Antimicrobial HVAC filtration to reduce the airborne transmission of infectious disease

V2.0

Industrial Polymers & Chemicals, Inc.

Prepared by: Ralph G. Dacey, Jr., Robert Roth, Thomas Kennedy

Executive Summary

Our company, Industrial Polymers & Chemicals Inc., has developed an innovative technology using biocidal polymer systems and bioactive filtration to dramatically increase the effectiveness of HVAC filters in inactivating airborne viral and bacterial pathogens. The international consensus is that indoor air quality must be improved including the effective filtration of airborne viruses. The new engineering standards for ventilation and improved air filtration, ASHRAE 241, will drive increased utilization and innovation in the design and operation of HVAC systems. Our bioactive filtration, ablative polymer technology is relatively inexpensive and will not require the reinstallation or modification of existing HVAC systems. We believe that our technology will prove to be a very important modality in the fight against airborne viruses and bacteria with the potential to significantly change the $12 billion HVAC filter industry across the globe. We have conducted environmental analysis - done by an independent third-party - indicating that our technology will be environmentally safe.

Our Development Team

- **Susan Dacey**, CEO and Chairman of the Board of IPAC.
- **Ralph G. Dacey, Jr.,** former Professor and Chairman, of the Department of Neurosurgery at Washington University School of Medicine and a member of the Board of Directors of IPAC.
- **Robert Roth**, virologist, inventor, and entrepreneur in biomedicine. He is a principal at Apath, LLC, a privately held technology licensing company engaged in the commercial application of virology and viral genetics to assist pharmaceutical companies in discovering and developing therapeutic products for the treatment of viral infections, most notably, the hepatitis C virus.
- **Thomas Kennedy**, Chief Technical Officer, IPAC (2019-2023), Consultant, IPAC (2023-present). Mr. Kennedy is the inventor of IPAC's bioactive polymer technology, he is a polymer chemist and patent agent.

About Us

Industrial Polymers & Chemicals Inc. (IPAC), is a manufacturing company located in Shrewsbury, Massachusetts. IPAC was founded in 1959 by Ralph G. Dacey. After graduating from Harvard Business School, Mr. Dacey served in the United States Navy and was a leader in the development and production of proximity fuses during World War II. Under his leadership, IPAC became the largest North American supplier of fiberglass reinforcement technology for the abrasives industry. In 1996, Susan Dacey became CEO and Chairman of the Board. Mrs. Dacey has driven continued success in IPAC's traditional business lines, and expanded the company into adjacent opportunities.

IPAC has almost 70 years of experience and expertise in coating woven fabrics with polymer systems for fiberglass-reinforced abrasive cutting and grinding wheels. The company also has extensive experience in kitting and cutting related to various fabric applications, including fiberglass reinforcement, Kevlar deployed in protective equipment for police officers and soldiers, as well as personal protective equipment for healthcare workers. In 2021, Mr. Kennedy invented an ablative polymer system to improve the performance of HVAC filters in inactivating the SARS-CoV-2 virus. This effort was spurred by an award in October 2020, issued by the Innovation Institute at the Massachusetts Technology Collaborative, to encourage the development of new technology related to the COVID-19 pandemic.

The Problem: Airborne Infectious Diseases

HVAC systems are vital to indoor air quality and comfort. During the COVID-19 pandemic it has become clear that HVAC systems can be used to reduce the risk of infection caused by unclean indoor air. The Environmental Protection Agency (EPA), in collaboration with the American Society of Heating, Refrigerating and Air conditioning Engineers (ASHRAE) created standard 241 to reduce indoor infectious aerosols. Standard 241 establishes minimum requirements to reduce the risk of airborne disease transmission in all buildings in the US. The standard applies to both new and existing buildings and provides requirements for many aspects of air system design installation operation and maintenance. Additionally, ASHRAE Standard 241 outlines the implementation of Infection Risk Management Mode (IRMM), a set of mandated requirements for infection risk management of buildings to be applied during identified periods of elevated disease transmission risk. (1,2,3,4,5,6)

