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CAPTURE COATINGS FOR THE IDEA INNOVATIVE DEMONSTRATIONS PROGRAM WITHIN DCAS FOR USE IN *NEW YORK* CITY WIDE BUILDINGS

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1. Introduction

Presented here is a detailed analysis of how the *Capture Coatings* from Curran Biotech can be used to prevent the spread of SARS-CoV-2 in buildings via a method of *cleaning the air* - ridding interior spaces of the virus without disrupting energy efficiency achieved by buildings across New York. The recent practice of substituting a higher rated filter to provide additional protection is not sufficient[1]. Filters are rated using the MERV system - Minimum Efficiency Reporting Value (MERV) rating which range from 16 (least porous) to 1 (most porous). Filters are designed to keep air cleaner, but not completely clean from viral loads[2]. While using an increased MERV rated filter provides a marginal reduction in the spread of the virus, the corresponding stress on HVAC equipment is significant (these systems were not meant to operate with the more dense, higher rated, more expensive filters). Breathability is impacted with higher rated MERV filters as well. To solve this problem, we deliver a better than MERV 14 effect on SARS-CoV-2 using filters that are rated MERV 7 or more. Curran Biotech technology does not change the MERV rating of filters for anything other than the SARS-CoV-2 virus.

1.1 Premise

The goal of this project is to stop the transmission of the SARS-CoV-2 virus across indoor environments.

1.2 Assumptions

In order to undertake this project, understanding and addressing *how the virus* is transmitted is necessary: structure, time airborne, and weaknesses. Determining *how far the virus can travel* and whether modern indoor air filtration (HVAC) systems can stop the virus transmission from room to room is of critical relevance.

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1 "Building Readiness," ASHRAE, accessed January 10, 2021, https://www.ashrae.org/technical-resources/building-readiness#ecip.

2 "Air Cleaners and Air Filters in the Home," EPA, accessed January 10, 2021, https://www.epa.gov/indoor-air-quality-iaq/air-cleaners-and-air-filters-home.

1.3 Not a Vaccine

Our goal is to decrease the transmission of the virus and help non-vaccinated people from getting the virus. Our technology is not a vaccine and does not kill the virus; it establishes an environment that minimizes the lifespan of the virus to the point it will *desiccate* (dry up and wither) and not be a threat.

1.4 SARS-CoV-2

If we wish to understand how to minimize the impact of SARS-CoV-2, it is critical to understand both the structural cell biology and the biochemistry that allows the viral transmission. The outer shell of the virus, similar to an eggshell, has an outer protein layer that pushes out from the underlying bilipid inner layer[3]. This is used to keep the virus stable as it travels in the environment around us, and within that shell are the critical components used to infect people and spread the virus. The outer protein then attracts water molecules in a form of a clathrin coating through a charged electrostatic interaction[4]. This outer layer, the inner membrane, the water molecules, proteins, and mucus are all critical for cell survival[5]. Disrupting the virus is possible when we focus our attention on removing water/moisture from the outer layer and look to desiccate it, terminating the viability of the virus[6].

Any environment where the water layer can be disrupted or absorbed will result in protein damage and therefore cause the inner contents of the cell to become weakened and eventually destroyed[7]. In many instances, virologists approach destroying the virus by attacking the external

