ADVANCED IAQ SOLUTIONS, INC.
A DEFINITIVE APPROACH TO INDOOR AIR QUALITY

[redacted] **HEPA FIELD STUDY**
Nail and Hair salon

An infield evaluation of the unit as to the measurable results in reducing odors and VOC's in a working commercial hair and nail salon conducted over 5 days.

Location: Bath, Pa. 18014
Project start: 7/27/21 to 7/31/21
Conducted by: Keith Roe, CIE/CMC

Testing Environment:
This is a commercial hair and nail salon that offers all services associated with pedicures, nail coloring, hair cutting and hair coloring.
The space is approx. 1200 sq.ft /10,400 cu.ft. There is a 3 ton forced air system that provides both heating and cooling uses a MERV 7 in line filter. There is an exhaust air system that is not being used. There is a single return air ceiling diffuser located in the rear of the salon.

Equipment Tested:
A portable unit containing an [redacted] treated HEPA filter that reportedly provides a CADR rate of 150-(cfm rate of treated air.) This delivery rate would provide approx. .86 air turns per hour for the entire space.
This unit ran continuously during the 5-day period after the initial testing and monitoring was performed.

Definitions of targeted contaminants:
Most odors consist of organic compounds, although some simple compounds not containing carbon such as hydrogen sulfide and ammonia, are also odorants. An odor is a volatized chemical compound that humans and animals can perceive by their sense of smell. Not all VOCs can be perceived by smell when in very low airborne concentrations. This salon uses many hair, nail and cleaning products that contain multiple chemical compounds. There is also a small storage room at the back of the salon that houses partially used and full containers of products that produced higher levels of emissions than found on the salon floor During the operating hours a strong odor persisted. I was not able to inventory all the products in use to establish an index of compounds for reference.

Equipment and Methods Utilized:
1. **Olfactory senses**- We have asked the owner of the store **to** provide their impressions of any odor changes they experienced over the 5-day period. I will also make reference to my observations.
2. **TO-15 SUMMA TYPE TVOC Sampling-** A two-hour sampling was taken on Day 1 (prior to [redacted] unit start) Day 3, and Day 5. This is a qualitative and quantitative sampling method that identifies 63 common indoor VOC's (volatile organic compounds) and identifies unknown compounds and makes tentative identifications. Not all odors are able to be identified with this method, but it is one of the most powerful tools an investigator can use for any evaluation identifying VOC's leading to subsequent airborne odors. (see Addendum A for further testing data)
3. **TVOC (Total Volatile Organic Compounds) and Formaldehyde (HCHO) gas monitoring:** Using a newly calibrated TemTop model LKC-1000 a laser multi-functional detector with a high precision electrochemical

sensor that can transform the concentration of pollutants in the air into visual data, readings were taken every day by Keith as he visited and supervised the project. The TVOC reading that this unit provides is representative of multiple airborne present simultaneously, but not all VOCs present will be captured. The TVOC readings were also taken using an Ion Science Tiger PID (photoionization technology) meter that records a wide range of VOC's while minimizing the effects of humidity and particle contamination . HCHO readings are part of the integrated results and are reported separately using the TemTop meter. These total results were reported in mg/m3. (milligram per cubic meter)

4. **PM2.5, PM10.0 and Respirable Particles Counts (ranging between .3 microns to 10. Microns.)**
   Since airborne particle concentrations play a key role transmitting airborne pollutants and diffuse deeply in the lungs even depositing into your bloodstream it is critical to minimize exposure to elevated levels. Since the unit is a functioning HEPA filter, the respirable particle count (RPC) levels were recorded every day using an Extech Video Particle Counter VPC300 with current calibration.
   PM2.5,10.0 are inhalable particle matter not a single pollutant, but a mixture of many chemical species. It is also a complex mixture of solids and aerosols. These are a at regulated levels set by OSHA .
   PM2.5 and PM10.0 counts were provided by the same TemTop LKC-1000 using a histogram function.
5. **ODOR Meter- A** newly calibrated Kanomax OMX-ADM meter was used which concentrates on chemical substances contained in a smell and this device shows a relative strength of a smell numerically by using semiconductor gas sensors. The scale is from 0 – 999.
6. **Relative humidity and temperature** were also monitored using the Extech VPV300 to determine if there was any discernable effect on the [redacted] operation when levels increased.