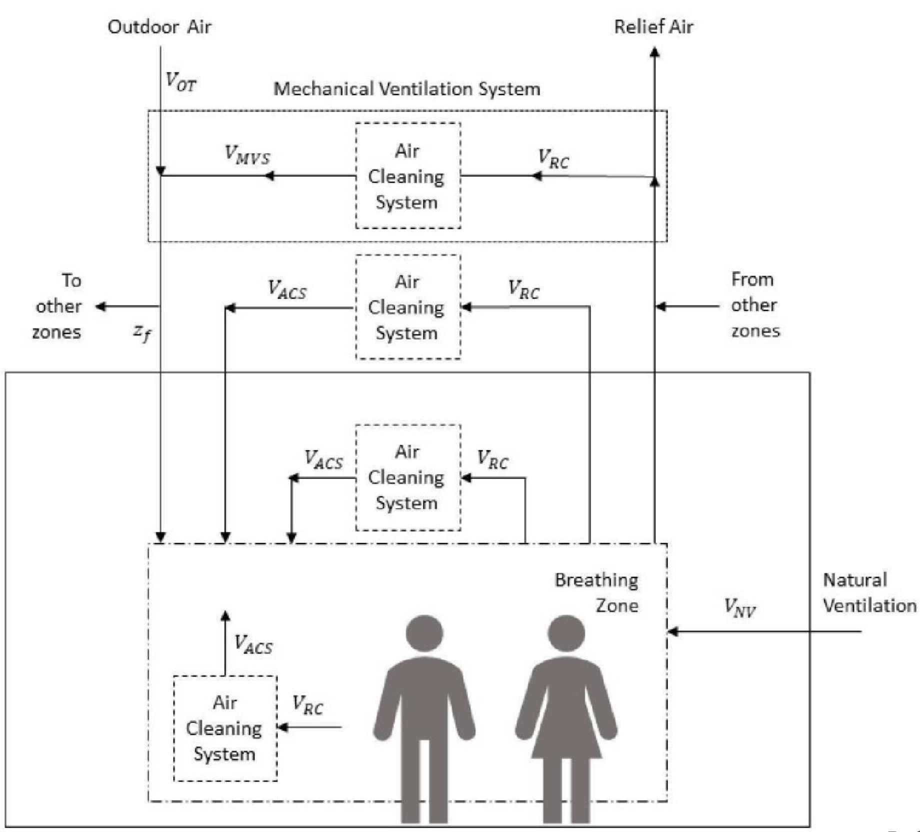


Figure 1 legend. Sources of clean air. This figure, from the ASHRAE 241 standards shows the airflow rates (v) from various sources: mechanical ventilation systems, air cleaning systems, and natural ventilation to the "breathing zone" in occupied indoor spaces.

Reference 8

Within the past century, buildings have increasingly been constructed to be more “energy efficient,” resulting in many buildings’ decreased ingress of clean fresh air. (12) Historically, indoor air quality depended on adequate clean air ventilation and the mechanical filtration of various particles, including viruses, bacteria, and fungi. (1,2,3,4,5,6)

It has been determined that as little as 100 to 1000 SARS-CoV-2 virus particles can cause an infection. (13) A single cough or sneeze by an infected person can emit 200,000,000 million virus particles traveling at a speed of 50 to 200 mph. Thus, effective filtration of recirculated air in HVAC systems is essential to diminish the risk of aerosolized viruses causing airborne transmission.

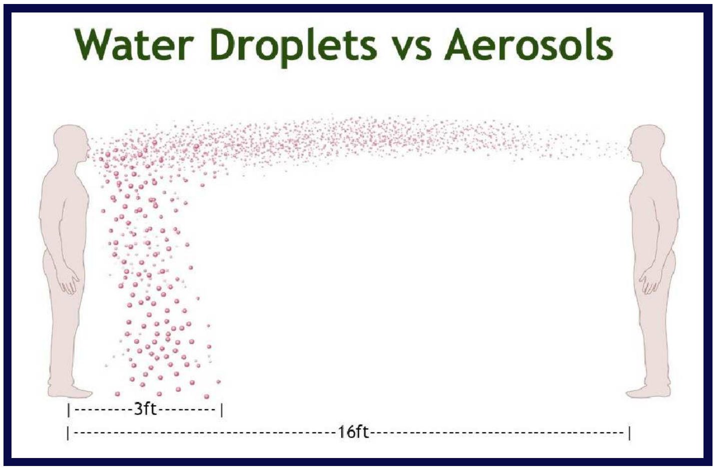


Figure 2 legend. Airborne infections can be disseminated in the environment as droplets which are relatively larger and aerosols consisting of smaller microscopic particles

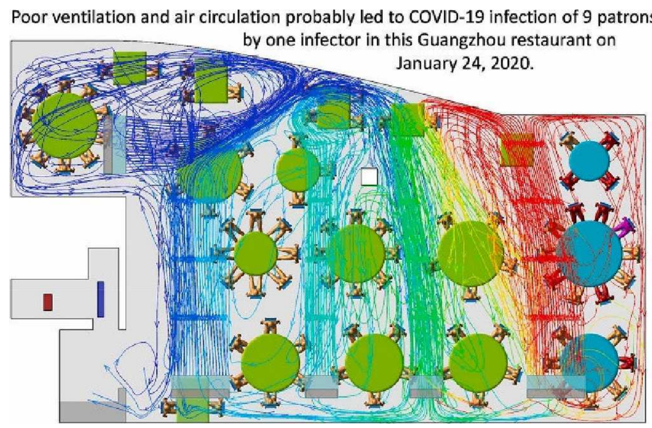


Figure 3 legend. A documented Covid 19 outbreak associated with air conditioning occurred in a restaurant in China in 2020

Figure 4 legend. Mechanical filtration in HVAC filters is dependent upon the exclusion by the filter material of particles of various sizes. The SARS CoV 2 virus as an aerosol has an approximate diameter of 0.3 μm. Viruses are among the smallest particles that can be excluded by filters

Mechanical filtration is an essential component of all HVAC systems. HVAC filters are classified according to their efficiency in eliminating particles of different sizes. Filters are classified according to the minimum efficiency reporting value (MERV). Common particles of dust range between five and 15 μm and respiratory droplets of a diameter of 5 to 10 μm. Viruses such as SARS-CoV-2 measure 0.1-0.5 microns. The higher the pressure drop the more restrictive the filter is to airflow. As mechanical filters become progressively more effective in removing small particles they have more resistance to airflow resulting in a pressure drop across the filter and a higher consumption of energy to push air through the filter. (6,7)

MERV Rating	Average Particle Size Efficiency in Microns
8	1.0-3.0 greater than or equal to 20% 3.0-10.0 greater than or equal to 70%
14	0.30-1.0 greater than or equal to 75% 1.0-3.0 greater than or equal to 90% 3.0-10.0 greater than or equal to 95%
15	0.30-1.0 greater than or equal to 85% 1.0-3.0 greater than or equal to 90% 3.0-10.0 greater than or equal to 95%
16	0.30-1.0 greater than or equal to 95% 1.0-3.0 greater than or equal to 95% 3.0-10.0 greater than or equal to 95%
High Efficiency Particulate Air filter (**HEPA**)	99.97% of particles in the 0.3-micron range Particles that are larger than 0.3 microns are captured with a greater than 99.97% efficiency

Figure 6 legend. HVAC filters are classified according to the MERVs system to describe their efficacy in eliminating particles of different sizes.