[3] Hangping Yao et al., "Molecular Architecture of the SARS-CoV-2 Virus," *Cell* 183, no. 3 (2020): 730–38, https://doi.org/10.1016/j.cell.2020.09.018.
[4] Mark Zanin et al., "The Interaction between Respiratory Pathogens and Mucus," *Cell Host and Microbe* 19, no. 2 (2016): 159–68, https://doi.org/10.1016/j.chom.2016.01.001; Brandon L. Scott et al., "Membrane Bending Occurs at All Stages of Clathrincoat Assembly and Defines Endocytic Dynamics," *Nature Communications* 9, no. 1 (2018): 1–9, https://doi.org/10.1038/s41467-018-02818-8; Till Böcking et al., "Key Interactions for Clathrin Coat Stability," *Structure* 22, no. 6 (2014): 819–29, https://doi.org/10.1016/j.str.2014.04.002.
[5] Rajneesh Bhardwaj and Amit Agrawal, "Likelihood of Survival of Coronavirus in a Respiratory Droplet Deposited on a Solid Surface," *Physics of Fluids* 32, no. 6 (2020): 061704, https://doi.org/10.1063/5.0012009; F. E. Buckland and D. A.J. Tyrrell, "Loss of Infectivity on Drying Various Viruses," *Nature* 195 (1962): 1063–64, https://doi.org/10.1038/1951063a0.
[6] Haiyue Huang et al., "COVID-19: A Call for Physical Scientists and Engineers," *ACS Nano* 14, no. 4 (2020): 3747–54, https://doi.org/10.1021/acsnano.0c02618.
[7] Jane Flint et al., *Principles of Virology, Volume 1: Molecular Biology* (John Wiley & Sons, 2020).

protein spikes[8]. Damaging these protruding structures makes the virus unable to penetrate the cells they want to infect[9]. Curran Biotech technology enables a more direct and physical solution - providing an environment where the outer protein layer of the virus dries out, eliminating the threat from the virus.

1.5 Water Repellency – Hydrophobic Coatings

Waterproofing products exist in the market place (3M's Scotchgard[10], Dupont's Stainmaster[11]) as well as in nature (the naturally water repelling lotus leaf). The most successful ones in the last few decades fall into a category known as *surfactant fluorocarbon*[12] which are banned by the EPA and most countries around the world because of their toxicity risk. Others base their technology on a thin layered coating (breathable), but these in general clog up filters as they form thin films in order to function[13]. Still others are made up of nanoparticles or beads that fill in spaces within fabrics or surfaces but will eventually bleed out[14]. None of these coatings are truly breathable and can be broken up easily and therefore unsuitable for many environments including filter fabrics.

Curran Biotech has focused on creating molecules that are chain like in nature (polymeric), can bond chemically onto a surface, become part of the surface they are protecting, and *remain breathable*. Solving for this essential aspect of waterproofing is a distinguishing aspect of our Curran Biotech technology and follows a decade of research since 2010. Breathability is a critical function of the filters and is the ability of fabrics to allow moisture vapor to be transmitted through

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[8] Lianpan Dai and George F Gao, "Viral Targets for Vaccines against COVID-19," *Nature Reviews Immunology*, 2020, https://doi.org/10.1038/s41577-020-00480-0.
[9] Yetian Dong et al., "A Systematic Review of SARS-CoV-2 Vaccine Candidates," *Signal Transduction and Targeted Therapy* 5, no. 237 (2020): 1–14, https://doi.org/10.1038/s41392-020-00352-y.
[10] "Risk Management for Per- and Polyfluoroalkyl Substances (PFAS) under TSCA," EPA, accessed January 10, 2021, https://www.epa.gov/assessing-and-managing-chemicals-under-tsca/risk-management-and-polyfluoroalkyl-substances-pfas.
[11] "Basic Information on PFAS," EPA, accessed January 10, 2021, https://www.epa.gov/pfas/basic-information-pfas#health.
[12] "Risk Management for Per- and Polyfluoroalkyl Substances (PFAS) under TSCA"; "Basic Information on PFAS."
[13] Arunangshu Mukhopadhyay and Vinay Kumar Midha, "A Review on Designing the Waterproof Breathable Fabrics Part II: Construction and Suitability of Breathable Fabrics for Different Uses," *Journal of Industrial Textiles* 38, no. 1 (July 1, 2008): 17–41, https://doi.org/10.1177/1528083707082166.
[14] Shanshan Wei et al., "Preparation of Hydrophobic Nano-Silver Colloid and Aqueous Nano-Silver Colloid by Phase Transfer," *Materials Chemistry and Physics* 126, no. 1–2 (2011): 12–15, https://doi.org/https://doi.org/10.1016/j.matchemphys.2010.11.012.

the fabric without duress. The static tests are critical, as they will demonstrate the breathability of the coatings and therefore their applicability.