NOTE: Readings were taken at the front and rear of the salon for comparison.

Unit Placement/Operation:

The [redacted] unit was placed midway down on the inside wall within the primary service area approx. 12" from the wall. The salon extended another 40' to the rear of the store where additional products were stored in a small room with an open door.

Most services provided to customers were withing 8' to 12' from the [redacted] unit.

FINDINGS:

Olfactory observations: The odor level during the day remained quite high but fluctuated upward during any hair or nail services provided. The levels at night reduced noticeably when the store was closed. Becky, the salon owner said she really noticed a big difference especially in the morning when she first entered. Every morning after the first day, when I entered, I was able to smell a typical odor, but it was at a much lower threshold and not unpleasant or overwhelming.

Initial TO-15 results:

Sampling was done in the front half of the store in the primary work space.

Initial air Sampling:

Report # 492100446-

A combined TVOC level **of 28,000 ug/m3** was reported comprised of 14 separate compounds. **This is an untypically elevated total.** Isopropyl Alcohol and Ethyl Acetate was reported above the IAQ Pa. state health standard.

Day 3

Report # 492100449-

A combined TVOC Level of 11,610 ug/m3 was reported, comprised of 17 separate compounds. The 3 additional compounds were unable to be identified by CAS #. Isopropyl Alcohol still remained over the Pa. IAQ health standard for exposure.

This was a 59% reduction from the previous levels.

Day 5

Report # 492100450-

A combined TVOC level of 18,300 ug/m3 was reported comprised of 14 sperate compounds. The same 3 compounds of Isopropyl alcohol, Ethanol and Acetone remained the primary compounds reported throughout the study.

This total represented an increase of approx. 57% from the previous recorded level, most likely reflecting the cleaning effort performed that morning that produced pollutant spikes. An overall decrease of about 35% was recorded from the initial levels was reported.

TVOC/HCHO :

The initial readings taken around 4 pm prior to [redacted] operation was reported at 3.71 mg/m3 of TVOC and HCHO at 1.15 mg/m3. This was in the main service area. Also rear of the store readings were also taken for comparison. (see worksheet A)

