SUNY Canton Implementation of Ionization Purification of Air Amid COVID-19

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COVID-19 proved an opportunity for SUNY Canton to introduce ionization technology as part of our indoor air quality improvement. Day and Nite All Service approached the administration to install three systems of ionization tubes. The ionization tubes are located immediately after the air handler units in three different types of indoor environments. SUNY Canton chooses these three campus spaces, the second-floor classroom building, the student service center, and the health center.

Background:

The campus was built from 1967 to 1968. As such, the HVAC equipment in the selected areas varies from original to new as the space needs have changed through renovation. The classroom spaces of the second floor of Cook Hall are a mix of the actual air handler with renovated distribution and return systems using heating coils with makeup air. The Student Service Center is a renovated and modified gym with a two-and-a-half-story ceiling height. The air handler is modern because the building was constructed during the early 2000s. The third space is our Campus Health Center, constructed during the same project as the Student Service Center renovation.

We distribute fresh air through this AHU during the non-heating season, as we are located in Northern New York. Our building is used primarily between September and May for academic activities. The Cook Hall AHU distributes 1550 CFM with an outside air draw of 735 CFM with a hot water heating coil without air conditioning. The AHU for Cook Hall's second floor uses a 26 x 10 duct to serve classroom and laboratory space. The laboratory spaces require additional makeup air as these are chemistry and biology labs.

The Health Center was designed and constructed in the 2000s; as such, this system is the most modern on campus. The 1500 square foot area comprises four exam rooms, three offices, a conference room, a reception desk, and a small lobby holding three waiting patients. 1100 CFM supplies only the Health Center via the AHU with outside air 260 CFM and filters, which are MERV 10.

The Student Service Center is four thousand square feet of open space with a lobby, service counters in the middle, and seven-foot-high cubical walls with doors for private offices outside the room. The ceiling is twenty-five feet high with concrete masonry units for exterior walls with sandwiched insulation. The area was renovated from a modified gymnasium where students could have pickup basketball games. The AHU and ducts provide 5280 CFM of supply air with the outside air of 820 CFM and filters, which are MERV 10.

The populations in these spaces are a mix of people entering and leaving on different schedules. Cook Hall's second floor is primarily operated from 8:00 AM to 5:00 PM for ninety percent, with ten percent between 5:00 PM to 9:00 PM, with people changing space on the hour. Classrooms hold forty-five seats, with the laboratory spaces having seats for eighteen. There are five lab spaces, two lecture rooms holding forty-five students, and a classroom holding thirty students. The Health Center is staffed from 8:00 AM to 4:30 PM with at least two nurses and a varying student population.

All AHUs in campus buildings use a MERV 10 filter pack as the primary filter system. The addition of ionization units could assist in purifying the air consumed by our population of students, faculty, and staff. Our goal is to provide systems that would neutralize the COVID-19 virus. The trial of three AHUs is a plausible air purification plan to protect our population.

The ionization system that SUNY Canton installed is AtmosAir Solutions. The Matterhorn 1000 is mounted directly in the supply ducts of an air handler, where these are used for heating, cooling, or simply ventilation. If the fan is causing fluid motion, the ionization tubes will perform the ionization of the particles in the airflow. A pressure switch is connected to the ionization tubes to identify the fan that creates motion in the supply duct. The AtmosAir ionization tubes are sized to meet the demand for the intended space's airflow.

Development:

SUNY Canton is a significant player in this project to ensure protection from viruses that could close the campus if there is a considerable outbreak of COVID-19. AtmosAir products seemed to meet the need for air purification, and their supplier, Day and Nite All Service offered to provide the necessary technicians to complete the installations. As the world looks for ways to battle the virus causing COVID, these three partners are looking for ways to improve air quality beyond the pandemic.

SUNY Canton, an academic institution, decided to conduct this as an experiment and choose systems and spaces that would offer the most impact. The areas selected were chosen for the populations and hours of operation with the most diversity. A mold and bacterial auger plate with air samples were used in each location for 24 hours. Additionally, IAQ samples were gathered over 24 hours. The equipment used in this baseline Gray Wolf Advanced Sense IQ-610 monitor, along with the Gray Wolf PC 3016 particles counter, was used to record and log the air testing results.

The parameters measured pre- and post-powering of the ionization tubes are temperature, relative humidity, carbon dioxide, Total Volatile Organic Compounds, Carbon Monoxide, Ozone, and Particles PM 0.5, PM 1.0, PM 2.5, PM 5, PM 10. EMSL Analytical Inc. analyzed the sampling results using Method MICRO-SOP-132 for microbial sampling.

Results

See below for summary charts showing the results of the sensor air quality readings.