1.6 Viral Transmission

In the 1930s, William F. Wells[15] measured the duration and distance it takes for large droplets to fall to the ground - on the basis of understanding the spread of tuberculosis (TB). In fact, the presumption was the droplets were going to dry out and leave a virus exposed to the elements, desiccating within seconds. This is the source for today's 6 foot separation recommendation/social distancing. It should be reinforced that 6 feet is not a guarantee of safety but more likely the *least distance* as you approach individuals, especially - and in particular - indoors. However, TB has proven to be very air stable. The distance calculated by the six-foot rule, also known as the d2 law, can only be applied to an isolated spherical water droplet[16].

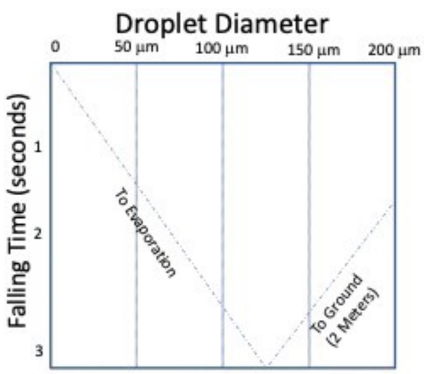

Chart 1: Falling and evaporation rate for droplets of varying diameters (Redrawn from W. F Wells (1934)

Figure 1: *Falling Time vs. Droplet Diameter (d2 law)*[17]

[15] William F Wells, "On Air-Borne Infection. Study II. Droplets and Droplet Nuclei.," *American Journal of Hygiene* 20 (1934): 611–18.
[16] Li Liu et al., "Evaporation and Dispersion of Respiratory Droplets from Coughing," *Indoor Air* 27, no. 1 (2017): 179–90.
[17] Wells, "On Air-Borne Infection. Study II. Droplets and Droplet Nuclei."

In the decades since, there has been little push to examine or extend these ideas and Wells' work became the rule of thumb for all medical agencies — including the WHO — in part because of necessity[18]. *We must examine the Wells assumptions again.* In fact, we understand now that when someone coughs, sneezes, and breathes, significant numbers of droplets are smaller than 10 microns[19]. In non-technical terms, that's about 1/5 the diameter of a human hair, so small the human eye cannot really see them. We also know those droplets can travel up to 17 meters — and beyond — indoors, while any droplets smaller than 5 microns (1/10th diameter of a human hair) do not fall to the ground at all[20]. They will travel in air currents until they are sucked into someone's lungs, land and remain on a random surface, or find a circulating path through a ventilation system.

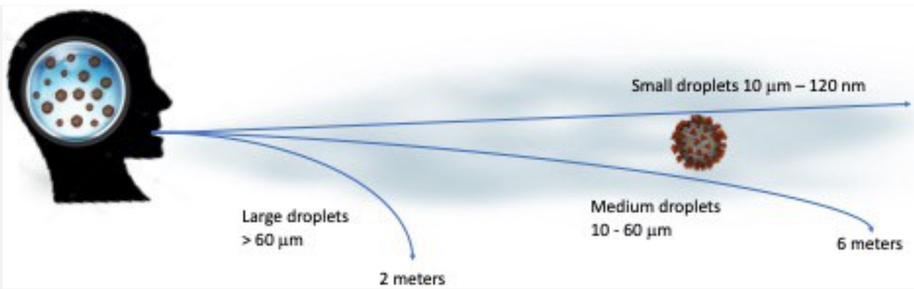

Figure 2: *Representation of droplet size and travel distance*[21]

According to a paper from *Li et al*[22], the Wells model is not very effective when it comes to the SARS-CoV-2 virus and practically any other similar-sized and respired types of viruses. So, we can discern that SARS-CoV-2 will stay airborne for a prolonged period and will still have an outer layer of saliva as we have seen in other viral transmissions (including salts, proteins, and other inorganic and organic matter)[23]. They will form nuclei and aggregate in numbers, which in itself

