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Elevator Cabin Aerosol and Droplet Disinfection With Particle Control Technology™

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Presented: Healthy Buildings America, Jan 19, 2022

ISIAQ INTERNATIONAL SOCIETY OF INDOOR AIR QUALITY AND CLIMATE

HEALTHY BUILDINGS AMERICA 2021

Background and Motivation

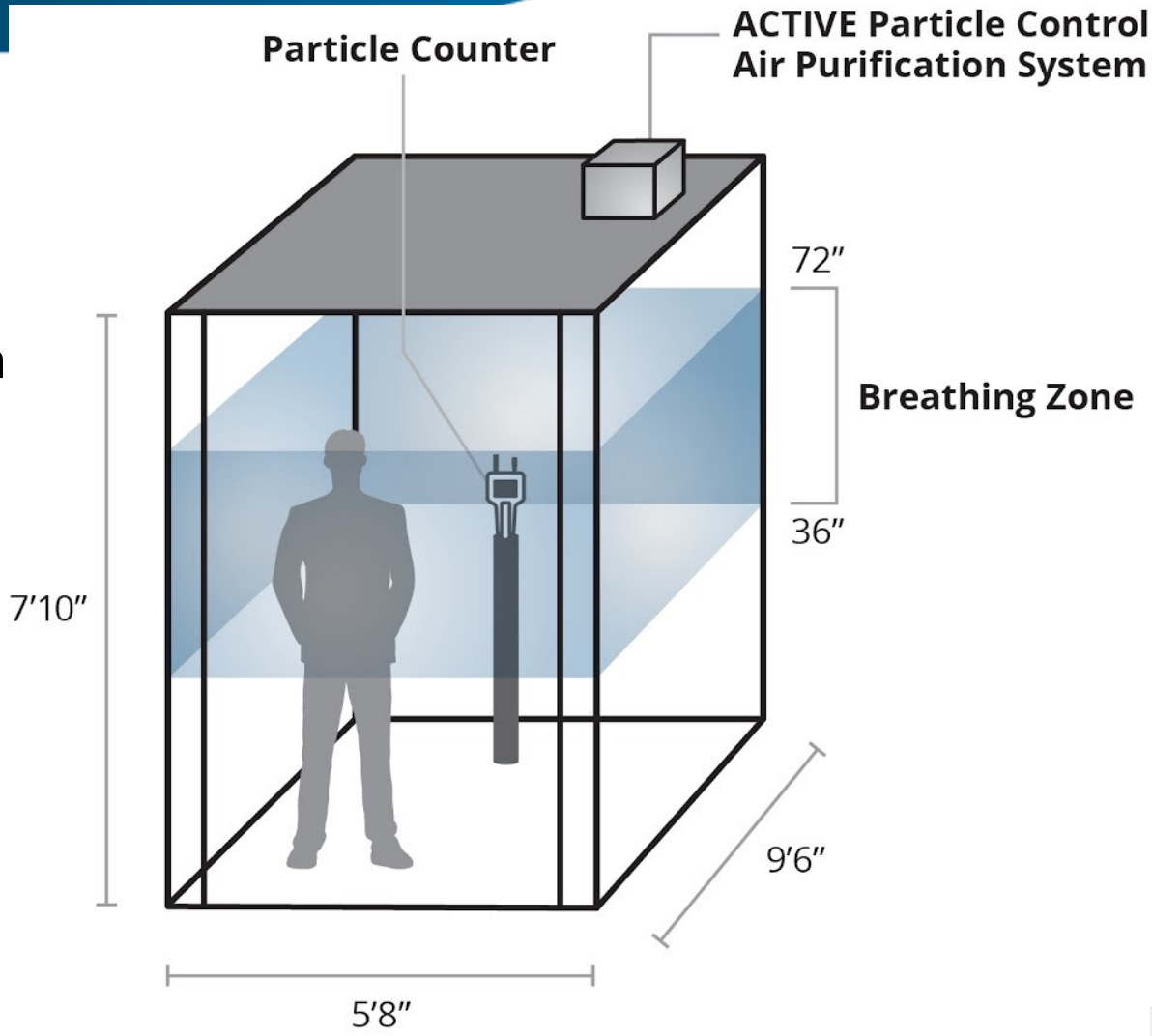
Indoor air bioaerosols are a transmission vehicle for diverse infections, including influenza viruses, severe acute respiratory syndrome viruses, and the novel human coronavirus (SARS-CoV-2). Pathogen droplets and aerosols can persist in elevator cabins for up to 25 minutes (Rijn, 2020). Elevator cabins have fans and vents to facilitate air flow but rarely provide any fresh air or clear particulate or pathogen contamination. Even when active with elevator doors opening and closing pathogen aerosols can linger for up to 18 minutes. New passengers may inhale exhaled aerosols from other passengers present during the previous eighteen minutes. Disinfection of elevator cabin air could significantly reduce the potential for airborne transmission of disease.

