

H Live Webinar **Hospital Air Filtration and Facemasks to Fight COVID-19**

> Open educational forum
 > Experts to answer questions online



Moderator: Christine Sun, President, WFI



Dr. Sun is a globally renowned expert and leader in the filtration Industry. She served as the Chair of the American Filtration and Separations Society (AFS) from 2016-2017 and is the current Operation Chair of 13th World Filtration Congress. She received the AFS Fellow Award in 2019. With over 30 years of experience in both academia and industry, Dr. Sun has both broad and in-depth knowledge of filtration, and extensive and hands-on experience in product development. © All Rights Reserved © '



Panel Experts

- Mr. Tom Justice, Waterloo Filtration Institute (USA)
- Dr. Peter Tsai, University of Tennessee (USA)
- Mr. Bob McIlvaine, McIlvaine Company (USA)
- Mr. Bob Burkhead, Blue Heaven Technologies (USA)
- Rights Reserved © All Rights Reserved Mr. Stephen Nicholas, Air Industrial Technical Services (USA)
- Dr. Gajanan Bhat, University of Georgia (USA)
- Dr. Chao Tan, University of Waterloo (Canada)
- Mr. Eric Fu, Aimwell, Australia
- Mr. Jay Forcuchi, Cerex (USA)
- Dr. John Zhang, 3M (USA)
- Dr. Christine Sun, Waterloo Filtration Institute (USA)



Panel Speaker: Tom Justice, Director of Marketing, WFI



Mr. Justice is well known throughout the filtration industry having spent over 38 years in various assignments from R&D to Operations and Sales. He served as VP of Operations for Clarcor until 2005 and later as COO of Flanders. Active in industry trade associations, he is currently President of the National Air Filtration Association, member of UL Standards Technical Panel for Air Filter Units, a voting member of the US TAG to ISO/TC to ISO for Aerosol Filters for Nuclear Applications. 142 for international air filter test standards and US expert



Current Debate

- The World Health Organization issued a statement that SARS-CoV-2 is not airborne and does not spread between people who are more than 6 feet apart.
- Other research now suggests that viral droplets can travel further than 6 feet and that the virus can persist in the air in aerosol form





Can it Spread Through the Air

- Most scientists agree that the virus is transmitted primarily through droplets.
 Scientist and the virus is transmitted primarily through
- Scientists still debate to what degree aerosols could stay suspended and infect the next person.





Recent Studies

• A new CDC study found that the virus could travel up to 13 feet

In a hospital in Wuhan, China air sampling identified "live" coronavirus in 35% od samples from ICU and 12.5% of air samples from general wards.





Aerosol Transmission in Hospitals

- Healthcare workers are exposed to much higher concentrations of the virus.
- Higher airborne concentrations recorded in medical-staff - Procedures during ventilator intubation
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Personal protective equipment (PPE) for health workers

Is Air Filtration Effective ?

- "But we can infer from what we know for similar viruses, like SARS", that there is reason to think air purifiers might help in some situations.....Jeffrey Siegel, University of Toronto
- "In theory, if an air purifier removes viruses from the air, it reduces concentrations in the room and thus reduces the potential for exposure"Linsey Marr, Virginia Tech





Air Purifiers Used at Frontline Hospitals in Combatting COVID-19 in Wuhan





Airborne Infection Isolation Rooms (AIIR)



Bag In / Bag Out Housing



Principles of Airborne Infectious Disease Management

- Administrative –work practice controls
- Environmental controls
- Personal protective equipment (PPE) for a fight s Reserved (PPE) of a fight s Reserv





Temporary Negative Pressure Isolation TNPI

- Discharging Air to the Outside
- Discharging Air to the Return Air System

Curtain THPI



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STANDARD

ights Reserved © All Rights Reserved ANSI/ASHRAE/ASHE Standard 170-2017

(Supersedes ANSI/ASHRAE/ASHE Standard 170-2013)

C All Rights Reserved Ventilation of Health Care Facilities



Panel Speaker: Peter Tsai, Univ. of Tenn.



