A NOVEL METHOD TO CONTROL WORKPLACE ANTHROPOGENIC POLLUTANT PARTICLES

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Abstract: A novel method of controlling inhaled workplace anthropogenic pollutant particles (APP) is presented. This in vitro study investigated electrically charging effect on the deposition of inhaled APP in a hollow throat cast model. Many occupational lung diseases are associated with exposure to workplace dust particles and other pollutants. Use of air-purifying respirators may remove particulates but they have a limitation besides leakage around respirator seal, which is, particles smaller than pore sizes pass through the filter and enter into tracheobronchial airways. Since the throat is an effective filter, this study devised a novel idea of charging particles, and studying their deposition in the throat. Simulated workplace aerosol particles (polydispersed and in the size range of 0.1 µm to 20 µm with geometric standard deviation, GSD > 1.5) were generated from a commercially available nebulizer, and charged by a corona charger. Charged and uncharged particles were allowed to pass through a polyester resin cast of cadaver based throat, a replicate of a human oropharyngeal region. Then these aerosols held in an aerosol sampling chamber (ASC) for characterization. The ASC’s inside walls were lined with a grounded wire mesh to discharge any static electricity that may acquire by chamber’s wall from the ambient. A battery operated fan was placed inside to maintain circulation (i.e., prevent the aerosol from settling). The aerosol particles’ size and charge distribution were characterized by an Electronic Single Particle Aerodynamic Relaxation Time (ESPART) analyzer before and after passing the throat cast. The ESPART drew aerosols from the ASC and operated on the principle of Laser Doppler Velocimetry to measure simultaneously aerodynamic diameter and electrostatic charge (magnitude and polarity) on a single particle basis and in real time. The study results revealed that electrically charging increased agglomeration of smaller (aerodynamic diameter < 4.5 µm) particles and increased deposition. Deposition of charged particles increased with increasing particle size which can be explained as the effect of inertial impaction. Electrically charging and depositing particulate matters prior to entering into the tracheobronchial region are also discussed.

Keywords: workplace pollutants, atmospheric aerosols, electrostatic charge, aerodynamic size, human throat, respirators

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