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Removal of viable bioaerosol particles with a low-efficiency HVAC filter enhanced by continuous emission of bi-polar air ions.

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Continuous emission of bi-polar ions has been shown to improve the performance of respirators and stationary filters challenged with non-biological particles. In this study, we investigated the ion-induced enhancement effect while challenging a low-efficiency heating, ventilation and air-conditioning (HVAC) filter with viable bacterial cells, bacterial and fungal spores, and viruses. The aerosol concentration was measured in real time. Samples were also collected with a bioaerosol sampler for viable microbial analysis. The removal efficiency of the filter was determined, respectively, with and without an ion emitter. The ionization was found to significantly enhance the filter efficiency in removing viable biological particles from the airflow. For example, when challenged with viable bacteria, the filter efficiency increased as much as four- to fivefold. For viable fungal spores, the ion-induced enhancement improved the efficiency by a factor of approximately 2. When testing with virus-carrying liquid droplets, the original removal efficiency provided by the filter was rather low: 9.09 +/- 4.84%. While the ion emission increased collection about fourfold, the efficiency did not reach 75-100% observed with bacteria and fungi. These findings, together with our previously published results for non-biological particles, demonstrate the feasibility of a new approach for reducing aerosol particles in HVAC systems used for indoor air quality control. PRACTICAL IMPLICATIONS: Recirculated air in HVAC systems used for indoor air quality control in buildings often contains considerable number of viable bioaerosol particles because of limited efficiency of the filters installed in these systems. In the present study, we investigated - using aerosolized bacterial cells, bacterial and fungal spores, and virus-carrying particles - a novel idea of enhancing the performance of a low-efficiency HVAC filter utilizing continuous emission of unipolar ions in the filter vicinity. The findings described in this paper, together with our previously published results for non-biological particles, demonstrate the feasibility of the newly developed approach.

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