MERV	Nominal Size	CFM	Pressure Drop
HEPA	Variable	1000	2.0
14	20x24x1	1000	0.29
8	20x24x1	1000	0.14

Figure 7 legend. HVAC filters of increased efficiency in eliminating particles are associated with higher pressure drop.

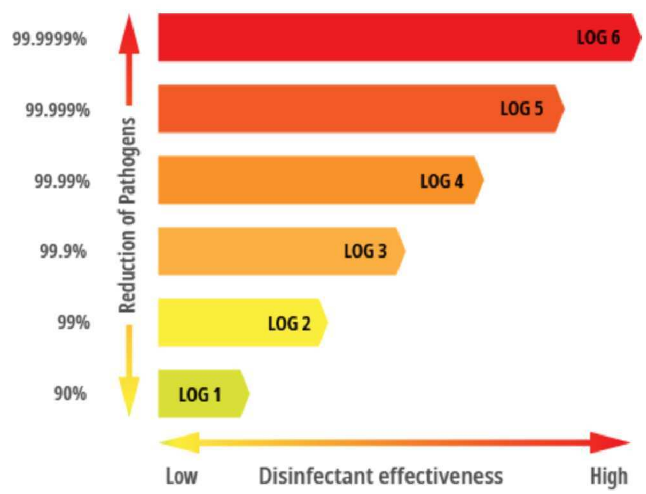


Figure 8 legend. Antimicrobial Efficacy - The ISO 18184 is an antiviral textile test that measures viricidal and antimicrobial activity on textiles and other porous materials. The minimum standard for the US is a 3 log reduction (99.9%), and the minimum standard for the EU is a 4 log reduction (99.99%).

The higher the MERV the more restrictive the filter is to airflow and the higher the pressure drop. A HEPA filter is approximately 16 times more restrictive to airflow than a Merv 8 filter. The increased resistance to airflow leads to higher static pressures within the HVAC system increasing energy costs and maintenance costs. Approximately 39% of energy consumption in commercial office buildings is related to HVAC. Energy use in buildings accounts for about 18% of all energy used in the United States. An enhancement of HVAC filtration efficiency would diminish this substantial building energy utilization. (15)

Typical Energy Consumption Breakdown in an Office Building

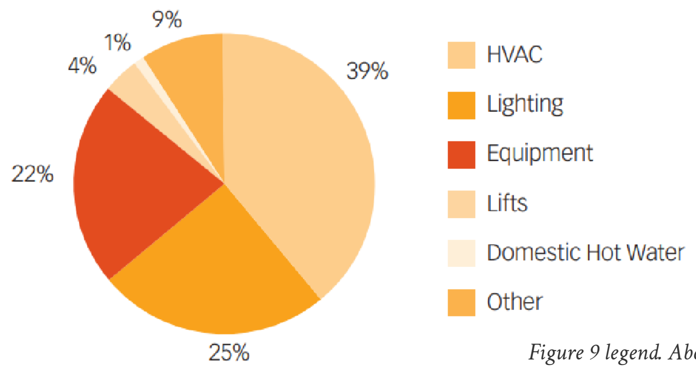


Figure 9 legend. About 39% of total energy consumption in an office building is attributable to the HVAC systems.

We pose the question: Is it reasonable to expect that mechanical filtration of virus particles with diameters of 3 µm should be the only defense within HVAC systems to prevent the spread of a pandemic disease like COVID-19?

Bioactive HVAC Filtration

A biocidal agent inactivates a virus by destabilizing the membrane and nucleocapsid proteins. (12)

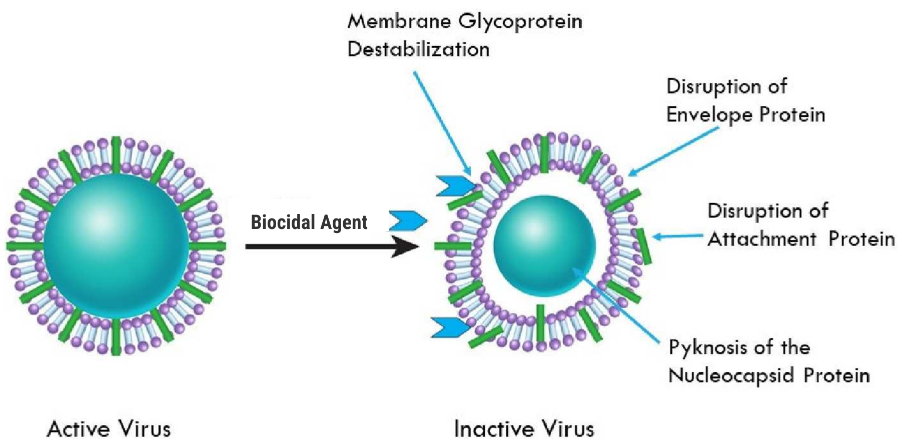


Figure 10 legend. Mechanisms of biocidal inactivation of viruses.

The IPAC filtration technology is based on the principle that two separate attacks on a target can be more effective than one treatment. There is ample precedent for this in the field of oncology in which multiple drugs are used to target a single cancer. This is also seen with malaria prevention in which a combination of a mosquito met and an insecticide is more effective than either treatment alone. The evidence is clear that the use of the IPAC biocidal polymer on traditional HVAC filters reduces the transmission of airborne viruses across the filter in a clinically significant way.

Figure 11 legend. Insecticides applied to mosquito netting augment the capability of the net to exclude mosquitoes despite the presence of holes in the net.

Our Ablative Polymer Bioactive Filtration System

Ablative polymers are coatings that change over time on the surface they have been applied to. Common uses within the industry include the capsule that holds pharmaceuticals, the heat shields used in the aerospace industry and the coatings that are applied to ships to prevent fouling with marine organisms.