Education: Ph.D. in Material Sciences, The University of Tennessee (UT) Expertise: Development of meltblowing (MB) system and the electrostatic charging (EC) of materials for making air filter electrets. The MB and the EC developed by PT have been used in the industries worldwide making billion pieces of N95 or above face masks. He receives three most prestigious awards from UT in recognition of his entitled by AFS as a Fellow Member. contribution in technology innovation and transfer. PT is



Electrostatic Charging of Fibrous Materials (Electret)

- Corona charging Efficiency increased by 10X

- Polarization (not suitable for filter media), see Reserved Induction (included in the c'



Air Filtration Mechanisms



- Mechanical
- Electrostatic

Coulombic force to capture charged particles

Image force by polarization to capture neutral particles including smog,





Charge decay phenomena

- Ambient conditions (25C, 50% RH), shelf time
- Heat (Dry, moist, steam, boiling)
- H2O2
- In and after use
- NRights Reserved © All Rights Reserved © All Rights Reserved • UV, Gamma, under sunshine depending on dose and exposure time
- Alcohol erases the charges https://www.n95decon.org/
- Soap wash or Bleach erase the charges



Dry or moist heat



Quiescent decay

- Shelf life 5-10 years or longer
- Embedded charges, no dissipation to the air or in contact with water or conductive metals Contact Reserved © All Rights Reserved © All conductive metals



New England Journal of Medicine (NEJM, March 17, 2020)

- Viral Particle (Fomite) Survival Time (tested at 70–73°F and 40% humidity)

- Up to 4 hours on copper (median half-life 1.1–1.2 hours) Up to 24 hours on cardboard (hts Reserved © from graph)
- Up to 2 days on stainless steel (median half-life 5.6 hours)
- Up to 3 days on plastic (median half-life 6.8 hours)





Before and after H2O2 immersion

				After H2O2 treatment and				
	N95	Before H2O2 treatment		dry		orved		
	Respirators	FE (%)	R (mmH2O)	FE (%)	R (mmH2O)	Right's Reser		
	1	99.629	8	99.562	7.7 med	© All no		
	2	99.648	8.1	99.579	7.9 ^{eset}			
	3	99.674	7.9	99.583 °	All Kib 7.7			
	4	99.67	8.2	99.582	8			
			IIA O boy	KIP.				
Before H2O2 immersion treatment - New								
	N95	O All RIP						
After2.5% - 3.5% H2O2 immersion treatment for five minutes. The respirator wetted out.								
	Dripping dry fo	ipping dry for 24 hours, not quite dry, then heat treated at 70C for 30'						
Tested using TSI 8130 according to CFR 42 Part 84 at 85 lpm to test N95								
	© All rights reserved							

Deactivation approved by FDA for COVID-19

Vaporous H2O2 for two hours (two companies)

1. Vapors on the mask surface

The captured virus will remain captured inside the mask if they are not deactivated. 2. Vapors through the mask

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Deactivation methods validated by NIH for COVID-19

https://www.nih.gov/news-events/news-releases/nih-study-rights Reserved validates-decontamination-methods-re-use-n95-respirators

- Vaporous H2O2
- erved © All Rights • Dry heat at 70C for 50 minutes (vs 56C -75C, 30' for SARS • Ethanol, Reserved © All Rights Reserved © All

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Panel Speaker: Bob McIlvaine



Bob McIlvaine is president of the McIlvaine Company which he founded in 1974 to analyze air and water purification technologies.

Recently a daily Coronavirus Market Alert was initiated. It covers masks, filters and other mitigation technologies and markets.



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Back to Work with Masks and Filters

A safe way to restart the economy





Pandemic Impact on the Filter and Mask Market



The world needs to address the pandemic with a solution which is safe but allows near normal functioning of business and society. McIlvaine believes that using the latest cleanroom and hospital mitigation technologies this Distancing and Sheltering Alternative can be safely cost effective.

The extent to which it will be employed has major implications for the filter and mask markets. It could triple the media market and double the filter equipment sales under conservative forecast parameters and the market could be orders of magnitude greater under assumptions that the virus proves hard to mitigate





It Will Very Likely Be Proven That Airborne Transmission is a Major Cause of Infection

- If the virus travels long distances in the form of droplets smaller than 5 microns, these droplets have a good chance of deep lung penetration.
- The best protection will be a mask of N95 or even higher efficiency.
- The virus will travel through HVAC systems and unless HEPA efficiency filters are installed will travel from space to space within an office or apartment building.
- It is common knowledge in the filtration industry that very small particles can travel thousands of miles



The general public is being wrongly advised about social distancing when standing one foot upwind may be better than 30 feet downwind. A voting line moving slowly at a 6 foot distance means walking through a continuous virus cloud. Medical workers with proper masks work closely with patients without being infected.





