NPBI® Needle Point Bipolar Ionization Reduces Particles Faster

HVAC systems equipped with GPS Air NPBI products remove fine and ultra-fine particles better than systems without. Independent testing shows NPBI decreases particles faster even with standard commercial filters. Results show NPBI is very effective on virus sized particles leading to the conclusion that **systems with MERV8 filters and NPBI manage small particles like MERV13 equipped systems.**

Why Managing Small Particles Matters

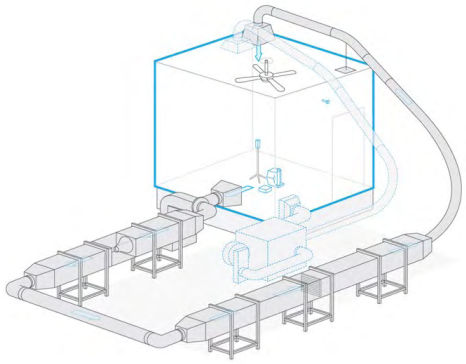
Particles 2.5 µm and smaller challenge human health because they penetrate deep into the respiratory system. Due to small size and low mass they are difficult for standard HVAC systems to capture. [1] [2]

- Fine (≤ 2.5 µm) and ultra-fine particles (≤ 1.0 µm) make up 99% of particles in the air and are such low mass that airflow of commercial and residential HVAC systems are not effective at carrying them to filters.[3]
- Due to their size, fine and ultra-fine particles achieve deep penetration in human respiratory systems, the bloodstream, and are likely to cause cardiopulmonary distress.[1] [4]
- Long-term studies indicate that asthma-susceptible populations have more healthcare burden the closer they are located to major roadways, where fine particle counts are higher.[5] [6]
- Particles between 0.2 and 0.5 µm are categorized as the Most Penetrating Particle Size (MPPS), most filters do not capture a high percentage of these particles. Viruses and bacterium are in this size range.[7]

Managing these particles is easier with GPS NPBI soft ionization because it lowers fine and ultra-fine particle concentrations quickly, particularly MPPS, helping to lower exposure in the breathing zone.

Testing Method and Data Analysis

Fine and ultra-fine particles were added to a large (AHAM-standard chamber) with a recirculation duct. Air was circulated at six air changes per hour (6 ACH). Particle counts were measured every minute. Two rounds of testing confirmed how soft ionization performed with different MERV8 synthetic media filters (Filter A and Filter B). In each round a control with ionization turned off was also measured.



Test Chamber Configuration

Particle Testing Summary & Graphs

GPS NPBI technology provides three benefits in particle reduction:

1. Reduction in the mass of particles in the test chamber. This is illustrated by analysis of the mass (< PM1.0) of the particles in the test chamber. **The results demonstrate real time or instantaneous particle impact (60 - 160% improved).** Figures 1 and 2.
2. Impact on the Most Penetrating Particle Size (MPPS). MPPS is defined at ~0.3 microns, as this size particle is not captured by most filters**. NPBI technology dramatically improves the capture and removal of MPPS particles from the air stream (60 - 1,200% better)**. Test data demonstrate the effectiveness of bipolar ions in space in improving filter performance. Figures 3 and 4.
3. Agglomeration of particles. GPS test data illustrate the **shift in particle sizes from small to large with an analysis based on the fraction of particles remaining in each bin size**. Figure 5.

1. Reduction in the mass of particles in the chamber

Figure 1 Filter A: During the first 20 minutes the mass of particles is extremely high. After 20 minutes, the data reflects a greater than 80% improvement in the reduction rate with ions present.

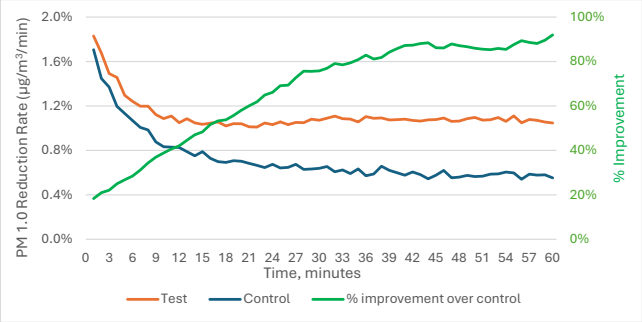
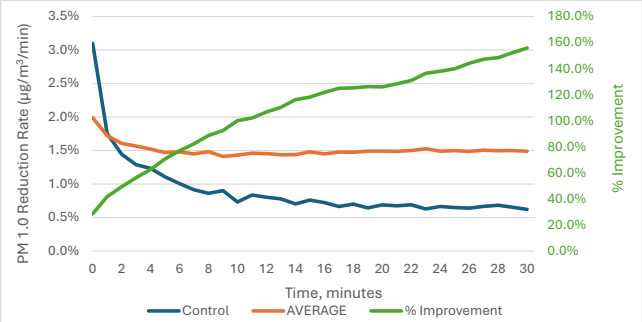


Figure 2 Filter B: During the first 10 minutes the mass of particles is extremely high. After 10 minutes, the data reflects 100-160% improvement in the reduction rate with ions present.



2. Impact on the Most Penetrating Particle Size (MPPS). MPPS is defined at ~0.3 microns, as this size particle is not captured by most filters. Particle Count Reduction with NPBI.

Figure 3 Filter A: During the first 20 minutes, the number of particles is extremely high. After the first 20 minutes, the data reflects a consistent 60-75% improvement in the rate of reduction in particle counts with ions.