Figure 12 legend. Capsules used in the pharmaceutical industry are a common example of sacrificial polymers. The polymer dissolves on exposure to gastric contents to deliver the pharmaceutical agent.

Figure 13 legend. Certain paints function as ablative polymers when they are applied to a ship's hull to prevent fouling by marine organisms.

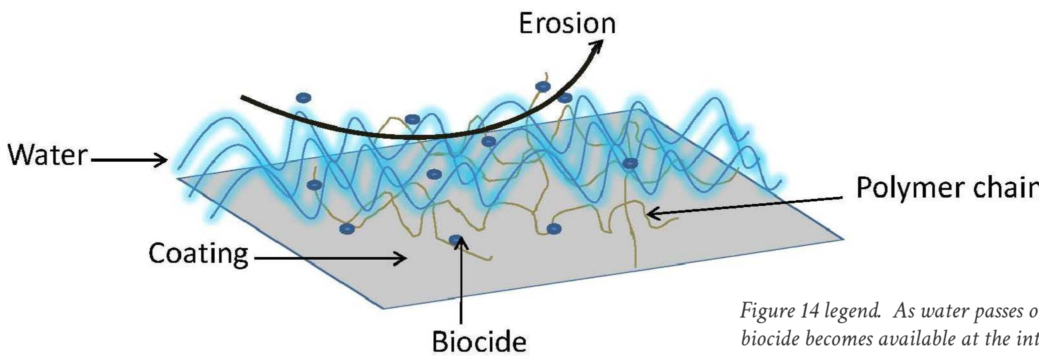


Figure 14 legend. As water passes over the ship's hull, the biocide becomes available at the interface between the water and the coated surface of the ship.

The IPAC ablative polymer system consists of three polymers, one of which is a biocidal agent, benzalkonium chloride. A solution of the three polymers is spray-coated as an aerosol onto one surface of our prototype filters.

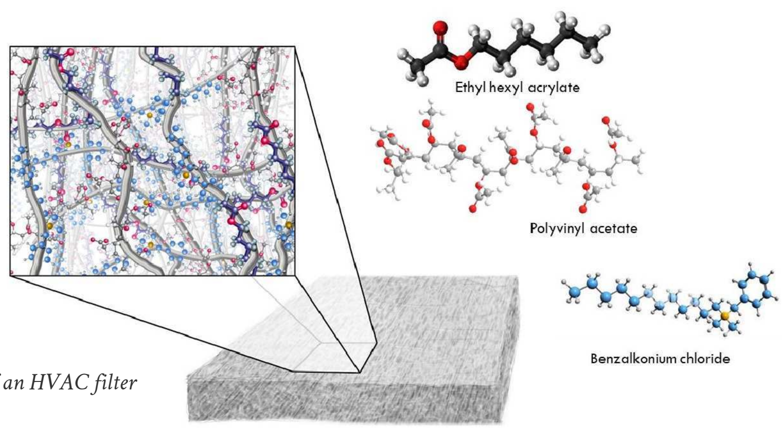
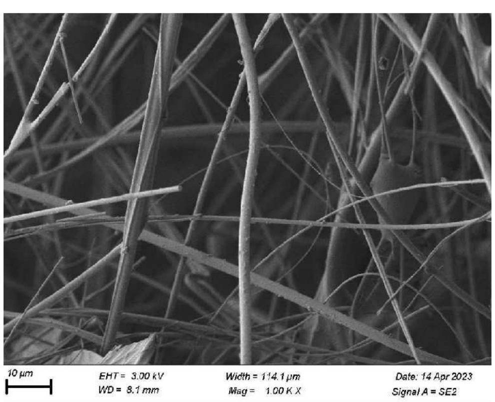


Figure 15 legend. Triple polymer coating is applied to one surface of an HVAC filter



When the filter is deployed within the airflow of a simulated HVAC system, the benzalkonium chloride ablates, moving deeper within the filter substrate: some of the benzalkonium chloride also remains on the coated surface of the filter. In our prototype system, fiberglass filters have diameters of about 8 to 10 µm.

Figure 16 legend. Scanning electron microscopy image of uncoated nonwoven fiberglass filter.

Scanning electron microscope images of the polymer solution coating a filter. The coating enhances inactivation of bacteria and viruses compared to mechanical filtration alone.

Eight weeks of use did not diminish the efficacy of the biocidal coated filter.

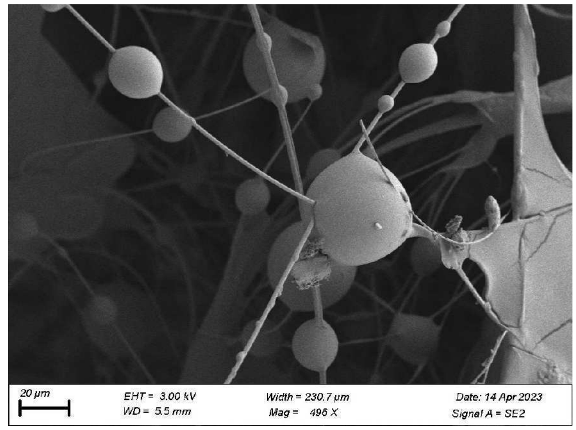


Figure 17 legend. Scanning electron microscopy image of coated nonwoven fiberglass filter. Globules of the coating polymer adhered to individual fibers with diameters ranging between 15 – 80 µm.