[18] Lidia Morawska and Junji Cao, "Airborne Transmission of SARS-CoV-2: The World Should Face the Reality," *Environment International* 139 (2020): 105730, https://doi.org/https://doi.org/10.1016/j.envint.2020.105730.
[19] L Morawska et al., "Size Distribution and Sites of Origin of Droplets Expelled from the Human Respiratory Tract during Expiratory Activities," *Journal of Aerosol Science* 40, no. 3 (2009): 256–69, https://doi.org/https://doi.org/10.1016/j.jaerosci.2008.11.002.
[20] Y. Li et al., "Role of Air Distribution in SARS Transmission during the Largest Nosocomial Outbreak in Hong Kong," *Indoor Air* 15, no. 2 (2005): 83–95, https://doi.org/10.1111/j.1600-0668.2004.00317.x.
[21] Morawska et al., "Size Distribution and Sites of Origin of Droplets Expelled from the Human Respiratory Tract during Expiratory Activities."
[22] Li et al., "Role of Air Distribution in SARS Transmission during the Largest Nosocomial Outbreak in Hong Kong."
[23] Sander Herfst et al., "Airborne Transmission of Influenza A/H5N1 Virus Between Ferrets," *Science* 336, no. 6088 (June 22, 2012): 1534–41, https://doi.org/10.1126/science.1213362.

will likewise alter the evaporation rates. Until the airborne viral particles reach HVAC filters, they have the potential to be active and infect those not wearing proper protective masks. This remains an area of active debate, however, as arguments ensue about how infectious these small particles really are.

1.7 Conclusion

It's good to filter the air, but not all filters are capable of stopping the virus. According to ASHRAE, with a MERV 14 filter it can take *4 or 5 flushes* (recycling the same air), before air quality improves[24]. Most homes use MERV 4–6, depending on tolerance for pollen, dust, and dander. Schools and office areas typically use filters with ratings as high as MERV 8.

[24] Morawska et al., "Size Distribution and Sites of Origin of Droplets Expelled from the Human Respiratory Tract during Expiratory Activities."

2. Results from Edison Energy and Water Lens

Water Lens – *Rapid Molecular-Based SARS-CoV-2 Testing for buildings and Individuals*

Early in the pandemic, Water Lens emerged as a pioneer in monitoring for SARS-CoV-2 in sewage at wastewater plants for major municipalities. Since the beginning of the pandemic, sewage has been studied as an effective indicator of the presence of SARS-CoV-2. It was pioneered in The Netherlands and is being deployed around the world. And now, they can monitor infection levels in buildings by sampling the air in high-traffic areas or through the HVAC system. This is especially useful in places such as schools, dormitories, offices, business complexes, multi-tenant residential complexes, nursing & retirement homes, and low and high-rise condominiums.[25]

Water Lens has developed a fast and accurate saliva test for SARS-CoV-2 that is simple to administer and results can be as fast as 30 minutes. The solution uses the gold-standard qPCR molecular test with CDC-approved primers with a simple mouth rinse.[26]

Edison Energy

Providing a suite of specialized services across sustainability, analytics, renewables, supply, demand, and efficiency, Edison Energy works to resolve the key challenges of cost, carbon, and the increasingly complex choices in energy today. Using data-led analytics and depth of knowledge puts Edison Energy in a unique position to empower organizations with economic certainty, sustainability, and competitive advantage.[27]

Edison Energy Results and Discussion

Department of Citywide Administrative Services retained the services of Edison Energy Solutions, L.L.C. to provide Measurement & Verification (M&V) consulting services. Other methods exist to block the virus via filters including using film forming hydrophobic materials or

[25] "Water Lens COVID-19 Scout," Water Lens, accessed January 10, 2021, https://www.waterlensusa.com/covid-19.

[26] "Water Lens COVID-19 Scout."[27] "Energy Optimization," Edison Energy, accessed January 10, 2021, https://www.edisonenergy.com/energy-optimization/.

[27] "Energy Optimization," Edison Energy, accessed January 10, 2021, https://www.edisonenergy.com/energy-optimization/.