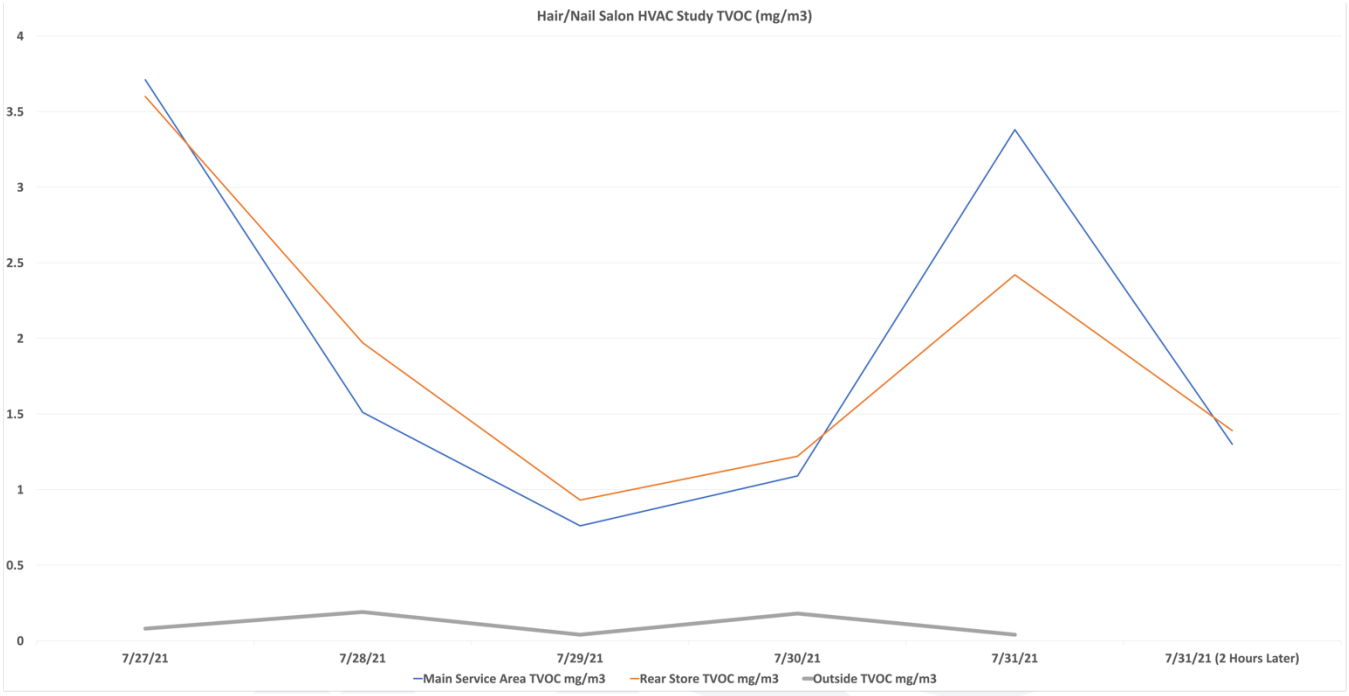
These are classified as elevated levels and classified as unhealthy by known standards and guidelines.

By the second day after approx. 16 hours of continuous unit operation at 10:00 AM and while a nail customer was being serviced, the TVOC level in the service area was recorded as reduced to 1.51 mg/m3 and the HCHO to .50 mg/m3. With slightly higher reduced levels at the rear of the salon.

The TVOC total was reduced by approx. 60% and the HCHO total was reduced by approx. 57%.

Over the remaining 3 days, the TVOC readings fluctuated during and after service periods, but remained significantly reduced from the initial levels. At points of measurement at approx. the same time each day in the AM operating hours, the TVOC levels were reported between .76 mg/m3 and 1.30 mg/m3. The HCHO level was reported between .20 and .41 mg/m3, *maintaining a significant reduction*.

On 7/31/21, the salon was being swept and cleaned and levels peaked similar to the initial levels, but within two hours returned to similar lower levels recorded the morning before. (See graphs provided for trending details.)