Particle Control Technology™ conditions ambient particles which collide and agglomerate and are carried to the capture media where any biologic material is inactivated or killed. Particle Control Technology™ has been shown to reduce fine and ultra-fine airborne particles and pathogens in live operating rooms, reduce bacterial contamination in active hospital compounding pharmacies, and rapidly inactivate or kill the highly resistant Anthrax surrogate (*Bacillus subtilis*) in a research laboratory (Ereth, 2020) and reduce hospital acquired infections by 45% (Ereth, 2021).

We sought to determine the impact of Particle Control Technology™ on elevator cabin particle counts.

Methods

Baseline particle counts were obtained in an operational commercial building elevator serving six floors with a Gray Wolf PC-3016A particle counter and a Gray Wolf IAQ probe. It was secured to the rear cabin wall with the sampling port 42 inches above the cabin floor. Particle counts at PM 0.3 microns, PM 2.5 microns, and PM 10.0 microns were obtained for 100 consecutive minutes during late morning operation. Control ventilation was with a MERV 13 filter and 27 air changes each hour. A modified Particle Control Technology™ device was then installed above the ceiling in place of the elevator ceiling fan. Repeat particle counts were then obtained.



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Results

During the experiment temperature was maintained between 23.7-25.3 °C and humidity ranged between 40.7 and 45.7%. Cabin ridership remained consistent with an average of 20 single riders each hour throughout the study.

Mean and median particle mass at PM 0.3 micron, PM 0.5 micron, PM 1.0 micron, PM 2.5 microns, PM 5.0 microns, and PM 10.0 microns were all significantly reduced by 77-100% (mean 88% reduction) with APC compared to control ventilation ($p<.0001$).

