

White Paper – Controlling Virus Spread Control though Air Filtration/Sterilization with UV-C Light and Bi Polar Ionization

Since the Covid-19 virus was declared a Pandemic in March of 2020, the scientific community has been focussed on spread control/prevention and a vaccine. Hand sanitization, 2M physical distancing and PPE will always be a part of spread prevention but what else can we do?

Evidence through contact tracing and air-flow modeling have shown that the new strains of the virus such as B-117, can travel up to 4.5M, (15ft), by following air patters created from a HVAC’s air distribution system.

This paper focuses on air filtration utilizing UV-C radiation and bi-polar ionization to reduce the risk of air borne transmission.

Filtration

The unit of measurement for a virus is microns – 1 micron = 1/1000th of a millimeter. A N95 mask or 95% HEPA filters air particulates down to 0.3 microns. So is any mask or filter effective against virus spread? The answer is “yes” because the virus cannot travel on it’s own. The virus becomes attached to water droplets or aerosols, that are generated by breathing, talking, sneezing, coughing etc. These water droplets or aerosols consist of water, mucus, protein and other biological material making them larger than 1 micron making N95 lasks and HEPA filters affective in arresting the virus.

Even though N95 masks and 95% HEPA are rated to filter particulates to 0.3 microns, they can be effective in filtering much smaller particles due to two factors:

- 1/ Brownian Motion - the name of a physical phenomenon in which particles smaller than 0.3 microns move in an erratic zigzag motion increasing the chance they will be snared by the mask/filter fibres.
- 2/ Electrostatic Absorption – particles are drawn to the filter fibre and trapped instead of just passing through.

The depth of HEPA filter determines the “loading” or life span of the filter. A one inch thick HEPA filter will require replacement much more often than six inch deep due to the increased surface area.

UV-C Light

Ultraviolet purification has been utilized for many years in clean rooms, liquid treatment, domestic ponds, and in food preservation. UV-C works using a photolytic effect whereby the radiation destroys or inactivates the micro-organism so that it can no longer multiply. The ideal UV-C wavelength is 254 nanometers which is effective in cell destruction, safe for human exposure, and will not generate ozone. UV-C radiation is generated using a low pressure mercury discharge lamp where on average, 35% of the input energy, is converted to UV-C light. (watts), making it very efficient in the lighting world.

UV-C radiation cannot instantly destroy a cell so is ineffective on a virus or bacteria travelling through an air distribution system at a high velocity. The UV-C intensity, referred to as “the dose”, determines its cell destruction effectiveness which is expressed as:

$$1\text{mJ}/\text{cm}^2 = 1000 \text{ micro-watts}/\text{second}/\text{cm}^2$$

<u>Dose (mJ/cm²)</u>	<u>Reduction in no. of Live Organisms</u>
5.4	90.0%
10.8%	99.0%
16.2%	99.9%
21.6%	99.99%

A UV-C lamp emitting radiation on the inlet side of a HEPA filter bathes the face of the filter with UV-C radiation where the bacteria and particles are trapped.

Bi-polar Ionization

This technology uses an electronic charge to create a plasma field filled with high concentrations of + and – ions that replicate those commonly found in nature. As these ions travel with the air stream, they attached to particles, pathogens, gases. As the ions attach to air borne particles including fine sub-micron articles, they are then attracted to each other making the particulate larger and more easily filterable and increasing capture efficiency. The second advantage of this technology is Ions also deactivate pathogens by robbing them of life-sustaining hydrogen.

Air Changes

No filtration or sterilization system can be effective if the air is not passing through it. A single zone portable air filtration/sterilization unit is effective in an area up to 750 sq ft, 70 sq m before recirculation or “short cycling” reduces the efficiency. Multiple units would better serve larger areas to ensure complete filtration/sterilization.

Temspec Air Medic Air Filtration/Sterilization Unit

The Air Medic unit is a standalone unit offering up to 5 stages of air filtration/sterilization. A MERV 10 prefilter, and 95% HEPA filter are standard with optional activated carbon, bi-polar ionization and UV-C light being options. Model TIF-06 delivers 400 CFM in standard operating mode with 650 CFM purge make it effective for spaces up to 750 sq ft., 70 sq m, (classroom, waiting room, board room, change room, common area, lunch room)

References 1. Biological Effects of Ultraviolet Radiation W. Harm, Cambridge University Press 1980 2. The application of ultraviolet Germicidal radiation to control Transmission of Airborne Disease, Public Health reports/ March -April 2003 , VH118. 3. IES Lighting Handbook, Application Volume, 1987, 14-19.