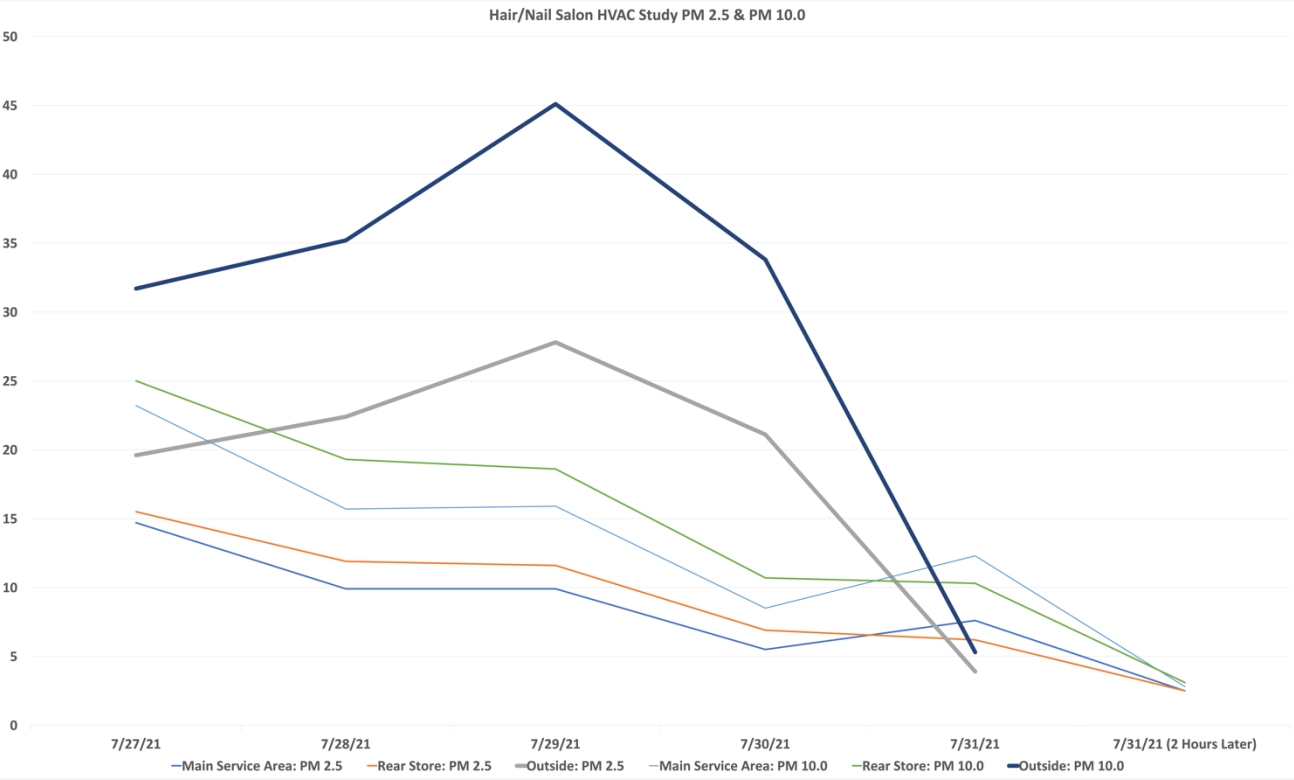

Hair/Nail Salon HVAC Study TVOC (mg/m3)
4
3.5
3
2.5
2
1.5
1
0.5
0
7/27/21
7/28/21
7/29/21
7/30/21
7/31/21
7/31/21 (2 Hours Later)
Main Service Area TVOC mg/m3
Rear Store TVOC mg/m3
Outside TVOC mg/m3

PM2.5/PM10.0

The initial readings at 4:00 pm on the first day were significantly elevated. The PM2.5 count was recorded at 14/7 ug/m3, and the PM10.0 count was at 23.2 ug/m3. Similar levels were reported at the rear of the salon.

Day 2 at 10:30 AM the PM 2.5 total was recorded at 9.9 ug/m3, and the PM10.0 at 15.7 ug/m3, a significant reduction of PM2.5 by approx. 37% and PM10.0) by 33%.

Over the remaining 3 days, the PM2.5 count ranged between 2.5 ug/m3 and 9.9 ug/m3. The PM10 counts ranged between 2.8 to 15.9. ug/m3. Levels rose abruptly on 7/31/21 during the cleaning operation, but *dropped to the lowest levels during the 5 day period within 2 hours at 2.5 and 2.8 ug/m3 respectively, reflecting a decrease of 68% to 78% respectively.*



