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MEASUREMENT OF THE EFFECT OF CARTILAGINOUS RINGS ON PARTICLE DEPOSITION IN A PROXIMAL LUNG BIFURCATION REPLICA. *YU ZHANG Warren H. Finlay Dept. of Mechanical Engineering University of Alberta Edmonton, Alberta Canada*

Although cartilaginous rings are present in the trachea and main bronchi of actual human conducting airways, no systematic experimental study has been conducted to quantify the effects of such localized morphological features on particle deposition despite previous authors' theoretical predictions that these effects are significant. In the present study, the possible effects of cartilaginous rings upon particle deposition in idealized airway replicas are investigated experimentally. The airway replicas include the oral cavity, pharynx, larynx, trachea, and first three generations of bronchi. Gravimetry is used to measure the deposition of monodisperse aerosol particles with mass median diameters ranging between 2.9-6.3 micron for steady inhalation flow rates of 30 and 60 L/min. The results are compared with data obtained from a smooth walled tracheo-bronchial replica. Significantly increased deposition in the cartilaginous trachea is observed for all inhalation rates and particle sizes. Inhomogeneous deposition patterns within the trachea are observed as well. These results imply that the disturbance of the airflow within the trachea by the presence of cartilaginous rings promotes deposition of particles through the entire trachea. The present work confirms previous authors' predictions that cartilaginous rings may be a critical element to be integrated into future modelling of airways due to their significant effect on inhaled aerosol deposition.

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DEPOSITION OF CARBON FIBER IN A HUMAN AIRWAY CAST. *WEI-CHUNG SU, Yue Zhou, Yung-Sung Cheng, Lovelace Respiratory Research Institute, Albuquerque, NM*

Many occupational diseases are associated with the deposition of aerosolized fibers in certain regions of the human respiratory tract. Exposures to airborne asbestos and other fibers increase the incidence of lung cancer and fibrosis. Ethical constraints severely limit the use of fibers in human volunteer studies. As a result, no data have been published on controlled studies of fiber deposition in human subjects. This lack of information hampers our understanding of the etiological process of fiber-related lung diseases, verification of a lung deposition model, and development of an exposure index to assess and control exposure to fibers in the workplace. With this in mind, this research sets out the basis for the development of larger body of experimental work to investigate the effects of fiber dimension and breathing rates on the deposition pattern in a geometry-defined human airway cast. The human airway cast used in this research including the oral cavity, pharynx, larynx, trachea, and three generations of bronchi. The oral cavity portion of the cast was molded from a dental impression of the oral cavity in a human volunteer, while the other airway portions of the cast were made from a cadaver. Preliminary experiments were conducted by using carbon fibers of uniform diameter (3.74 µm) with fiber lengths from 5 to 100 µm and a density of 1.83 g/cm3. The carbon fiber aerosol was generated by a small-scale powder disperser (Model 3433, TSI Inc., St. Paul, MN). Fiber deposition was achieved by delivering the aerosolized fiber into the human airway cast at constant inspiratory flow rates of 15, 43.5, and 60 L/min. After the experiment, the airway cast was cut into sections corresponding to defined lung generations. Fibers deposited on each region were acquired by washing out sections with filtered 70% ethyl alcohol. The suspension was vacuum-filtered to deposit the fibers uniformly on a membrane filter (mixed cellulose). The filter was then examined by optical microscope with a G22 Walton-Beckett gratitude (Pyser-SGI Ltd., Kent, UK). The total number of fibers and the length of individual fibers in the viewing area were determined based on NIOSH method 7400. By obtaining the fiber numbers and length distribution from each lung section, fiber deposition efficiency was then acquired throughout the human airway. The initial results showed that the impaction mechanism is the dominant deposition mechanism. This might due to the fact that fibers used in this research are in relatively large Stokes' number regime; therefore, their behavior in the air stream is affected mainly by the inertial effect. Compared with available theoretical data, our experimental data agree with calculated data for most lung generations. (Research supported by the US NIOSH grant 1RO1 OH03900)