Revenues for Filters,

Air Filter and Systems Market in 2021 Reserved © All Rights Reserved 35000 ed © All Rights 30000 C All Rights Reserved CANNERS Reserved 9 10000 Media Systems Filters Without High Low

■ Filters ■ Systems ■ Media





Pandemic Impact on the Mask Market



V Rights Reserved The potential to change the mask market is even greater. In any case the market will be much larger. In addition meltblown media may be largely replaced with new washable and more efficient nanofiber membranes. New mask designs built around a permanent washable structure with replaceable filtration media inserts could capture market share.

Media options: more efficient meltblowns, new spunbond composites, two polymer spunbonds, nanofiber membranes charged and uncharged, various other membranes





Comparative Unit Sales



In an extreme situation where COVID-19 keeps reappearing and vaccines are only effective for a year, it may be necessary for most people to wear N95 efficiency masks when in public. Even at the low cost of ten cents per wearing this would create a market of over \$100 billion per year which is orders of magnitude larger than the present market.

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\$109 Billion/yr 3 billion spend \$0.10 on masks per day= \$300 million per day

World Population of 8 billion





Distancing and Sheltering Alternative

The distancing and sheltering alternative involves the following technologies in combinations which optimize the life quality costs. Each technology will be used to the extent that benefits outweigh the costs.

General Technologies

- Virus and antibody testing
- Walk through temperature scanners
- Cell phone based contact analysis for all employees



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Air Filters and Systems

The ability of HEPA filters to capture the COVID-19 viruses to Reserved Percentage of world population who will contract the UP The ability of the virus to reasonable of the virus to Here are some factors which will determine whether the air filter market boost will be modest or very large.

- Willingness of governments to support the investment in filtration systems to address the problem
- Coordination in a proactive program which combines air filtration technology with personal protective equipment and operating practices
- Acceptance of a common metric to measure the life quality impacts as well as economic costs of alternative strategies (McIlvaine has prepared © All Rights analyses based on Quality Enhanced Life Days)
 - Education of governments, industries, and individuals relative to the science and impacts





Masks

Will demand drop when a coronavirus vaccine is in wide use? Inthe second of masks to provide the first of masks to provide the The market for face masks will soar over the next few years. Suppliers need to continually seek answers to the following questions.

- What will be the ratio of disposable vs reusable?
- What materials are most compatible with various decontamination methods?
- What will be the role of nanofibers and other materials to compete with spunbond, meltblown laminates?
- surgical masks, N95, N95 medical, elastomeric reusable, novel designs? What will be the market segmentation between do it yourself, medical masks,





Geography

There are separate analyses which need to be applied to each country

- Projected infection rate
- Population
- **Mitigation Policies**
- Existing healthcare and business structure
- GDP and ability to undertake an effective program

In effective program All refrective program All refr

A number of associated technologies will shape the market.

- Masks can be decontaminated and reused
 - What are the economics of H2O2 vs alcohol, vs ozone, UV, heat etc.?
- What is the existing equipment which can be used?
 What is the cost of new equipment?

 - Rooms and HVAC systems can be treated with UV light







Competition

A number of competitive factors will shape the market for the individual suppliers

- Regional demand fluctuation. The large surge of mask demand and production in China will have implications for the worldwide market
- Innovative technology:
 - The use of membranes in filters and masks is
 likely to greatly influence the markets.
 - There are major developments in filter and mask designs.

N95 efficiency washable mask with valve sold through retail stores in China for \$33





Panel Speaker: Robert Burkhead



Education: BS in Mechanical Engineering Technology – Western KY University Expertise:

- Blue Heaven Technologies 16 years of air filtration product performance testing and evaluation
- Multiple trade organization participation for 40+ years (ASHRAE, ISO, ASTM, INDA, NAFA etc.)