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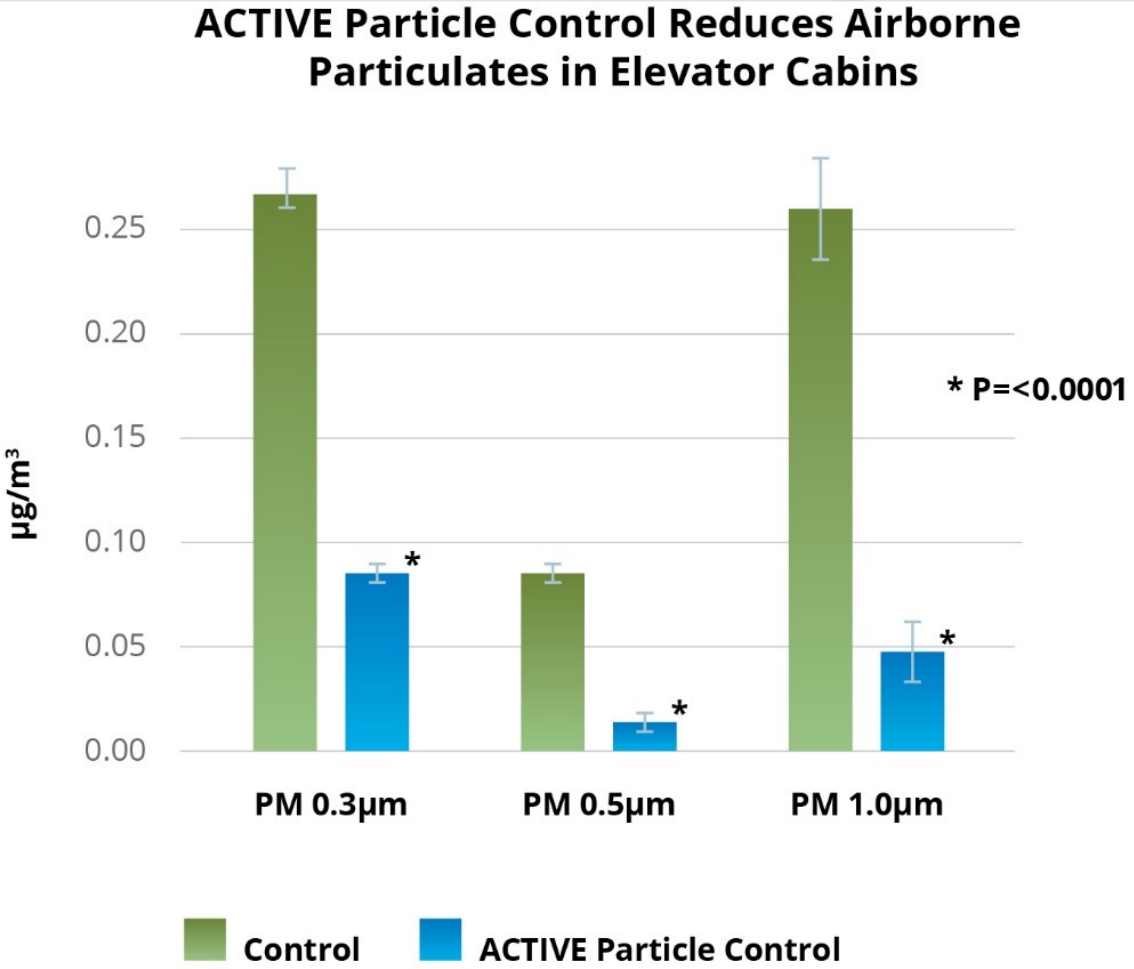
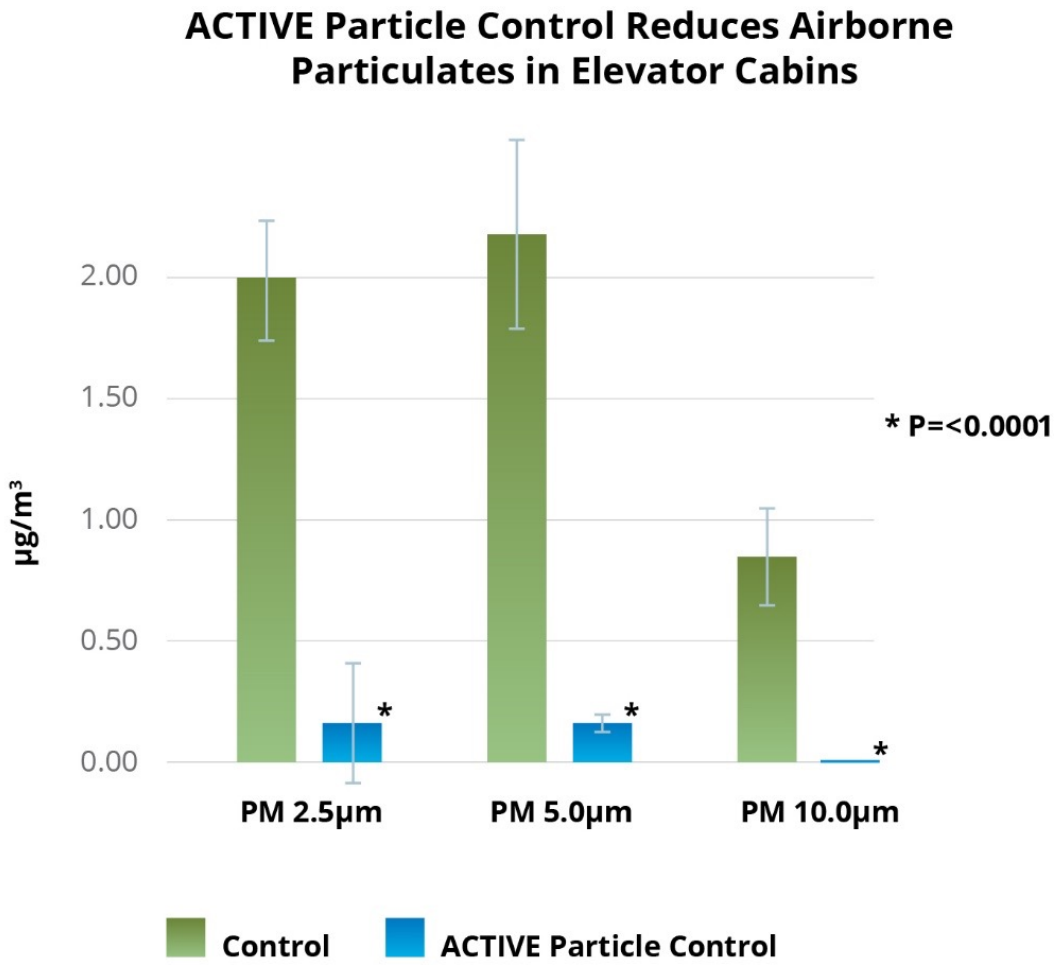
Results





ACTIVE Particle Control™ reduced sub-micron and supra-micron particles (ug/m^3) by 77-100% (mean 88%; p< .001) in an active elevator cabin. Each bar represents 100 air samples with a total of 1,200 data points represented in the figures. PM, particulate matter.

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Conclusions

In this real-world operating elevator cabin, Active Particle Control™ significantly reduced particle mass for all particulate sizes measured. Reducing non-viable airborne particles is an excellent surrogate for reducing airborne pathogens (Raval, 2014). Thus, this indicates an ability to clear airborne pathogens as well. The significant impact of Active Particle Control™ was compared to a control with MERV 13 filter and 27 air changes each hour.

The significant reductions in particle (and pathogen) counts suggest that such an engineering modification may reduce airborne transmission of viral or bacterial disease between elevator passengers.

ACTIVE Particle Control™ is effective on airborne particles of all sizes and very likely effective in clearing aerosolized bacteria and viruses. This work is consistent with other published studies. (Ereth, 2020; Ereth, 2021).

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References

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