Readings taken Building 1 Pre AtmosAir Installation

Element	CO2	Temp	RH	TVOC	Ozone	CO
Avg. Values	914 ppm	76 F	41%	349 ppb	0.03 ppm	3.33 ppm
Guidelines	5000 ppm	68 to 78 F	30 to 60%	500 ppb	.10 ppm	9 ppm
Element	PM .3	PM .5	PM 1	PM 2.5	PM 5	PM 10
Avg. Values	N/A	.272 ug.m3	.353 ug/m3	.728 ug/m3	1.32 ug/m3	1.32 ug/m3
Guidelines	N/A	N/A	N/A	35 ug/m3	N/A	150 ug/m3

Readings taken Building 1 Post AtmosAir Installation

Element	CO2	Temp	RH	TVOC	Ozone	CO
Avg. Values	738 ppm	73 F	43%	220 ppb	0.03 ppm	2.47 ppm
Guidelines	5000 ppm	68 to 78 F	30 to 60%	500 ppb	.10 ppm	9 ppm
Element	PM .3	PM .5	PM 1	PM 2.5	PM 5	PM 10
Avg. Values	N/A	.173 ug.m3	.323 ug/m3	.646 ug/m3	1.61 ug/m3	3.13 ug/m3
Guidelines	N/A	N/A	N/A	35 ug/m3	N/A	150 ug/m3

Readings taken Building 2 Pre AtmosAir Installation

Element	CO2	Temp	RH	TVOC	Ozone	CO
Avg. Values	836 ppm	74 F	41%	255 ppb	0.06 ppm	3.62 ppm
Guidelines	5000 ppm	68 to 78 F	30 to 60%	500 ppb	.10 ppm	9 ppm
Element	PM .3	PM .5	PM 1	PM 2.5	PM 5	PM 10
Avg. Values	N/A	.624 ug.m3	1.06 ug/m3	1.96 ug/m3	4.79 ug/m3	8.34 ug/m3
Guidelines	N/A	N/A	N/A	35 ug/m3	N/A	150 ug/m3

Readings taken Building 2 Post AtmosAir Installation

Element	CO2	Temp	RH	TVOC	Ozone	CO
Avg. Values	560 ppm	71 F	52%	214 ppb	0.01 ppm	3.15 ppm
Guidelines	5000 ppm	68 to 78 F	30 to 60%	500 ppb	.10 ppm	9 ppm
Element	PM .3	PM .5	PM 1	PM 2.5	PM 5	PM 10
Avg. Values	N/A	.313 ug.m3	.403 ug/m3	.635 ug/m3	.715 ug/m3	.715 ug/m3
Guidelines	N/A	N/A	N/A	35 ug/m3	N/A	150 ug/m3

Readings taken Building 3 Pre AtmosAir Installation

Element	CO2	Temp	RH	TVOC	Ozone	CO
Avg. Values	584 ppm	74 F	42%	186 ppb	0.05 ppm	3.33 ppm
Guidelines	5000 ppm	68 to 78 F	30 to 60%	500 ppb	.10 ppm	9 ppm
Element	PM .3	PM .5	PM 1	PM 2.5	PM 5	PM 10
Avg. Values	N/A	.805 ug.m3	1.32 ug/m3	1.94 ug/m3	5.03 ug/m3	6.63 ug/m3
Guidelines	N/A	N/A	N/A	35 ug/m3	N/A	150 ug/m3

Readings taken Building 3 Post AtmosAir Installation

Element	CO2	Temp	RH	TVOC	Ozone	CO
Avg. Values	727 ppm	73 F	41%	161 ppb	0.05 ppm	3.28 ppm
Guidelines	5000 ppm	68 to 78 F	30 to 60%	500 ppb	.10 ppm	9 ppm
Element	PM .3	PM .5	PM 1	PM 2.5	PM 5	PM 10
Avg. Values	N/A	.169 ug.m3	.288 ug/m3	.483 ug/m3	1.06 ug/m3	1.89 ug/m3
Guidelines	N/A	N/A	N/A	35 ug/m3	N/A	150 ug/m3

Airborne bacterial and fungal sampling were performed at the same time air testing was performed. Selection was done in the same areas as air sampling. The samples were taken as per typical protocol in the breathing zone area. Sampling was performed by drawing air through a microbial impactor and collecting it on a TSA agar plate for bacteria and an MEA agar for fungal spores for laboratory analysis. EMSL Analytical Inc. analyzed Method MICRO-SOP-132.