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Face mask and media testing confusion:

- Current heavy interest in media screening and evaluation
 Lack of basic understanding of the task Lack of basic understanding of design and testing constraints
- Specific difference in respirator vs medical mask criteria
- FDA and NIOSH rules and "emergency response" strategy © All Rights Reserved © All Right



Fractional Efficiency Measurements for Masks

		Certification Testing Requirements			
Description		N95 Respirator Masks	Medical Masks		
Federal Regulation in Control		42 CFR 84 -subpart K	21 CFR 878.4040		
Test Method Document		NIOSH TEB-APR-STP-0059	ASTM F2100 - ASTM F2299		
Destructive test?		Yes	Yes		
Format	Mask Flat media	Yes Yes	No Yes		
Test Stand requirement		TSI 8130 or equivalent	Recommended in the document		
Conditioning step		85% RH and 35° C for 25 hour 30 to 50% RH and 21° C			
Loading step		200 mg of NaCl	None		
Challenge Aer Material Size target (Nanome		NaCL 75	PSL Spheres 100 (up to 5000)		
flow rate	l/min ft3/min	850 AM RIB	not Specified		
media velocity cm/sec ft/min		7.25 (195 cm ² mask) 14.27 (195 cm ² mask)	.5 to 25 1 to 50		
Performance	e requirements Efficiency (%) Resistance	>= 95	Level 1 Level 2 and 3 >= 95 >= 98		
Inhale Exhale		20 (mm of H ₂ 0) 35 (mm of H ₂ 0)	< 5 <6 (mm of H ₂ 0/cm ²) both		

Methods comparison

• KEY PROBLEM – confusion about what particle size is targeted (NOT .3 micron!!)
 • N95 conditioning and loading

steps

Clarification on what is a "Medical N95"

Sources:

https://www.cdc.gov/niosh/npptl/topics/respirators/disp part/default.html NIOSH - TEB-APR STP-0051 through 0059 ASTM - F2299-19 ASTM - F2100-19 EN 14683-2019



Panel Speaker: Stephen W. Nicholas





Education: Harvard School of Public Health Executive and **Continuing Professional Education Expertise:** Past President of The National Air Filtration Association. Certified Air Filtration Specialist and Certified Level II Technician for Bag/In-Bag/Out HEPA Applications. Certified Testing Adjusting and Balancing Technician for Commercial Building HVAC Systems. Over 35 years field experience in the air filtration industry. Served as consultant to ANSI/ASHRAE/ASHE Std. 170 "Ventilation of Health Care Facilities" and past member of ANSI/ASHRAE Std. 52.2 Air Filter MOT.

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ASHRAE Standard 170

Table 6.1 Minimum Air Filter Efficiencies

MERV-7

MERV-7

MERV-7

MERV-7

- Space Designation
- Operating Rooms
- MERV-7 Impatient care and treatment
- Protective Environment Rm.
- Laboratory, procedures
- Administrative, bulk storage
- All other Outpatient spaces

Filter Bank #215 Reserved Filter Bank #1 MERV-14 red © All Righ MERV-14 HEPA, cd MERV-13 b N/R N/R N/R



ASHRAE Standard 170, 6.4 Filtration

- MERV 12 or greater shall have installed pressure differential device
- Filter Bank # 1 shall be located upstream of heating and cooling coils
- Filter Bank # 2 shall be installed downstream all wet-air cooling coils. All secondary filter banks shall have sealing interface surfaces
- Filter Bank Blank Off Panels shall be permanently attached to frame
- Filter Frames shall be durable and proportioned to provide an airtight fit. All joints between filter segments shall have gasket or seals.

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Gajanan Bhat, Chair Professor, UGA



• Dr. Bhat was a faculty member at the University of Tennessee, Knoxville for 26 years, where his research covered nonwovens - melt blown, spunbonded and biodegradable, plastics recycling, nanotechnology, sustainable materials, and high performance fibers. Since July 2016, he has been the Head of the Textiles and Merchandising and Interiors department at University of Georgia, where he continues to be active in Nonwovens R&D. He is active in INDA. TAPPI and the Fiber Society.

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Home-made and Alternate Masks

- There is increasing trend to make masks from available cloth at home.

- It will not give protection close to what is needed
 Depending on the cloth and multiplicity
 - protection
 Should be careful from false sense of security



Facemask Media Technologies

Electret PP meltblown nonwovens are dominantly used



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New Developments with Nanofibers



Source: UFT CAN, Univ. of Waterloo

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New Developments with Membranes



THANKS to Expert Panel

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Introduction to Global Filtration Market



Panel Discussion: Impact of COVID-19 on Global Filtration Market

Mr. Jay Forcucci WFI 2020 Co-Chair VP of Cerex Advanced Fabrics Tuesday, May 05, 2020, 8:00am-10am, ET Canada & US



Thanks to WFI Members



Thank You for Your Attention

For Questions, Contact Us

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