Electrostatic and Biological effects of indoor air ionization

(Abstract)

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Keywords: ESP air cleaners, indoor air ionization, charge neutralization, air sterilization

The presence of air ions indoors is thought to affect person mood, prevent exposure to microorganism, and reduce static charges on surfaces. We studied four electrostatic precipitator-type air cleaners (ESP) that might produce ions secondarily, a negative ion generator, and both unregulated and regulated bipolar ion generators.

We used a room-sized chamber designed to simulate a hospital isolation room. We evaluated all units for positive and negative ion output, selected units for reducing static charges, and the bipolar ionizing units for increasing the decay rate of bacterial aerosols (Serratia marcescens). The biocidal effect of dedicated bipolar ionizers was also studied in a confined environment where high ion concentration could be achieved in the comparatively small volume of air.

The ESP air cleaners are generating ions for dist charging and collection, but most of the ions get trapped inside the collector and very few get introduced in the exhaust air. Two of the 4 ESP air cleaners released in the ambient air an excess of positive ions, and the other two released essentially no ions. When equipped with negative ion generators, one of these produced a small excess of negative ions, the other no ion excess. The dedicated negative ion generator, as expected, produced an excess of negative ions. The bipolar ion generators produced balanced positive and negative ions with concentrations depending on mode of operation. The addition of bipolar ions to the chamber reduced static discharge time from hours to minutes. In the confined setting where ion concentrations were high (up to 1E5 ion/cc) bipolar ions strongly increased the decay rate of the Serratia aerosol. However, changes in aerosol decay in the larger room, even when measured relatively high ion concentrations (up to 5E4 ion/cc), were minimal.

During life time single air born ions are transforming to cluster ions changing their dimensions, mobility and chemical activity. Possibly, this ion aging process is responsible for big difference in the biocidal effects in small and room-size chambers.

The use of bipolar ionizers in the indoor environment restores ion balance and strongly decreases time for electrostatic charge dissipation. The latter may play an important role in limiting transfer of microorganisms from, for example, a nurse to a patient, reducing charge build-up on electronic equipment, and preventing uncomfortable shocks that often occur in dry environments.

We were able to reproduce the biocidal effects of bipolar ions in a confined setting. However, the effect was minimal in our room-sized chamber. The most efficient of the ESP air cleaners were more effective at removing and/or killing bacteria than only the addition of bipolar ions. Therefore, combination of ESP air cleaners and bipolar ionizers is the most preferable way to provide healthy indoor environment.