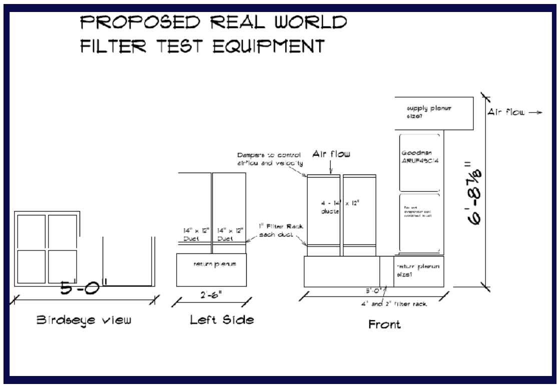


Figure 18 legend. Design of our HVAC simulation system for filter prototyping.

Data on the Effectiveness of Our Technology

Test 1 - Filtration Efficiency - *University of Massachusetts Lowell Fabric Discovery Center*:

Studies performed by the University of Massachusetts Lowell Fabric Discovery Center determined that airflow is not impeded by the biocidal coating.

FILTRATION EFFICIENCY RESULTS TABLE

Sample ID	Manufacturer/ Model	Description	Standards	Test No.	Flow Rate (lpm)	Pressure (mmH20)	Penetration (%)	Filtration (%)
IPAC-001-14-DEC-21		Yellow fiberglass nonwoven, 10261442 3 AFS		1	85.26	6.61	43.83	56.17
IPAC-001-14-DEC-21		Yellow fiberglass nonwoven, 10261442 3 AFS		2	85.21	7.12	40.12	59.88
IPAC-001-14-DEC-21		Yellow fiberglass nonwoven, 10261442 3 AFS		3	85.25	6.63	42.09	57.91
IPAC-001-14-DEC-21		Yellow fiberglass nonwoven, 10261442 3 AFS		4	85.09	7.60	37.28	62.72
IPAC-002-14-DEC-21		Yellow fiberglass nonwoven, 10261441 3 AFS		1	85.13	6.73	47.91	52.09
IPAC-002-14-DEC-21		Yellow fiberglass nonwoven, 10261441 3 AFS		2	85.27	7.57	41.67	58.33
IPAC-002-14-DEC-21		Yellow fiberglass nonwoven, 10261441 3 AFS		3	85.19	6.82	45.50	54.50
IPAC-002-14-DEC-21		Yellow fiberglass nonwoven, 10261441 3 AFS		4	85.23	6.76	45.96	54.04

NOTES:
1. A blank cell indicates that no data was available.

Figure 19 legend. Coating the filters did not increase pressure drop across the filter.

Measurement of Virucidal Activity of Pre-treated Textiles via Direct Contact per ISO 18184 –Severe Acute Respiratory Syndrome-Related Coronavirus 2 (SARS-CoV-2) (COVID-19 Virus)

Project No. 1123-101

RESULTS (continued)

Table 1
Titer Results

Sample	Contact time	Replicate	Titer ($Log_{10}TCID_{50}/mL$)		Volume (mL)	Viral Load ($Log_{10}TCID_{50}$)
Virus Stock Titer	N/A		6.43		-	-
Cell Viability Control	N/A		no virus was detected, cells remained viable; media was sterile			
Liquid virus (no-textile) control	15 minutes	1	4.18		20	5.48
		2	4.18		20	5.48
		3	4.05		20	5.35
	Average					5.44
IPAC TK015-2 (Control)	0 minutes	1	4.43		20	5.73
		2	4.05		20	5.35
		3	4.43		20	5.73
	Average					5.60
	15 minutes	1	4.18		20	5.48
		2	4.30		20	5.60
		3	4.18		20	5.48
	Average					5.52
IPAC TK015-1	15 minutes	1	≤ 0.83	*	20	≤ 2.13
		2	≤ 0.83	*	20	≤ 2.13
		3	≤ 0.83	*	20	≤ 2.13

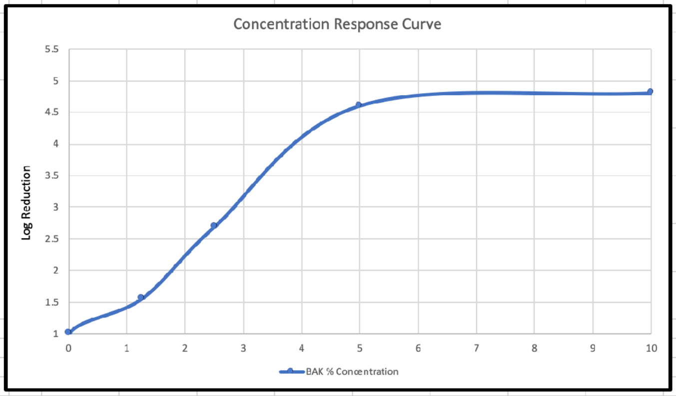
* No virus was detected, the theoretical titer was determined based on the Poisson method.

Figure 20 legend. Coating the filters demonstrated SARS-CoV-2 virus completely inactivated.

Test 2 - Inactivation of SARS-CoV-2 Virus - Mechanical & Bioactive Filtration - *Microbac Laboratories:*

Studies on the inactivation of the actual SARS-CoV-2 virus were performed by independent Microbac Laboratories, Inc, located in Sterling, Virginia, a company with 50+ years of experience in analytical testing. Investigators at Microbac utilized the Washington strain of the SARS-CoV-2 virus in a direct contact assay by applying an infectious sample to the surface of coated and uncoated filters for 15 minutes and determined that the virus was undetectable on the coated filters by a TCID50 assay method. These initial studies were performed at a benzalkonium chloride concentration of 10%. Next, investigators at Microbac Laboratories compared the relative contributions of mechanical versus bioactive filtration. Using a MERV 13 filter that was uncoated, the mechanical filtration effectiveness of the filter was 76%, as expected based on industry product standards. Bioactive filtration at a benzalkonium chloride concentration of 1.25% was 83% effective. The combined filtration, bioactive and mechanical filtration, was 93% effective (approximately 1.63 logs).

