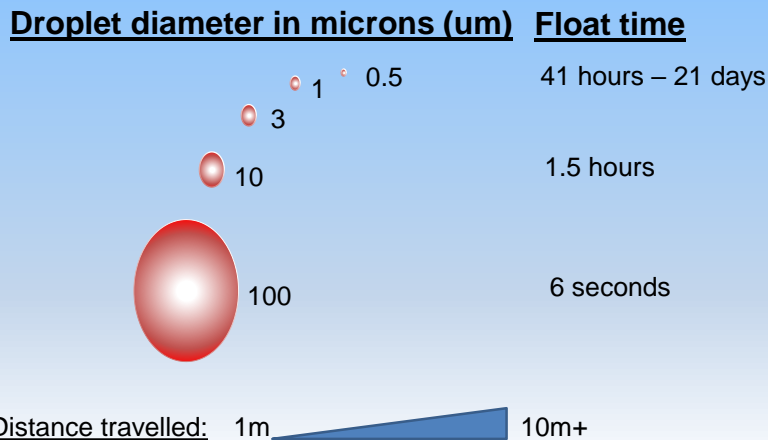
50% RH inactivated Coronavirus particles in air and on surfaces – true for all temps. (Taylor)



26

Infectious Droplets

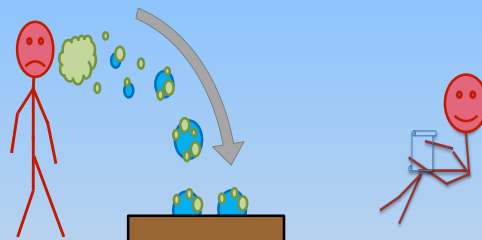
Infectious droplets shrink, travel far and evade surface cleaning when the air is dry. (Taylor)



27

Role of Relative Humidity

With healthy RH of 40%–60%, infectious droplets settle out of the airborne environment. (Taylor)



- Disinfection benefits of proper air hydration:
 - Bedrails and other frequently touched surfaces cleaned more effectively
 - Hand hygiene is maintained
 - Settled infectious droplets are not re-suspended

28

Viruses vs Surfactants

- 90% of all pathogens live in biofilms.
- Bacteria and viruses thrive in biofilm.
- Biofilm is difficult to penetrate - even with harsh chemicals and sanitizing methods.
- Microbes have different life spans on different surfaces.
- Sanitizers alone do not work. Proper cleaning is imperative.
- Biosurfactant and water will deactivate COVID 19.
- Testing to verify results is critical.

29

Viruses vs Surfactants

“Viruses are like tiny grease balls.
Therefore, scrubbing with surfactant
and water is the most effective solution
for deactivating unprotected virus!”

30

Other Environmental Stressors

Poor IEQ (Indoor Environmental Quality)

- Lighting – Glare
- Noise – Too much or not enough
- Vibration
- Ergonomic Stress
- The “New” Normal - PSYCHO-SOCIAL FACTORS

31

31

What To Do With an IAQ Problem – Real or Perceived

- Respond Immediately!!
 - If you don't, 1 goes to 2, 2 goes to 4, etc., until you have “Mass Psychogenic Illness”
 - Remember, “Perception Is Reality” to the person with the perception
- Identify Problem (if there is one)
- Make Necessary Corrections as Needed

32

32

Don't Do This



33

When Should Owner Seek Outside Assistance for IAQ Mitigation?

- Cannot identify the problem
- Mitigation efforts have been unsuccessful
- Air sampling is required
- Mistakes or delays could be serious
- Management feels that an independent investigation is more credible

34

34

How to Maintain Sustainability? Proper Operation & Maintenance

- Best designs and construction – doomed to failure without proper and ongoing maintenance
- Commissioning and re-commissioning
- Retro-commissioning to return to original design concepts and operation
- On-going Commissioning
- BE AWARE!

35

35

Owner Defensive Strategies (1)


- Avoid Potentially Offensive Building and Maintenance Materials
- Fully Commission Mechanical Systems Prior to Occupancy
- Understand Liability Insurance Coverage and Operate Within its Limits
- Document Everything



36

36


Owner Defensive Strategies (2)

- Operate with Adequate Ventilation
 - Operate Cooling & Heating Systems Conservatively
 - Toward the center of the Thermal Comfort Zone, see ASHRAE Standard 55
 - Clean and Maintain Equipment **Properly**
 - Operate Systems As Designed
- 

37

37

Owner Defensive Strategies (3)

- Periodically Check For:
 - Sensor stress: Auditory, Visual, Olfactory
 - Psychologically Stressful Conditions
 - Ask “Would I want to work/live there?”
 - Periodically Check Occupant Satisfaction
 - Re-Commission Systems Every Year To Ensure Proper Operation
- 

38

38

Summary: Why Be Concerned About Good IAQ?

- Overall Health of Employees and Tenants
- Reduced Absenteeism
- Increased Productivity
- Increased Profitability (cost of employee vs. operating costs)
- **Minimized Litigation Risk**
- *Saves Money & Makes Money*

39

39

Basic Conclusions

- IAQ - a large issue – **not** a simple issue
- IAQ - a part of IEQ
- HVAC - a large part of IAQ issues
- Proper Cleaning and Disinfection – HVAC/Other Surfaces
- Owners need assistance to avoid liability

40

Resources

Pandemic Resources: NewmanConsultingGroup.us/web-sites

Government & Industry Resources:

- AIA Committee on the Environment - www.aia.org
- ASHRAE - www.ashrae.org
- Building Owners & Managers Association - www.boma.org
- CDC – Indoor Environmental Quality - www.cdc.gov/niosh
- EPA – Indoor Air Quality - www.epa.gov
- IAQA – Indoor Air Quality Association - www.iaqa.org
- US Green Building Council - www.usgbc.org
- World Green Building Council - www.wgbc.org

41

41

“The greatest challenge we face today is failure to adapt to change”

Tim Wentz, ASHRAE President, 2016-17

For Further Information:

James L. (Jim) Newman

- JimN@NewmanConsultingGroup.us
- www.newmanconsultinggroup.us
- +1-248-626-4910

42



**James L. Newman, CEM, CSDP, LEED AP BD+C, ASHRAE OPMP & BEAP
ASHRAE**

- Co-Chair, IAQ Subcommittee for new Chapter on Climate Change in 2021 Handbook of Fundamentals
- Member, COVID-19 Task Force (Local)
- Distinguished Lecturer since 2010
- Former Member, now Corresponding Member, Air-to-Air Energy Recovery Technical Committee (TC), Operations and Maintenance TC
- Past Vice-Chair, Industrial Air Conditioning TC
- Member, Energy Position Committee, 2008
- Fellow, 2021
- Past Board Member (Local)

BUILDING OWNERS & MANAGERS ASSOCIATION (BOMA)

- Immediate Past Chair, Sustainability for Savings Committee (Local)
- Trainer, High Performing Building Certification

ENGINEERING SOCIETY OF DETROIT (ESD)

- Past Chair, Council of Affiliated Organizations
- Fellow, 2010

U.S. GREEN BUILDING COUNCIL (USGBC)

- Founding Member, Detroit Regional Chapter
- Past Chair, Public Policy/Advocacy Committee (Local)
- Past Board Member (Local)

AMERICAN INSTITUTE OF ARCHITECTS (AIA)

- Member, Committee on the Environment (COTE)

URBAN LAND INSTITUTE (ULI)

- Member, Technology and Real Estate Council