completed a health symptom questionnaire. Acetone-exposed workers perceived odor and irritation from acetone exposure to be significantly lower than did naive controls ($p<0.001$). This adaption was specific to acetone; ratings of odor and irritation to PEA did not differ between workers and controls. However, on the health symptom questionnaire, workers rated irritation from acetone significantly higher than during chamber exposure. Perceived risk also influenced the perception of odor and irritation. During exposure, controls that received positive information about acetone exhibited the most adequate adaption to its odor and the lowest perceived irritation; following exposure they reported the fewest health effects. The study supports the observation that prolonged exposure to odorants reduces both odor intensity and irritation. It also suggests that cognitive expectations about a chemical can significantly affect how it is perceived. Moreover, because differences between workers and controls could arise from sensory and /or cognitive factors (i.e., exposure and perception of risk) there may be limited value in using non-exposed controls to assess the irritancy of chemicals for worker populations.

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Odor and Irritation Thresholds for Acetone in Acetone-Exposed Factory Workers And Non-Exposed Control Subjects. C. Wysocki, M. Brody, P. Dalton, H. Lawley, Monell Chemical Senses Center, Philadelphia, PA

Many volatiles stimulate two sensory nerves in the nose: the cranial nerve (CN) I for olfaction and CN V for chemesthesis (irritation). Olfactory detection thresholds (ODT) are usually lower than intranasal chemesthetic thresholds (ICT). Historically, ICT have been obtained from anosmics, who cannot provide ODT and are without normal olfactory/chemesthetic interactions. Unfortunately, asking a subject with a normal sense of smell to focus on irritation, while disregarding odor, introduces subjectivity and variation. We developed an alternative technique to determine both ODT and ICT which uses a series of bottles capped with teflon nose plugs; each bottle has either odorant in solvent or solvent only (blank). Using a two-choice task, viz., odor vs. blank, and a "staircase" procedure, in which headspace concentration in the bottle (measured by gas chromatography) is varied, we determine ODT. For ICT subjects sniff simultaneously from two bottles; one blank one with odorant. If the odorant is strong enough to produce irritation, the odorant can be lateralized, ie., the stimulated nostril can be identified; compounds that stimulate only olfaction cannot be lateralized. We obtained ODT and ICT for butanol and acetone from 32 acetone-exposed workers and 32 controls. Neither butanol ODT nor ICT differed between the two groups. In marked contrast, both thresholds differed for acetone. ODT for acetone in exposed workers (median = 855 ppm; range ≈860-fold; $p=0.0003$). Exposed workers also had elevated acetone ICT (median = 41 ppm; range ≈15-fold) compared to the control subjects (median = 17,348 ppm; range ≈136-fold; $p=0.0009$). These results demonstrate that long-term exposures to acetone induce olfactory and irritation adaption which appears to be specific to acetone. Furthermore, the acetone ICT was well above the current TLV (750 ppm) suggesting that true sensory irritation, as measured by this alternative, objective sensory test, is not experienced below the TLV. Investigators need to take exposure history into account when evaluating volatile chemicals for sensory irritation.

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Human Nasal Passage Deposition: The Effect of Particle Size, Flowrate, and Anatomical Factors. L. Kesavanathan, D. Swift, Johns Hopkins University, Baltimore, MD

The nasal passage filters particles which enter the respiratory system. Previous human studies have shown a large inter-subject variation in nasal deposition for a given particle size and flowrate. Our previous study showed that particle size, nostril shape, and nasal passage cross-sectional area affect deposition at a constant flow rate of 30 l min^{-1}. This study was conducted to determine the effect of nostril shape and nasal passage cross-sectional area at three constant flowrates on deposition efficiency in human subjects. An empirical equation for deposition efficiency was derived from these experimental data.

Ten healthy, nonsmoking adult subjects were included in this study. The nasal deposition efficiency, DEN, of 1-10 µm diameter particles at 15, 25, and 35 l min^{-1} constant flow rates was measured. The nasal passage cross-sectional areas were measured by acoustic rhinometry, and the nostril dimensions (nostril length and width) were measured. A mixed non-linear SAS procedure was used to develop the best-fit empirical equation. the results show that particle diameter, d_p, flowrate Q, nostril length/width ratio, E, and minimum nasal cross-sectional area, A_m, affect particle deposition ($p<0.06$). The efficiency equation is:

$$DE_n = 1 - \exp(-0.1 * d_p^{1.78} * Q^{1.12} * A_m^{-1.33} * E^{1.26})$$

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Regional Deposition of Unattached Radon Progeny (Polonium-218) in Tracheobronchial Region. W. Li, J. Xiong, B. Cohen, NYU Medical Center, Tuxedo, NY

Indoor radon is one of the leading causes of lung cancer. The unattached fraction of radon daughters that reached the tracheobronchial region of human airway deposits efficiently in tracheobronchial region because of its high diffusion coefficient. The aim of this study is to investigate the deposition of unattached Po-218 in tracheobronchial region and compare with the existing theories.