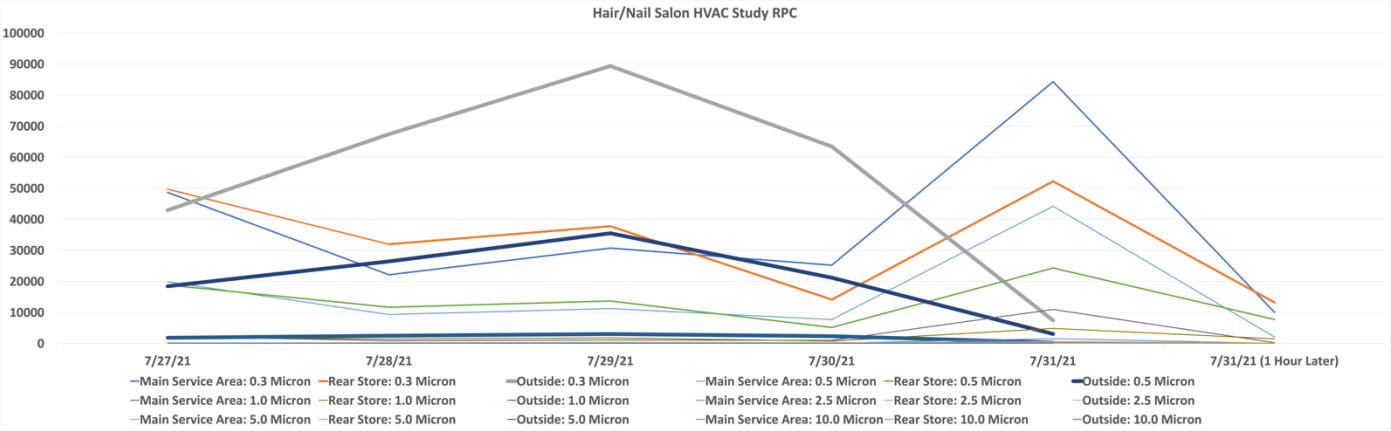
RPC counts:

The initial day collective counts were reported at 71,006 microns in the service area and 70, 650 microns at the rear of the salon, *higher than the outside level at 63,404 microns, by approx. 11.5%.*

Day 2 RPC readings had been significantly reduced by approx. 53% from the previous day and below the outside levels by approx. 67%.

Over the remaining 3 days, the indoor levels remained significantly reduced and well below the outside control levels.

On 7/31/21, the levels spiked significantly during the cleaning, but within .5 hours the levels dropped dramatically and within 1 hour, the RPC levels were the lowest level recorded during the 5 day period, *reflecting an approx. reduction of approx. 83% from the initial levels.*

