Promoting productive workplaces through safety and health research NIOSH

Alice B. Hamilton Awards 2004

Biological Science Category

Winner:

- **Title:** Rapid Detection and Determination of the Aerodynamic Size Range of Airborne Mycobacteria Associated with Whirl-pools
- **Authors:** Schafer MP, Martinez KF, Mathews ES.
- **Source:** Applied Occupational and Environmental Hygiene 18(1): 41-50, 2003
- **Abstract:** Novel environmental air and water mycobacteria sampling and analytical methods are needed to circumvent difficulties associated with the use of culture-based methodologies. To implement this objective, a commercial, clinical, genus DNA amplification method utilizing the polymerase chain reaction (PCR) was interfaced with novel air sampling strategies in the laboratory. Two types of air samplers, a three-piece plastic, disposable filter cassette and an eight-stage micro-orifice uniform deposit impactor (MOUDI), were used in these studies. In both samplers, 37-mm polytetrafluoroethylene (PTFE) filters were used. Use of the MOUDI sampler permitted the capture of airborne mycobacteria in discrete size ranges, an important parameter for relating the airborne mycobacteria cells to potential respirable particles (aerodynamic diameter <10µm) capable of causing health effects. Analysis of the samples was rapid, requiring only 1-1.5 days, as no microbial culturing or DNA purification was required. This approach was then used to detect suspected mycobacteria contamination associated with pools at a large public facility. PCR was also used to analyze various water samples from these pools. Again, no culturing or sample purification was required. Water samples taken from all ultraviolet light/hydrogen peroxide-treated pools and the water main supply facility. All air samples collected in the proximity of the indoor whirlpools and the associated changing rooms were strongly positive for airborne mycobacteria. The airborne mycobacteria particles were predominantly collected on MOUDI stages 1-6 representing an aerodynamic size range of 0.5 to 9.9µm. In conclusion, using this approach permits the rapid detection of mycobacteria contamination as well as the routine monitoring of suspected pools. The approach circumvents problems associated with culture-based methods such as fungal overgrowth on agar plates, and the presence of nonculturable or difficult to culture mycobacteria strains.
- **Keywords:** Mycobacteria, Polymerase Chain Reaction (PCR), Whirlpools, Hot Tubs, Bioaerosol

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Engineering and Physical Sciences Category

Winner:

- **Title:** Control of Wake-Induced Exposure Using an Interrupted Oscillating Jet
- **Authors:** Bennett JS, Crouch KG, Shulman SA
- **Source:** American Industrial Hygiene Association Journal, 64:24-29 (2003).
- **Abstract:** A problem may arise in ventilation when the contaminant source is located in the worker's wake, where turbulence and vortex formation can carry the contaminant into the breathing zone even though the source is downwind. It was found previously that forced directional variations in the flow can reduce or eliminate the vortex formation that causes these local reversals. Reported here is a simple realization of this concept, in which an oscillating jet of air was directed at a mannequin in an otherwise steady flow of air. A 50th percentile male mannequin was placed in a nearly uniform flow of approximately 0.18 m/sec (36 ft/min). A low-velocity tracer gas source (isobutylene) was held in the standing mannequin's hands with the upper arms vertical and the elbows at 90°. Four ventilation scenarios were compared by concentration measurements in the breathing zone, using photoionization detectors: (A) uniform flow; (B) addition of a steady jet with initial velocity 5.1 m/sec (1.0×103 ft/min) directed at the mannequin's back, parallel to the main flow; (C) making the jet oscillate to 45° on either side of the centerline with a period of 13 sec; and (D) introducing a blockage at the centerline so the oscillating jet never blew directly at the worker. At the 97.5% confidence level the interrupted oscillating jet (case D) achieved at least 93% compared with the steady jet (case B), and at least 45% exposure reduction compared with the unblocked oscillating jet (case C).
- **Keywords:** computational fluid dynamics, ventilation design , vortex formation

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Honorable Mention:

- **Title:** Development and Validation of a Simple Numerical Model for Estimating Workplace Aerosol Size Distribution Evolution through Coagulation, Settling and Diffusion.
- **Authors:** Maynard AD, Zimmer, AT
- **Source:** Aerosol Science and Technology 37:804-817 (2003)
- **Abstract:** Recent research has indicated that the toxicity of inhaled ultra-fine particles may be associated with the size of discrete particles deposited in the lungs. However, it has been speculated that in some occupational settings rapid coagulation will lead to relatively low exposures to discrete ultrafine particles. Investigation of likely occupational exposures to ultrafine particles following the generation of aerosols with complex size distributions is most appropriately addressed using validated numerical models. A numerical model has been developed to estimate the size-distribution time-evolution of compact and fractal-like aerosols within workplaces resulting from coagulation, diffusional deposition, and gravitational settling. Good agreement has been shown with an analytical solution to lognormal aerosol evolution, indicating good compatibility with previously published models. Validation using experimental data shows reasonable agreement when assuming spherical particles and coalescence on coagulation. Assuming the formation of fractal like particles within a range of diameters led to good agreement between modeled and experimental data. The model appears well suited to estimating the relationship between the size distribution of emitted well-mixed ultrafine aerosols, and the aerosol that is ultimately inhaled where diffusion loses are small.

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Human Studies Category

Winner:

- **Title:** Dying for Work: The Magnitude of US Mortality From Selected Causes of Death Associated with Occupation
- **Authors:** Steenland K, Burnett C, Lalich N, Ward E, Hurrell J
- **Source:** Amer J Ind Med. 43:461-482, 2003

there are a total of 55,200 US deaths annually resulting from occupational disease or injury (range 32,200–78,200). **Conclusions** Our estimate is in the range reported by previous investigators, although we have restricted ourselves more than others to only those diseases with well-established occupational etiology, biasing our estimates conservatively. The underlying assumptions and data used to generate the estimates are well documented, so our estimates may be updated as new data emerges on occupational risks and exposed populations, providing an advantage over previous studies. We estimate that occupational deaths are the 8th leading cause of death in the US, after diabetes (64,751) but ahead of suicide (30,575), and greater than the annual number of motor vehicle deaths per year (43,501). Am. J. Ind. Med. 43:461–482, 2003.

- **Keywords:** occupation, attributable fraction, mortality