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higher pleated filters. This negatively impacts the performance of the ventilation system and can increase the static air pressure of the HVAC system. The harder it is to pull air through the filters, the more damage can be done to the filtration system – possibly leading to cataclysmic effects and would result in replacing air handlers. Once the Curran Biotech capture coating was added to the filters, static air testing was essential to assure the long-term effects of the coatings would not lead to problems. Finally, Edison Energy conducted an exhaustive testing program (including calculating energy consumption costs by having the coatings present).

The new Curran Biotech technology consists of a hydrophobic material sprayed on to the MERV 8 filters of air handling units (AHUs) to stop the SARS-CoV-2 virus from passing through the filters. The purpose of this application is to eliminate SARS-CoV-2 virus within the airstream / ventilation system without incurring an increase in AHU fan energy due to increased filter differential pressure

The results and findings from the M&V site visits and equipment tests, show a slight increase in energy consumption of the supply fan motor. The electric energy consumption after the application of the hydrophobic spray on the AHU filters results in an increase of 1,674 kWh/yr. The energy cost penalty for the increase in electric consumption is $71 per year. However, there is little to no impact on the pressure drop pre and post spray application on the filters (*Table 1*).

	Measured kW	Operation hrs/yr	Annual Energy
Pre-Installation	30.1	3,120	94,016
Post Installation	30.7	3,120	95,690

Table 1*: M&V results – energy consumption*

After analysis of the key parameters pre and post application of the hydrophobic spray. The AHU-11 supply fan air flow measurements were taken pre and post application of the hydrophobic spray. There was a slight decrease in supply fan air flow of 2.3%, this is within the measurement error of duct traverse method and does not represent a significant decrease in air flow. The measurement results for the air flows are listed in the *Table 2*:

Key Parameters	Pre-Install	Post Installation	Diff.	% Diff.
Total CFM	36,325	35,504	-821	-2.3%

Table 2: *M&V results from Air Handling Unit (AHU) -11*

The impact of the spray on the post static pressure drop across the filters is 2.0% higher than the pre-spray static pressure across the filters. The 2% increase in the static pressure which is close to the error of measurement. The results of the M&V field testing (*Table 3*) are aligned with the claim by Curran Biotech that the hydrophobic spray adheres to the fibers of the filters and do not block the spaces between the fibers. Hence having none to minimum impact on the energy consumption of the fan.

Key Parameters	Pre-Install	Post Installation	Diff.	% Diff.
Discharge SP	3.45	3.52	0.07	2.0%
Suction SP	-1.35	-1.33	0.02	-1.5%
Total SP	4.8	4.85	0.05	1.0%

Table 3: *M&V results - field testing pre and post test*

The impact of the hydrophobic spray on the filters on the post power draw of the fan motor results in an increase of 1.8% (*Table 4*). The 1.8% increase in the post fan power draw is close to error of measurement. The results of the M&V field testing show that there is a small increase in post fan power draw, and this may increase the fan electric energy slightly.

	Measured Demand kW
Pre-Installation	30.1
Post Installation	30.7
Difference	-0.54
Percentage Diff.	-1.8%

Table 4: *M&V results - field testing pre and post test*

The electric energy consumption for the supply fan motor was calculated for the pre and post spray application on the filters. There is an increase of electric consumption for the post conditions. The increase of 1.78% post supply energy results in a cost penalty of $71 (based on the facility electric utility rate of $0.0425 per kWh). *Table 5*, below shows the pre and post energy consumption and the percentage difference in electric energy.

	Annual Energy kWh/yr
Pre-Installation	94,016
Post Installation	95,690
Difference	(1,674)
Percentage Diff.	-1.78%

Table 5: *M&V results – annual energy usage pre and post test*

The cost of energy increase for the installation/application of hydrophobic spray on the AHU-11 filters is minimum and can be offset by reduced cost of replacement of filters. Currently the filters are being replaced every month for the AHUs. With Curran Biotech *capture coating* technology applied, NYC can resume normal filter replacement (currently every three months). The SARS-CoV-2 virus threat is eliminated by adhering to the hydrophobic solutions.

