Ventilation for industrial settings during the COVID-19 Pandemic.

Jonathan Hale, MPA

On today's episode of IAQradio, Jonathan Hale, MPH discussed a new ASHRAE paper called Ventilation for Industrial Settings during the COVID-19 Pandemic.

Nuggets mined from today's episode:

After being a high school science teacher, Johnathan went to work for the EPA as a permit engineer where he did a lot of environmental testing. He then worked for Douglas Batteries where he was responsible for the health and safety of 500 workers. He wanted to design systems and got involved with the North Carolina Ventilation Conference and has taught ventilation courses at colleges and universities including Johns Hopkins and Michigan State. Now, Jonathan fixes broken ventilation systems and consults on minimizing risks to employees.

Jonathan discusses the white paper with IAQradio's hosts and audience: Ventilation for Industrial Settings during the COVID-19 Pandemic. A MUST download: https://www.acgih.org/news/2020/08/18/acgih-sup-reg-sup-covid-19-white-paper---complimentary-access

The current ACGIH ventilation manual (30th edition) is recognized and used globally. The next revision will include COVID-19 recommendations. The manual is about engineering controls. Air principles are the same for all engineers.

Turbulent air delivered through high velocity grilles creates temperature uniformity which is the antithesis of what you want if you are dealing with COVID-19.

Hierarchy of control- Elimination (of hazard), Substitution (replace hazard), Engineering controls (e.g. isolation of hazard), Administrative controls (e.g. change behavior pattern), PPE (protect workers). Industrial hygienists and environmental engineers don't like masks, they want fitted respirators.

Ventilation engineers want to segregate unwanted substances from the other air.

Paint spray booth provides good worker protection. While a working line in a meat packing plant does not. Risks should be minimized at every opportunity and given point. Greater air turnover rates use more energy.

Workers should be placed between clean air and the exhaust point.

Designing ventilation systems is based upon the rules of goes-inta and goes-outta.

Humans are a mobile source of COVID-19. Exhaled breathe is warm and humid. Exhaled breathe is buoyant because water is lighter than air. When compared the molecular weight of water is 18 and the molecular weight of air is 28.96. When dealing with COVID-19 bring in air, low and slow.

COVID-19 viruses come in 2 sizes, greater than 1 micron and as small as .10 micron. Expelled cough or sneeze particles comprised of water and protein are larger and fallout of the air in 2 meters. Breathing and talking particles are much smaller and can travel further.

Mixing ventilation uses high velocity grilles to attain uniform temperature and will uniformly distribute COVID-19. In displacement ventilation intake air is drawn in low and slow where it stratifies upwards and is exhausted. Displacement ventilation reduces human exposure. Displacement ventilation is used in automotive painting, indoor shooting ranges and hospital operating theatres.

We cannot mitigate COVID-19, we can only reduce it.

Room purge equation. [Definition- The basic room purge equation is used in industrial hygiene. It determines the time required to reduce a known vapor concentration existing in a closed space to a lower vapor concentration.
The equation can only be applied when the purged volume of vapor or gas is replaced with "clean" air or gas.]

The COVID-19 Chinese restaurant study showed that COVID-19 spread laterally because the air in the restaurant was recirculated without the addition of fresh air.

Now is a great time to check your HVAC system for proper operation.

Local exhausts and ventilation systems should be operated continuously.

Clean air should be directed onto employees, airflow should be upward and exhausted.

The effect of local exhaust is limited by diameter. Beyond a distance of 1 diameter suction and sphere of influence degrades.

Capture velocity is 100-200 feet per minute. If you can feel air movement on a warm hand the air is moving at more than 100 feet per minute.

When air contacts air filters particles are buffeted around and move side to side due to Van der Waals forces. [Definition. Van der Waals forces include attraction and repulsions between atoms, molecules, and surfaces, as well as other intermolecular forces. They differ from covalent and ionic bonding in that they are caused by correlations in the fluctuating polarizations of nearby particles (a consequence of quantum dynamics). Wikipedia]. Curve of effect, HEPA filters work most effectively on large and nano size particles. HEPA filters are tested and certified based upon Most Penetrating Particle size of .3 microns.

Individual personal comfort units (e.g. heaters, air cleaners, fans) in offices can spread COVID-19.

Computational fluid dynamics is an important new research tool. [Definition: Computational fluid dynamics is a branch of fluid mechanics that uses numerical analysis and data structures to analyze and solve problems that involve fluid flows. Wikipedia]

Important Suggested Measures- COVID-19

Increase the outdoor air supply to 100%, if possible, or to the maximum allowed by the capabilities of the ventilation system. Some additional considerations include the climate, air pollution, and system capacity, and making sure the outdoor air intakes are clear and not drawing air from a parking lot, traffic side of building, or near smoking areas or loading docks. Make sure the ventilation system is performing as designed and has been properly maintained per ASHRAE 62.1 (ANSI/ASHRAE, 2019).

Maintain between 6 and 12 ACH, which will provide greater than 99% purge in 30−60 minutes (CDCd, 2019).

Increase the filtration efficiency of the system to MERV 13 or as high as the filter racks and fan pressure drop will allow. System designers should attempt to accommodate Tier 1 MERV filters (MERV 13 and 14) in their current and future designs, as applicable, to ensure best airflow through the system with equipment that can withstand the added pressure drop.

Provide additional dilution ventilation to disperse small airborne particles. Dilution ventilation should be introduced into the facility at low velocities at floor level whenever possible, with directed flow toward exhaust fans above, and spread over large areas.

Allow the ventilation system to operate continuously if the building is occupied or long enough to allow for several complete air changes following the departure of all building occupants. If the system is shut down or set back overnight, return to full operating conditions prior to occupant return.

Make sure restroom fans operate continuously and are exhausted directly outdoors with exhausts away from facility ventilation supply intakes. Temporarily disable or discontinue use of hand dryers in restrooms and replace with disposable paper towels.

Allow LEV (local exhaust ventilation) systems to operate continuously while attended. If variable air volume laboratory hoods are present, leave the hood sash in the up position to allow maximum airflow and maximum air volume to be exhausted when not in use.

General airflow direction should be from cleaner air to less clean air, and processes and workers should be placed on the cleaner side of the airflow pattern within this general airflow pattern to reduce their exposures. Avoid having personal or pedestal fans blow from one person to another. Remember they will blow 30−40 times the fan diameter very effectively.

Typically, more outdoor air is better. However, high velocity currents passing through open doorways or from a pedestal fan can project viruses hundreds of feet in rapid fashion (although some dilution will also occur). Where inflow occurs at high velocity near workers, attempt to diffuse large air currents by directing or blocking the flow stream to avoid moving the air from person to person.

Expanded metal and perforated or unperforated screens are very effective to diffuse large air masses at high velocity.

Jonathan Hale's Final Thoughts-

- It's all about that risk.
- Consider how protected do I need to be? When incubating a COVID-19 patient use PPE that will allow you to return home safely.
- CFM X ΔT is the experience.
- Acknowledged Frank Mortl and Dr. Lisa Brosseau at ACGIH

Z-Man's final comment- Jonathan has a knack for simplifying complex technical information.

Z-Man signing off

TRIVIA-

Name the term used to refer to the particle size at which an air filter has its lowest arrestance.

Neil Zimmerman