Test 3 - Inactivation of SARS-CoV-2 Virus - Dose Response - *Microbac Laboratories*:



A MERV 14 filter was studied for contact inactivation in a dose-response cure assessment of benzalkonium chloride ranging from 1.25% to 10%. There was an inflection point around 3% benzalkonium chloride concentration where effectiveness ranged between three and four logs (99.9% effective to 99.99% effective, respectively).

Figure 21 legend. Dose-response curve on a MERV 14 filter with benzalkonium chloride concentrations ranging between 1.25% to 10%.

Test 4 - Durability of Bioactive Filtration Effectiveness - *Microbac Laboratories:*

Durability of bioactive filtration effectiveness. Contact inactivation studies conducted at Microbac Laboratories demonstrated that filters stored for 16 weeks maintained a 99.99% effective rate (4 log reduction). Filters studied after eight weeks of deployment in the HVAC simulation device were found to maintain a 99.99% effective (4 log reduction).

Test 5 - Sneeze Evaluation Studies - *Nelson Labs:*

"Sneeze Evaluation" studies were performed by Nelson Labs, an independent lab in Salt Lake City, Utah. This lab has extensive experience in analytical testing, especially of fabric-related devices such as quality control studies of N95 masks. A bioactive MERV 14 filter was studied for aerosol inactivation in a dose-response cure assessment of benzalkonium chloride ranging from 1.25% to 10%.

Test 6 - Viral Filtration Efficiency - *Nelson Labs*:

The Viral Filtration Efficiency evaluation subjected the bioactive filter to an aerosolized exposure of bacteriophage for one minute at an airflow rate of 20 liters per minute. The efficacy evaluation was calculated by determining the amount of challenge sample on the backside of the filter utilizing an aerosol capture technology. The simulation pathogen for this evaluation was bacteriophage phiX174, the FDA-recommended surrogate for the SARS-CoV-2 virus. A TCID50 method, which measures infectious viruses, was utilized to verify the viral titer of the downstream virus sample. The dose-response of benzalkonium chloride was detected with the expected filtration efficiency of up to 99.99% effective at the highest dose for a MERV14 filter and 98.66% for a MERV8 filter. The coating appeared to effectively raise the pathogen-inactivating efficacy of the MERV14 filter rating equivalent to a HEPA filter without an increase in pressure drop across the filter or a loss of airflow through the filter. Moreover, unlike a HEPA filter, the bioactive filter is not a biohazard of trapped infectious viruses. Note that when we coated a MERV8 filter, we achieved almost 99% filter efficiency for virus particles.

Results:

Test Article	Total PFU Recovered	Filtration Efficiency (%)
Control (0%)	7.7×10^5	67.2
1.25%	1.4×10^4	94.8
2.5%	1.1×10^4	95.2
5%	2.9×10^3	99.7
10%	5.4×10^2	99.997

Figure22 legend.. Viral filtration efficiency studies showed a biocidal coated MERV 14 filter was 99.99% effective inactivating bacteriophage

The filtration efficiency percentages were calculated using the following equation:

$$\% \, VFE = \frac{C - T}{C} \, x \, 100$$

C = Challenge Level
T = Total PFU recovered downstream of the test article

Figure 23 legend. Viral filtration efficiency testing showed both MERV 8 and 14 biocidal coated filters had high efficiency for inactivating Bacteriophage

Merv-8 (Brown) Fiberglass:

Test Article	Total PFU Recovered	Filtration Efficiency (%)
0	9.5×10^5	36
1.25	5.7×10^5	62
2.5	3.3×10^5	78
5	7.8×10^4	94.8
10	2.0×10^4	98.66

Merv-14 (Yellow) Fiberglass:

Test Article	Total PFU Recovered	Filtration Efficiency (%)
0	3.6×10^5	76.0
1.25	6.3×10^4	95.8
2.5	2.8×10^4	98.5
5	7.2×10^3	99.5
10	1.4×10^3	99.92

Is This Bioactive Polymer Filtration System Safe?

We wanted to ensure that our system would be safe when deployed in HVAC systems. Benzalkonium chloride is widely used as a soap or sanitizer in hospitals, the dairy industry, and in common household products like soap. It is widely regarded as safe by the EPA and FDA. We did extensive testing to determine if the Benzalkonium chloride migrated through the filter. Scanning electron microscopy and energy dispersive X-ray spectroscopy showed that the Benzalkonium chloride did not travel through the filter even with prolonged use.

Nonetheless, despite the apparent safety of this biocidal agent, we were interested in determining whether the benzalkonium chloride was disseminated in the substance of the filter and then theoretically into the airflow of the HVAC system. To do this, we used scanning electron microscopy and energy dispersive x-ray spectroscopy (EDS) to image our polymer system within the filter substrate. EDS is an analytical technique that enables the chemical characterization and elemental analysis of materials. We applied the ablative polymer with benzalkonium chloride incorporated into the polymer matrix sprayed on a MERV 14 fiberglass filter. The resulting SEM micrograph demonstrated the fiberglass matrix and the applied particles with benzalkonium chloride.