2.1 Water Lens Results and Discussion

Water Lens was selected to complete the testing and measurements because they have the facilities and regulatory ratings necessary to test for SARS-CoV-2. In addition, they have on site virus to carry out the studies. Our approach to this was spraying a high concentration of virus on a small filter area and simulating the air movement function of a typical HVAC, pulling air with the virus through different MERV rated filters in order to suck them onto an absorbent cloth. In real terms, we would not expect so many viruses to be launched at such a small area of the filter, but the goal here was to push the filters as hard as possible, and therefore the Curran Biotech *capture coating*, to see how much they could take before breaking down. So far, we have gone from 1 million virus to 7 million virus and the result is the same, the coating performs better than MERV 14.

The technique used to detect is by having a qPCR instrument and rated reagent to fluoresce in the presence of the virus. This is the most accurate to date of any of the detection methods. Our goal was to make sure lower rated MERV filters could perform at a better standard than is expected for MERV 14 filters, but coating MERV 14 filters will also enhance the performance of the filters - but only as it relates to the virus. Our technology is not designed to change the MERV rating of filters, but to eliminate the threat of water borne virus and, for now, particular to SARS-CoV-2. At a later stage, we will start a process of testing for other virus with a high expectation of success and we will report on that in the Spring, 2021. Our primary concern is right now - SARS-CoV-2 is rampant and being indoors with poor ventilation systems is a huge risk.

With air drawn through the filter at a mean incident air velocity of 0.67 m/s and air temperature of 24.7^{o} C, a target area (7.5 cm x 7.5 cm) on the front face of the experimental filter was sprayed with 1.0 mL of inoculum at a viral titer of 1.0 million genomes/mL. The collection/retention filter carefully removed and eluted. Experimental collection/capture filter swatches (FPR-10) were eluted in 100 mL of 1% beef extract/0.05M glycine (pH 9) for 20 min. The eluant was concentrated to a final volume of 1.6 mL using a combination of tangential flow filtration and centrifugal ultrafiltration. Subsequently, 50 µL of each sample was treated with 6.5 µL of Proteinase K then incubated at 60 ºC (15 min)/98 ºC (5 min) prior to running RT-qPCR.

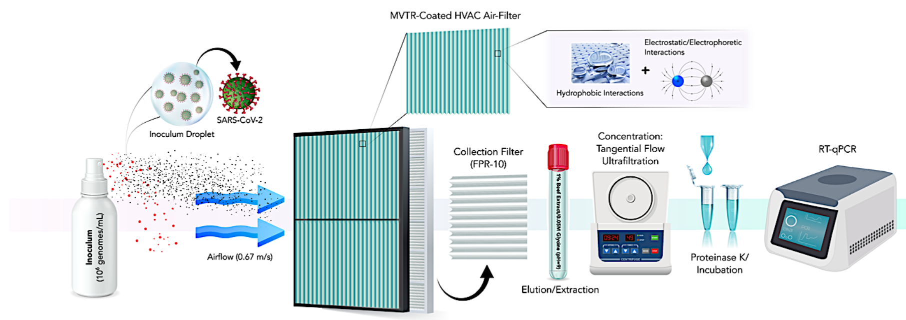

Figure 3: *Generalized depiction of the experimental setup used to evaluate the performance of MVTR-A1-treated HVAC air-filters against untreated/pristine HVAC air-filters. Note that the graphical components are not drawn to scale and are only intended to convey the general experimental procedure.*

RT-qPCR was conducted using 7 µL samples in triplet using a Chai Open qPCR instrument (Chai, Inc.). Gloves were changed between samples to minimize cross-contamination. A larger cycle quantification value (C_q) indicates a smaller initial concentration of captured thermally inactivated SARS-CoV-2 virions extracted from the collection filter, which corresponds to an increase in virion-filtration performance. We can see from this data that as we increase in MERV rating the cycle quantification requires a larger number of amplification/denaturation cycles before we get onset of fluorescence as there is less viral load penetrating the filters. The treated filters are far more effective than even the MERV 14 and substantially reduce transmission to a negligible rate, as shown in *Figure 4*.