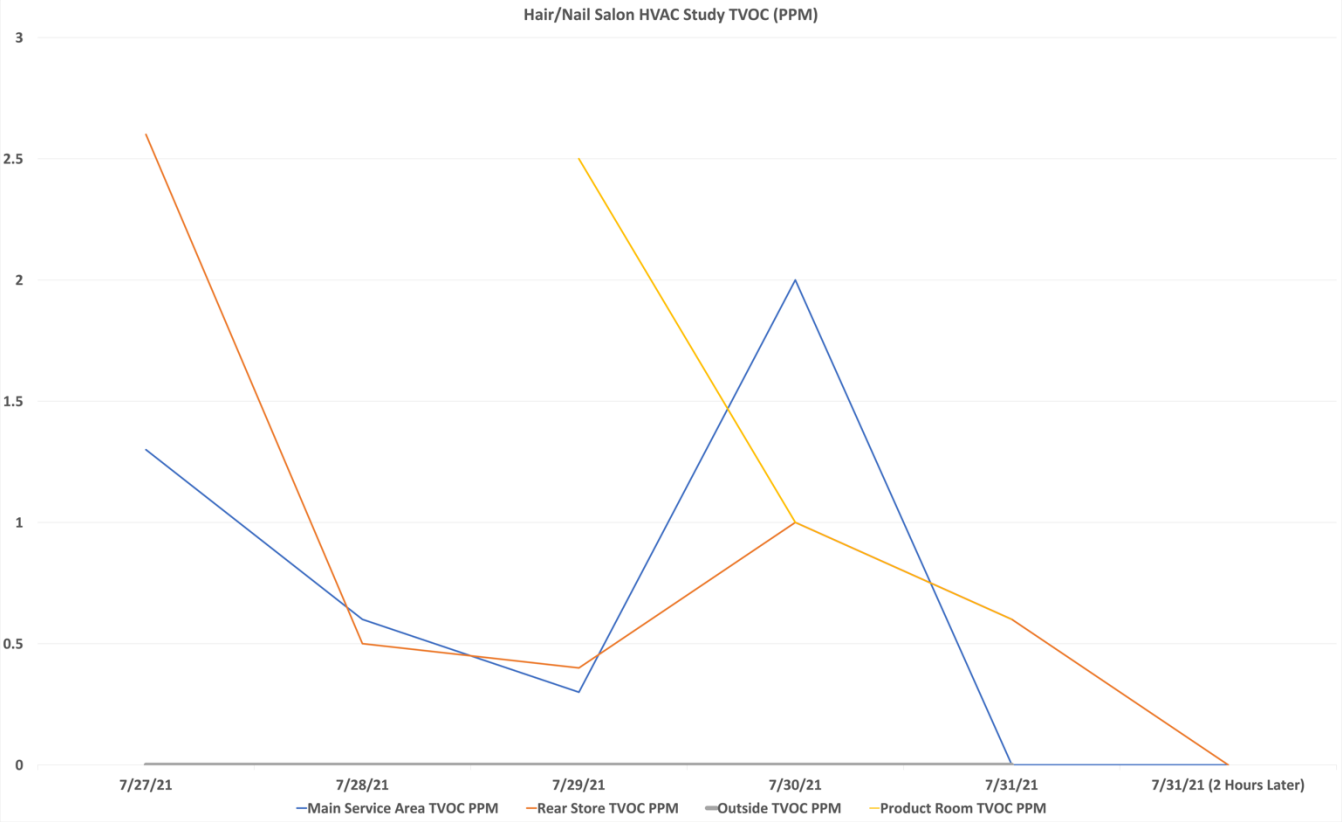


TVOC by PID measurement

The initial reading taken was recorded between 1.3 to 2.6 ppm. This is classified as "irritation exposure effects probable and headaches possible if other exposures interact." (see addendum A for additional reference data)

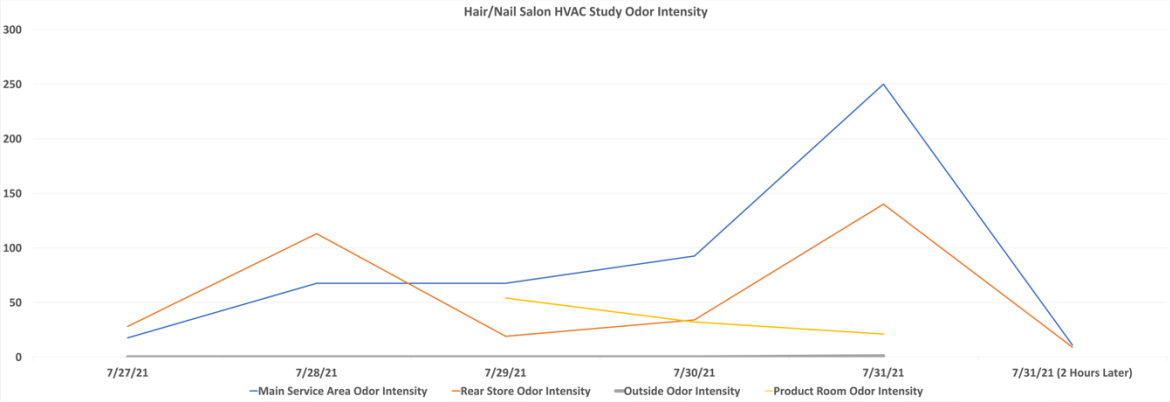
By Day 2, the levels had been reduced to .5 - .6 ppm, *reflecting approx. a 72% average reduction*.

Over the remaining 3 days the levels recorded during the day fluctuated between 0.0 and 2.0 ppm., maintaining a significant reduction from the initial levels.