See below a chart of the bacterial and fungal sampling results:

Total Bacteria CFU Building 1 Pre AtmosAir	Total Bacteria CFU Building 1 Post AtmosAir	% Difference
119 CFU	**ND**	**-100%**
Total Bacteria CFU Building 2 Pre AtmosAir	Total Bacteria CFU Building 2 Post AtmosAir	% Difference
126 CFU	**7 CFU**	**-94%**
Total Bacteria CFU Building 3 Pre AtmosAir	Total Bacteria CFU Building 3 Post AtmosAir	% Difference
1200 CFU	**ND**	**-100%**
Total Spore CFU Building 1 Pre AtmosAir	Total Spore CFU Building 1 Post AtmosAir	% Difference
35 CFU	**ND**	**-100%**
Total Spore CFU Building 2 Pre AtmosAir	Total Spore CFU Building 2 Post AtmosAir	% Difference
84 CFU	**ND**	**-100%**
Total Spore CFU Building 3 Pre AtmosAir	Total Spore CFU Building 3 Post AtmosAir	% Difference
441 CFU	**ND**	**-100%**
Total CFU Pre	**Total CFU Post**	**% Difference**
2005 CFU	**7 CFU**	**-99%**

N/A = Not Applicable
ND = Non Detectable
CFU = Colony Forming Unit

Conclusions

In comparing the readings, looking at the indicators of air cleanliness, the following differences were measured:

Building 1

Element	TVOC	PM .3	PM .5	PM 1	PM 2.5	PM 5	PM 10
Without AtmosAir	349	N/A	.272	.353	.728	1.32	1.32
With AtmosAir	220	N/A	.173	.323	.646	1.61	3.13
% Difference	**-37%**	**N/A**	**-37%**	**-9%**	**-12%**	**+21%**	**+135%**

Building 2

Element	TVOC	PM .3	PM .5	PM 1	PM 2.5	PM 5	PM 10
Without AtmosAir	214	N/A	.624	1.06	1.96	4.79	8.34
With AtmosAir	186	N/A	.313	.403	.635	.715	.715
% Difference	**-14%**	**N/A**	**-50%**	**-62%**	**-68%**	**-86%**	**-92%**

Building 3

Element	TVOC	PM .3	PM .5	PM 1	PM 2.5	PM 5	PM 10
Without AtmosAir	186	N/A	.805	1.32	1.94	5.03	6.63
With AtmosAir	161	N/A	.288	.288	.483	1.06	1.89
% Difference	**-13%**	**N/A**	**-64%**	**-78%**	**-75%**	**-79%**	**-71%**

In looking at the sampling and testing data results, no concern limits were measured concerning EPA, OSHA, or NIOSH guidelines. The readings show that with the AtmosAir systems operating, improvements to air quality were measured. There were reductions in Total Volatile Organic Compounds (TVOC) and Particles. TVOC is gaseous elements from humans and their activities, building materials, furnishings, and off-gasses from chemical use. TVOCs are typically a source of airborne irritants and odors. Particles come from dust, spores, and allergens and can be entrained in from outside air or generated within a space by people and their activities. Particles can cause allergic symptoms embedded in the lungs and cause respiratory distress in specific individuals. In the case of micro-organisms such as bacteria and viruses, these are microscopic particles, generally .5 microns and less in size.

Additionally, samples were taken for airborne bacterial and fungal spores. Significant reductions in total bacteria and spore colony-forming units were measured in all areas tested and were found to be 99% reduced with AtmosAir operating. Removal of bacteria and spores will result in a healthier environment and less possibility of illness transmission.

The scope of services above was performed with the level and skill exercised by members of the air testing profession currently providing similar services under similar circumstances at the time service is provided. This statement is instead of other statements, either expressed or implied.

The scope of services above is limited to conducting air quality testing only. Clean Air Group / AtmosAir makes no claims or warranties about any air quality testing pre-requisite requirements or building or HVAC system operating conditions. The air testing was done for comparison purposes only.

Future Work:

The SARS-CoV-2 is here to stay in such a way that the HVAC industry and building owners will need to provide means to eliminate or minimize the virus-causing COVID. The logical place to battle this virus is the air handling systems providing indoor air quality. We have become accustomed to ensuring clean air. The test results from this project indicate that ionization technology can help deal with viruses, as our PM data shows there was a reduction in particle size equivalent to the size of the SARS-CoV-2 virus.

The challenge of future testing is finding a biohazard level 3 containment facility large enough to accommodate an air handler in which a test sample of the SARS-CoV-2 virus is introduced in a series of planned tests to determine the full effectiveness of ionization on eliminating or reducing the virus in a dynamic flow condition relatable to a building environment.

Further testing requires funding from an agency, such as the National Institute for Health or others in the HVAC industry, to entice a laboratory with the correct facilities to fully test the ionization tube's impact on eliminating viruses from our designed airflow in buildings.