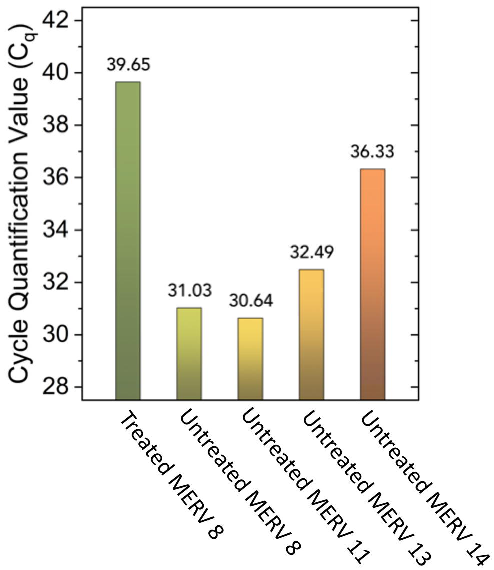

Figure 4: *Cycle quantification values of an untreated MERV 8, 11, 13, and 14 compared against a treated (MVTR-A1) MERV 8 after 45 amplification/denaturation cycles.*

A larger cycle quantification value (C_q) indicates a smaller initial concentration of captured thermally inactivated SARS-CoV-2 virions extracted from the collection filter, which corresponds to an increase in virion-filtration performance. We can see from this data that as we increase in MERV rating the cycle quantification requires a longer period before we get onset of fluorescence as there is less viral load penetrating the filters. The treated filters are far more effective than even the MERV 14 and reduce transmission to a negligible rate (*Figure 4*).

A more thorough examination of the process was to also look at the cycle quantification value and compare that to filter efficiency as shown in *Figure 5*. In this case on the bottom axis are the MERV ratings for different filters, on the left y axis is the cycle quantification value and on the right is the theoretical efficiency of the filters when dealing with virions that are smaller than 0.3 µm. Two lines are shown in the graph which depicts the actual values received for the cycle quantification value and the second is a theoretical estimation of what it should yield depending on the efficiency of the filter. This data shows that the performance of *MVTR-A1* is equivalent to or better than what would be expected for a MERV 14 or potentially 16 (we did not measure a MERV 16, only as high as 14).

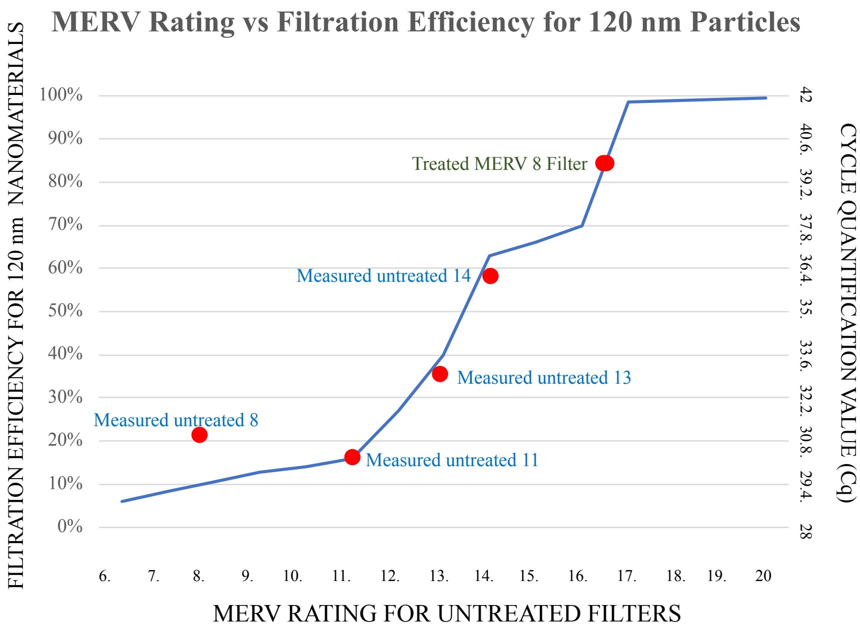

Figure 5: *Filter efficiency in theory mapped out against actual and equivalent cycle qualification values against treated MERV 8 filter and MERV 6 - 16 (experimental was from MERV 8 - 14).*

In order to determine if the filters immobilize the virus on the front face, we also carried out swab tests on the front face of the filter. Samples were taken from the same 3 pleats in the immediate target area at increasing exposure time to a constant draft of air at an incident air velocity of 0.71 m/s and air temperature of 23.0 °C, orthogonal to the filter face plane. Initially, we found significant number of virions on the front face as seen in *Figure 6.* However, after 30 minutes no detectable amounts of RNA could be found because the virions decompose to constituent nucleotides upon desiccation. The same procedure was conducted on the back face of the filter to corroborate these results, where no evidence of virion transmission was detectable.