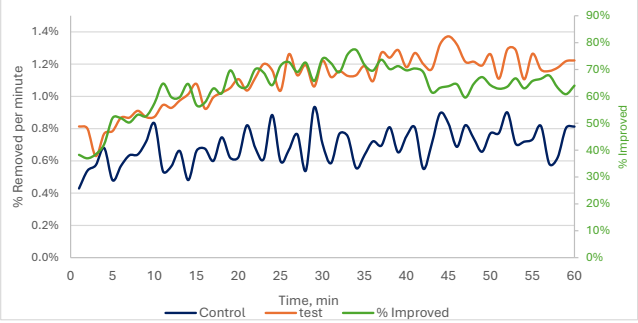
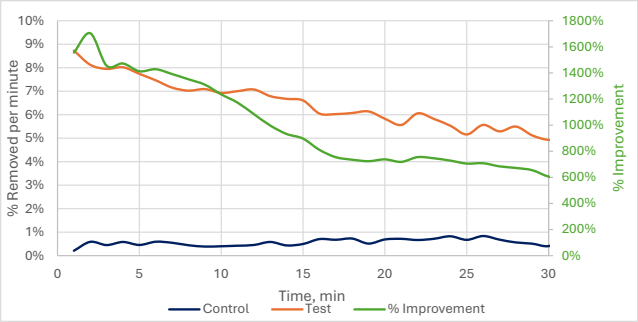


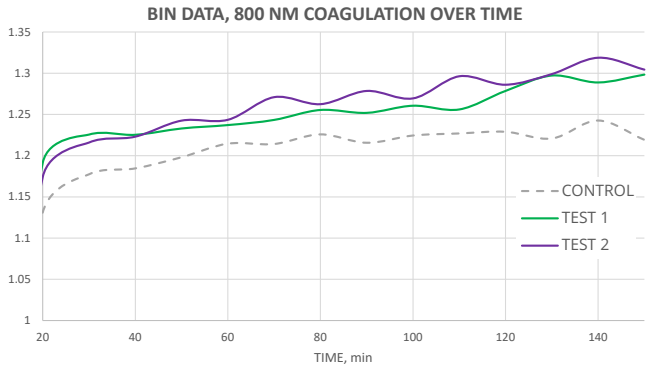
Figure 4 Filter B: During the first 10 minutes, the number of particles is extremely high. After the first 10 minutes, the data reflects a consistent 600% - 1,200% improvement in the rate of reduction in particle counts with ions.



3. Particle Agglomeration - Making Small Particles Larger for Faster Filtration

Figure 5 All Test Runs Averaged:

Particles in the 0.8 µm bin increase in count due to ionization (gap between the control and test lines) and the constant increase in the formation of 0.8 µm particles (as indicated by the upward slope of the line). This performance is a result of ultra-fine particles joining together via electrostatics and becoming larger.



Economics of Better Particle Management

The third party testing results lead to the conclusion that **systems with MERV8 filters and NPBI manage small particles like MERV13 equipped systems.** Despite the differences in filter performance, GPS soft ionization provides a boost to both. It is proven that soft ionization reduces fine and ultra-fine particles, lowering respiratory exposure. This results in better air quality overcoming some of the limitations of conventional HVAC equipment. The energy and maintenance costs are lower with ionization plus MERV8 when compared to higher performing filters in HVAC systems because soft ionization supports lower cost filters and lower static pressure typical of lower rated filters. These results align with prior third-party peer-reviewed journal articles on this topic. [8]

Research and Citations

1 Schraufnagel DE. The health effects of ultra-fine particles. Exp Mol Med. 2020 Mar;52(3):311-317. doi: 10.1038/s12276-020-0403-3. Epub 2020 Mar 17. PMID: 32203102; PMCID: PMC7156741.

2 Brochot, C., Abdolghader, P., Haghighat, F., & Bahloul, A. (2020). Performance of mechanical filters used in general ventilation against nanoparticles. Science and Technology for the Built Environment, 26(10), 1387–1396. https://doi.org/10.1080/23744731.2020.1787085

3 Clark, W. E., and K. T. Whitby, 1967: Concentration and Size Distribution Measurements of Atmospheric Aerosols and a Test of the Theory of Self-Preserving Size Distributions. J. Atmos. Sci., 24, 677–687

4 Li, N., S. Georas, N. Alexis, P. Fritz, T. Xia, M. Williams, E. Horner, and A. Nel. (2016). A Work Group Report on Ultra-fine Particles: Why Ambient Ultra-fine and Engineered Nanoparticles Should Receive Special Attention for Possible Adverse Health Outcomes in Human Subjects. Journal of Allergy and Clinical Immunology 138(2):38. 6–96

5 Particle Pollution Exposure, US EPA https://www.epa.gov/pmcourse/particle-pollution-exposure

6 Rice, Mary B, Rifas-Shiman, Sheryl L, Litonjua, Augusto A, et. al (2018). Lifetime Air Pollution Exposure and Asthma in a Pediatric Birth Cohort. Journal of Allergy and Clinical Immunology 141;5.

7 ASHRAE Standard 52.2-2017

8 Park, Jae Hong, Yoon, Ki Young, Hwang, Jungho. Removal of sub micron particles using a carbon fiber ionizer-assisted media filter in a heating, ventilation, and air conditioning (HVAC system). Building and Environment (46) 2011 1699-1708.