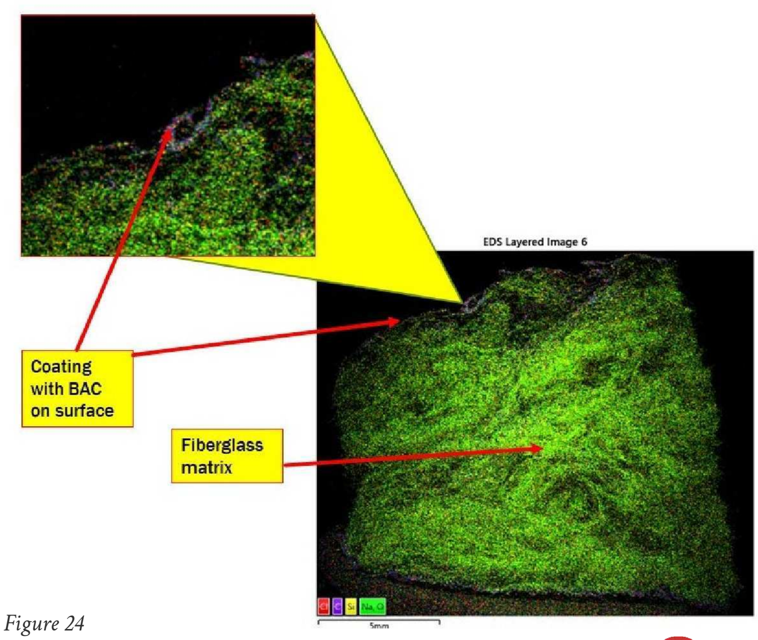


Figure 24

When we examined a cross-section of the filter orthogonal to the surface, we determined the coating thickness was approximately 0.001 inches 25.4 µm. The rest of the fiberglass matrix appeared to be green on the EDS images indicating a high concentration of silicon.

Additionally, we were able to image the location of the carbon in the polymer and the chloride in the benzalkonium chloride. As we examined the depth of penetration from the surface up to about 500 µm, we determined the chloride present in the benzalkonium chloride minimally penetrated into the depth of the filter, thus indicating the benzalkonium chloride remained localized to the site of application within the substrate of the filter.

Filters that had not been coated and deployed within the HVAC device were imaged and noted to have very little chlorine in the examined material. We next examined the EDS imaging of filters that were coated and then deployed into the HVAC simulator device.

These coated filters, examined after eight weeks of deployment in the HVAC system, were noted to have high amounts of benzalkonium chloride across a gradient of fibers, as indicated by the chlorine ion identified by EDS. Such a localized deposition of chlorine in the middle of the filter is consistent with the ablative process of the bioactive polymer. In summary, we concluded that virtually all of the benzalkonium chloride and co-polymer matrix in our bioactive system remains within the filter and does not traverse the filter substrate during deployment.

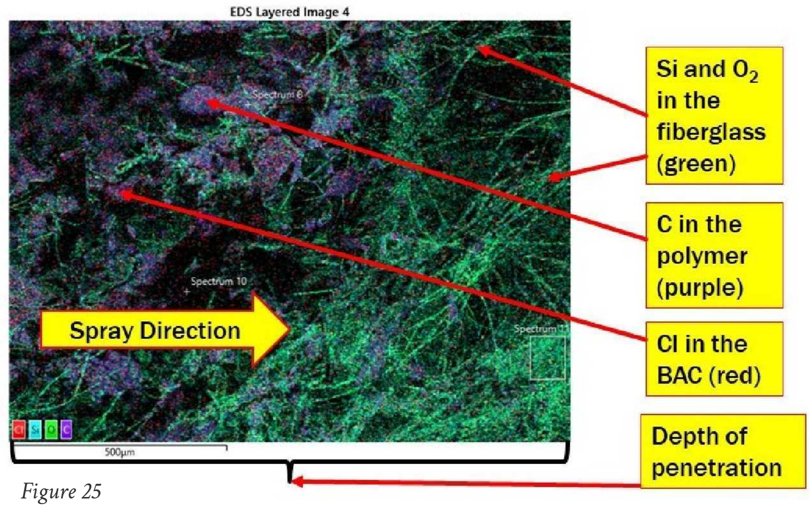
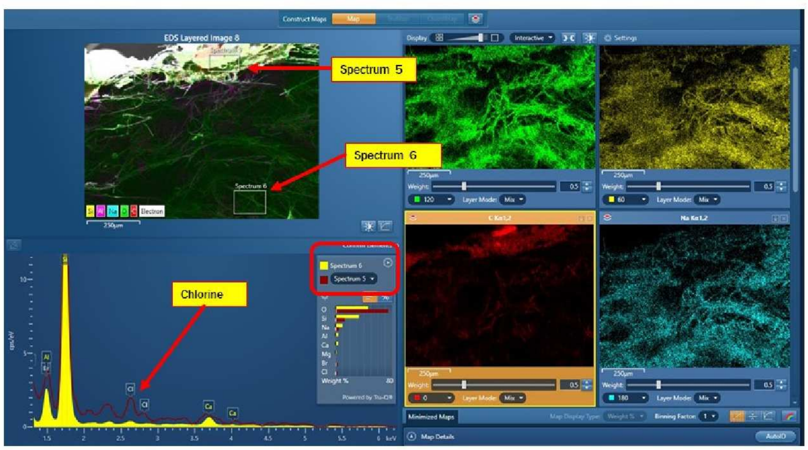
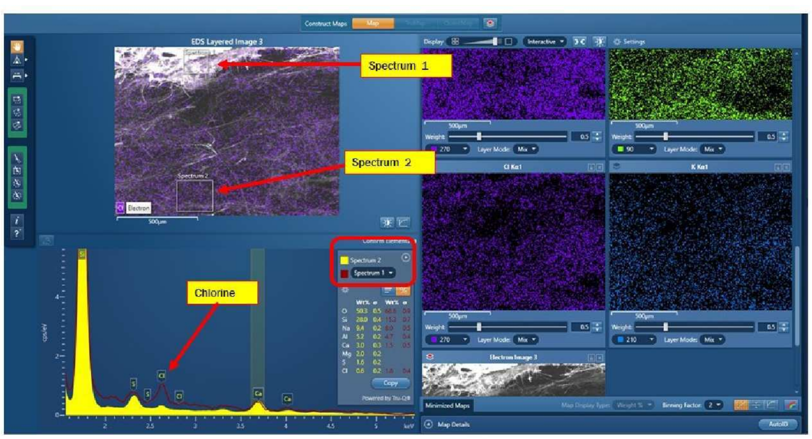


Figure 25



The control sample of a coated fiberglass matrix with T = 0 weeks exposure in the HVAC test stand was tested for chlorine at the surface and at approximately 500 micrometers into the fiberglass matrix. Here, the unexposed coated fiberglass matrix showed a large amount of chlorine available at the surface, Spectrum 5, due to the BAC in the ablative polymer coating but minimal amounts of chlorine 500 mm deep in the fiberglass matrix, Spectrum 6.