To measure the regional deposition of Po-218, a method that used iodine vapor as a surrogate of Po-218 has been developed. The experiments were conducted in a tracheobronchial replicate cast whose inner surface was coated with NaOH impregnated charcoal powder. This coating can trap iodine molecules by converting iodine into iodide and idodate so that the iodine gas molecules, behaving like particles, stick to a surface upon contact. It has been shown experimentally that the efficiency of this coating is close to 100%. The deposition of iodine in the cast is determined by measuring the iodine concentration before and after the cast.

The experiment has been conducted in the flow rate range of 5-50 LPM. It is found that the deposition of iodine can be described by diffusion in laminar flow. This result is different from that observed in previous experiment with submicrometer size particles (40-200 nm) which showed that the deposition is between the estimate for diffusion in laminar flow and the estimate for the diffusion in plugflow. Further study has shown that this discrepancy is caused by the difference in flow pattern through larynz (sinusoidal for the particle study vs. constant flow for the iodine study) and the effect of charge on particles.

The result of this study will be useful in modeling not only the radon lung dosimetry but also the deposition of all vapor and nanometer size particles whose lung deposition is dominated by diffusion.

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Universal Size-Distribution Aerosol Generator. C. Chen, College of Public Health, Taipei,Taiwan; F. Cheng, W. Li, Institute of Environmental Engineering, Taipei, Taiwan, ROC; P. Baron, NIOSH, Cincinnati, OH

A variety of aerosol generators have been developed to produce aerosol particles with different size distribution. Most of these aerosol generators can only be modified to produce aerosol particles of different count median diameter with about the same geometric standard deviation. No generator is specifically developed to produce particles having the same count median diameter but with different geometric standard deviation, which may be critical to some aerosol characteristics, such as optical and filter loading properties. Two computer-controlled peristaltic pumps were used to carry sodium chloride solution and water into a 60 kHz ultrasonic aerosol atomizing nozzle. The total solution feed rate is fixed at 0.4 ml/min. By varying the rotation speed of these two pumps, NaCl solution of different concentrations, after being ultrasonically atomized, produced particles with different size distribution. The aerosol charges were neutralized by an air ionizer. An Aerodynamic Particle Sizer and an Aerosizer were used to measure the aerosol concentration and size distribution. The aerosol charge was monitored by an aerosol electrometer. The mass concentration increased linearly with increasing solution feed rate, if the drying process was complete. The count median diameter was found to decrease with increasing power input to the atomizer, that also resulted in higher number concentration, but the mass concentration remained the same. The GSD decreased with increasing solution concentration, reflecting the effect of surface tension. By adjusting the solution mixing volume (inside the atomizer) and the length of run-time of each concentration phase, the system was able to generate aerosol particles with GSD range from 1.2 to 1.8 or higher while CMD remained the same.

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The Effect of Carbon Fiber Stiffness and Grinding Orientation on Composite Dust Particles Size Distributions. B. Johnson, 3M, Woodbury, MN; L.. Brosseau, J. Vincent, University of Minnesota, Minneapolis, MN

Carbon fiber epoxy composite materials are used on military and commercial aircraft, automobiles and for sports equipment. Parts are made by layering sheets of prepreg (fiber impregnated with uncured epoxy matrix resin), curing with heat and pressure and shaping by grinding and machining. This shaping process generates airborne dust that includes both carbon fibers and cured epoxy particles. Recent revelations about the fibrogenci and carcinogenic potential of asbestos, ceramic, and glass wool fiber aerosols have raised concern about any fine durable fibrous aerosol. This study investigates the effect of carbon fiber stiffness and orientation of a grinding process on the aerodynamic particle size distribution of composite dust.

A laboratory study was conducted on four different unidirectionally oriented carbon fiber epoxy composite flat panels. Each panel contained one fiber which ranged in stiffness from 300 to 800 thousand pounds per square inch (ksi). Each panel was ground parallel and perpendicular to axis of the fibers using a disk sander (60 grit). The dust generated was sampled using a personal inhalable dust spectrometer (PIDS), as described by Gibson et al. (Am. Occup. Hy., 1987), in the breathing zone of the grinder operator. The particle size distribution was obtained using a new inversion algorithm described by Ramachandran et. al. (J. Aerosol Sci., 1995). Samples were also examined microscopically using NIOSH method No. 7400.

We found, for composite made from fibers with stiffness greater than 600 ksi, that grinding perpendicular to the axis of the fibers resulted in a bimodal particle size distribution with one mass median aerodynamic diameter (MMAD) of 12 to 18 um, and another of 0.2 to 0.5 um. Grinding parallel to the fiber axis on all carbon fiber types or perpendicular to fibers with stiffness less than 400 ksi caused a monomodal particles size distribution with MMAD from 15 to 30 um. All of the fibers examined microscopically were found to have the same diameter as the original composite fibers. No respirable fiber were identified by NIOSH method 7400.

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