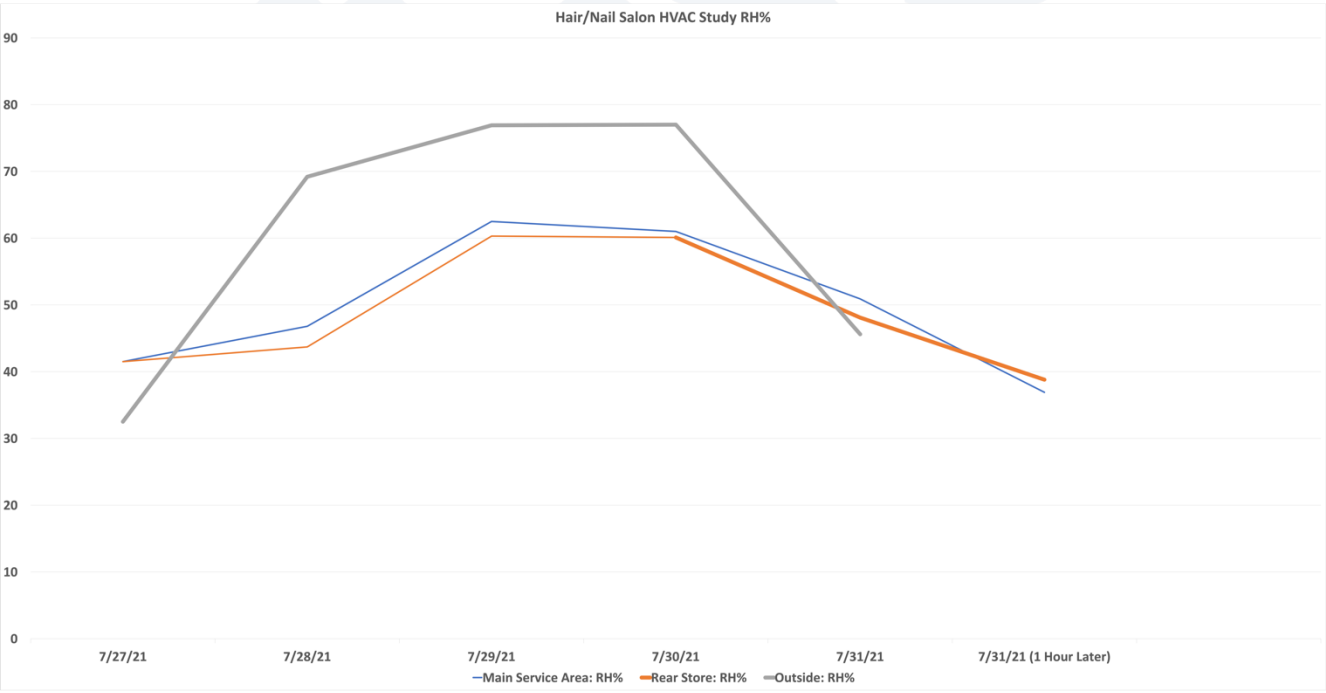
ODOR INTENSITY

This meter reflected an ever-changing level of intensity of odors that fluctuated upward during the different services being provided and then dropped significantly between treatments and to very low levels overnight. It should be noted that on 7/31/21 the final day, within 2 hours of the highest levels recorded after the cleaning and sanitation of the salon, *the recorded odor level dropped to the lowest range recorded during the 5 days coinciding with the lowest RH% inside.*



Relative Humidity and temperature:

The indoor RH% levels were consistently below the outdoor levels as expected ranging between 36.9 and 62.5%. It should be noted that on the 5th day the indoor *RH% was recorded was at the lowest level of 36.9% and the RPC, PM 2.5/10.0 and TVOC by PID and odor intensity were also reported at their lowest levels.*



Summary of Observations and Results:
Both qualitatively and quantitatively, there was a measurable and significant decrease in all air pollutants monitored and measured. The ongoing source of air pollutants was ever changing and fluctuating in intensity, but the decreases that were reported were during the working day when they collectively were at their peak. Improved efficacy was discernable at a RH below 45%. The reduction of the RPC levels were most noteworthy.

It is my considered opinion that…. for the size of the space and ongoing level of pollutants, the 150 CFM unit was undersized at less than 1 air turn/hr. It would be expected that an increase in the air turn rate per hour would be required to bring the overall pollutant level to a more typical sustained level.

Authorized Signature

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Date submitted: 8/11/21

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