Figure 26 legend. T=0 weeks coated filter



The sample of a coated fiberglass matrix with T = 8 weeks exposure in the HVAC test stand was tested for chlorine at the surface and at approximately 750 micrometers into the fiberglass matrix. Here, the coated fiberglass matrix showed a large amount of chlorine available at the surface, Spectrum 1, but minimal amounts 750 mm deep in the sample, Spectrum 2.

Figure 27 legend. T=8 weeks coated filter

Our EDS data demonstrate that the benzalkonium chloride, as indicated by the chloride ion localization, ablates into the depth of the filter matrix over time. This is not unexpected. In the case of the ablative anti-fouling paints applied to ship bottoms, the bioactive agents ablate into the ocean downstream in the fluid flow over the hull of the ship. In a similar way the benzalkonium chloride ablates downstream in the airflow across the filter.

Independent Environmental Analysis

2.0 SUMMARY OF RESULTS

The average results of the control and activated filter samples from this test program are summarized in the table below. Detailed individual run results are presented in the appendices, as well as the TICs detected concentrations.

Run ID	Pollutant Tested	Outlet Measured Emissions	Inlet Measured Emissions	Flow Rate (cfm)
Control	Benzalkonium Chloride (ug/m^3)	<0.85	<0.91	400
	TO15 (ppbv)			
	• Vinyl Acetate	<0.85	<0.85	
	• Benzene	<0.50	<0.50	
	• Benzyl Chloride	<0.80	<0.80	
Filter	Benzalkonium Chloride (ug/m^3)	<0.85	<0.91	400
	TO15 (ppbv)			
	• Vinyl Acetate	<0.85	<0.85	
	• Benzene	<0.50	<0.50	
	• Benzyl Chloride	<0.80	<0.80	

Note: All the above analytical results were at the indicated laboratory reporting limit.

A nationally accredited independent testing service with over 40 years of experience specializing in comprehensive emission testing and ambient air quality monitoring services, **revealed no evidence of deleterious materials, specifically benzalkonium chloride and TO-15 listed volatile organic compounds (VOCs), being introduced into the exit airflow.**

The Potential Global Market for Bioactive HVAC

The annual potential size of the global market for filters is $12.28 billion, $6.9B for HVAC filters and $5.38B for transportation-related filters. The air filtration market is expected to grow at a rate of 4.4% compound annual growth rate (CAGR) from 2022 to 2030, see figure. Moreover, it is projected that there will be dramatic growth in the use of air conditioning throughout the world over the next 25 years.

Market Analysis Summary

Likely applicable initial market segment focus includes HVAC and Transportation

- **HVAC**: **$6.90 Billion**
- **Transportation**: **$5.38 Billion**

Annual Potential Market Size: $12.28 Billion

*Air filtration market expected to grow at **4.4% CAGR from 2020 to 2030***[10]

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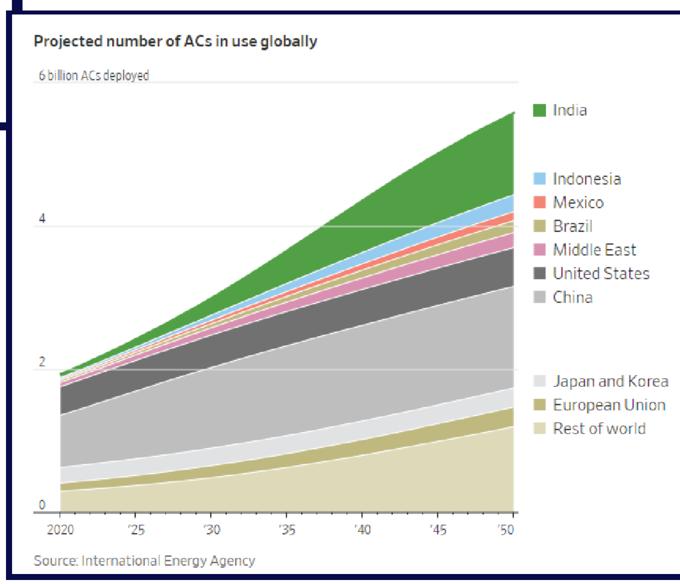

Conclusion:

IPAC has developed a new bioactive filtration technology that:

1. Dramatically improves the efficiency of viral inactivation by HVAC filters
2. Is safe
3. Does not impair the mechanical or energy efficiency of the filter
4. Does not require hazardous material disposal like a HEPA filter

This bioactive filtration technology has the potential to significantly enhance the $12 billion HVAC filter industry.

In the wake of the Covid 19 pandemic, there will be increased regulatory pressure and government spending directed towards new technologies designed to combat airborne transmission of viral diseases.

The IPAC system offers a way to address new standards without requiring replacement of, or aftermarket additions to legacy HVAC systems. It can also further augment the efficacy of new HVAC systems.

We anticipate that our technology can be easily incorporated into the current manufacturing paradigm for HVAC filters at the production source of the filter substrate.

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