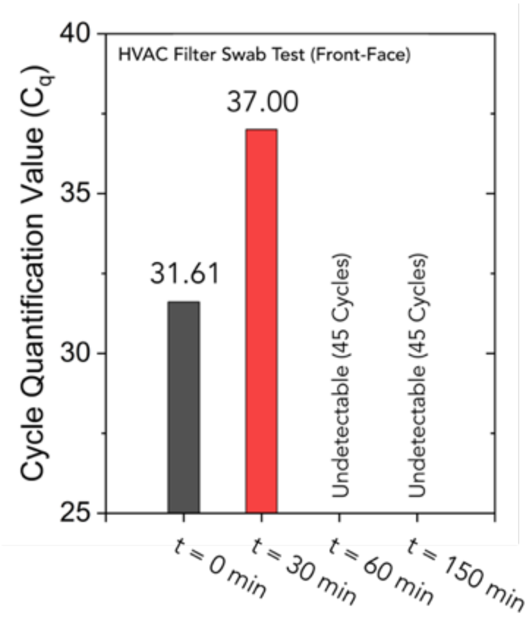

Figure 6: *Cycle quantification value versus time where swabs were taken of the front face of the filter where the virus was 'captured'.*

3. Conclusion

The results from Water Lens show a number of distinct outcomes:

1. The 'Capture Coatings' stop the water encased virus from penetrating the filters, rendering MERV 8 filters and beyond to perform better than MERV14 filters.
2. A single cycle/exchange results in a beyond 95% clean for any of the coated filters. *Uncoated filters require:*

MERV Rating	Efficiency	Cycles for 95% Clean Air
6	6%	41
8	11%	22
11	16%	15
12	27%	8
13	40%	5
14	63%	3
15	66%	2/3
16	70%	2

3. Because the hydrophobic coatings are very effective in reducing the water envelope around the virus, it will naturally desiccate within 40 minutes without having to use any chemical or detergent sprays.

The results from Edison Energy show:

4. Slight increase in energy consumption of the supply fan motor.
5. Electric energy consumption after the application of the hydrophobic spray on the AHU filters results in an increase of 1,674 kWh/yr.
6. There is little to no impact on the pressure drop pre and post spray application on the filters.
7. The coatings are indeed breathable and no impact on the AC system.

The results and study from Curran Biotech reveal:

8. The coatings will last the lifetime of the filters.
9. Normal and standard operation of capital equipment may resume with better protection via Curran Biotech *capture coating* applied on filters that are in place for an additional cost of ~$1.80 per filter.

The results from Edison Energy, Water Lens, and Curran Biotech have demonstrated the *capture coating* will effectively clean the air using filters that are coated and will prevent transmission of the virus through the buildings. The Curran Biotech technology will enable an efficient solution for stopping SARS-CoV-2 without substantial operational costs within the filtration system. No additional capital equipment is required. It does not improve the filtration system designated from a MERV 8 to above, but is designed solely to capture virus in buildings and retard their transmission.

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We would like to thank Edison Energy, Water Lens, and Dan Donovan of DCAS for their critical contributions and sterling work on this project. In addition, we'd like to thank Qahtan Al Jammali and Rebecca Isacowitz from DCAS DEM who have managed the Program.

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5. Appendices

Appendix A - Edison Energy Report
Appendix B - Water Lens Report
Appendix C - MSDS
Appendix D - TDS

Appendix A - Edison Energy Report

CURRAN BIOTECH

Appendix B - Water Lens Report

Appendix C - MSDS

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Appendix D - TDS