fraction of the air that is supplied comes from the outside, the balance recirculated from the plant, typically from the ceiling area. Often these return air intakes are located above machinery producing relatively high levels of air contaminants. Although most air handling units are equipped with air filters, the efficiency is low for the size of aerosols typically encountered. Since the performance of the filters in the make-up air units has a direct effect on the quality of the workplace environment, an extensive evaluation of the air handling unit performance was undertaken. The evaluation was performed in a large automotive machining plant. Measurements of particle size and concentration on both the "dirty" and "clean" sides of the filters were made in five air handling units using a single particle optical counter and an aerosol photometer. These units employed 60% nominal efficiency filters. The size of the metalworking fluid mist was about 0.5 µm (mass median diameter). Because the mist was so fine, the mass removal efficiency of the existing 60-65% filters was only about 30%. If a switch was made to a 95% filter, calculations indicate a mass removal efficiency in excess of 80% could be achieved. A statistical analysis was performed to look at the effect of the filter age and the inlet concentration on the efficiency. This analysis indicated that the inlet concentration (which depends on the area of the plant served) is the primary factor affecting filter life (efficiency). Aerosol photometer measurements correlated well with the mass concentration computed from the particle count data. This suggests that "quick and dirty" evaluations of filter performance could be done using that instrument.

197. _____

CHALLENGES OF IMPLEMENTING A VENTILATION MANAGEMENT PROGRAM IN A LARGE MANUFACTURING COMPANY. N. Wong, T. Johnson, L. Wash, S. Waisanen, 3M Company, St. Paul, MN.

As a large manufacturing company with numerous processes involving the use of chemicals, industrial ventilation has been an integral exposure control method. Because controlling exposures depends highly on a well performing system, it is important that ventilation systems are well maintained and work properly to ensure adequate contaminant control. To address this issue, a ventilation management program was developed to verify that new and existing ventilation systems perform effectively as intended and needed to protect employees from exposures. This presentation will provide an overview of the ventilation management program implementation steps and identify and discuss challenges faced by both corporate and location staff.

Major challenges for implementation include:

- Establishing uniform program expectations by integrating the ventilation management program as part of the company's comprehensive global safety and health plan
- Training for various levels of program participants
- Establishing ventilation management as a corporate EHS metric
- Establishing performance criteria for ventilation systems that lack design specifications
- Determining minimum performance evaluation requirements
- Coordination with corporate and facility engineering

198. _____

MANAGEMENT OF PEROXIDE-FORMING/SHOCK SENSITIVE (PFSS) CHEMICALS AT AMES LABORATORY. J. Withers, Ames Laboratory, Ames, IA.

The Department of Energy (DOE) has been scrutinizing the management of peroxide-forming/shock sensitive (PFSS) chemicals at its research laboratories. Ames Laboratory was audited by the DOE's Inspector General Office to assess the adequacy of management practices of these PFSS chemicals. Deficiencies identified included chemical containers that were not labeled with purchase and/or opening dates, chemical containers that had exceeded the recommended shelf-life time stated in the chemical hygiene plan (CHP), and lack of a life cycle management system that assured these materials were disposed of in accordance with recommended timelines. ES&H personnel instigated several corrective actions as a result of the audit. A comprehensive walkthrough inspection of laboratory spaces was conducted that identified additional chemical containers that were not in compliance with labeling requirements. A quarterly walkthrough program was established to assure that PFSS chemicals were identified and tracked to disposal. Finally, a working group composed of ES&H and research personnel was established to update the current CHP information and make it more useful to the chemical user. Many challenges were encountered during implementation of these corrective actions. The information available on the Web pertaining to PFSS chemicals is contradictory and confusing. Hazard information is lacking on Material Safety Data Sheets and container labels. Research chemists disagreed with current safety literature on the severity of the hazards associated with PFSS chemicals. Tracking of chemicals was made more difficult by the facility being contiguous with other non-DOE laboratories. Finally, the quarterly inspections required a significant commitment of time on the part of the ES&H staff. Despite the aforementioned challenges, an effective PFSS chemical management system was implemented. This case study demonstrates the challenges associated with management of chemicals with unique hazards. Effective management of PFSS chemicals can result in a safer work environment and avoid unnecessary waste disposal costs.

Podium 126. General IEQ Issues

Papers 199–210

199. _____

TRENDS IN IEQ DATA: A REVIEW OF COMMON INDOOR POLLUTANTS. B. Fleckner, D. Cortes, B. Epstien, E. Horner, Air Quality Sciences Inc., Atlanta, GA.

Industrial hygienists often use chemical and mycological data to resolve the most complex indoor environmental quality (IEQ) complaints. Data trends develop over time, and it becomes possible to determine what can be considered the more common pollutants and how they may affect the indoor environment. Chemical analyses appropriate for non-industrial environments, such as USEPA methodologies, can yield hundreds of unique compounds in a given environment. In this review, data obtained from more than 300 different building studies will be summarized. For example, toluene is the most frequently measured VOC. The most common odorants include terpenes, amines, and carboxylic acids. Between 30 and 150 different VOCs are identified in most buildings. Identification of their possible sources is of the utmost importance in remedying an IEQ concern. Review of mycological analyses provide general trends with regard to common outdoor fungal mixtures and those that indicate moisture problems in indoor spaces. Fungi that are not prevalent in outdoor air generally should not be dominant in indoor spaces. Common leaf surface-type (phylloplane) fungi such as *Cladosporium cladosporioides* or *Alternaria alternata* comprise many samples collected in outdoor locations. Alternatively, common indoor pollutants generally consist of soil-type fungi such as various *Penicillium* spp. (e.g. *P. chrysogenum, P. citrinum*) or *Stachybotrys chartarum*. IEQ complaints can be addressed more readily with a greater understanding of the contaminants present in the environment.

200. _____

INDOOR AIR QUALITY SAMPLING AT SPECIFIC AREAS WITHIN FITNESS FACILITIES. A. Ames, D. Newcomer, S. Milz, B. Harrington, M. Bisesi, F. Akbar-Khanzadeh, Medical College of Ohio, Toledo, OH.

Air sampling was conducted at four fitness facilities over the course of 12 days for chemical, biological, and comfort parameter components. Sampling was performed outdoors and at five indoor areas: office area, daycare, pool, locker room, and the fitness center. Samples were collected in five period intervals throughout the day representing the baseline, peak, and off-peak times. Real-time monitoring and sorbent tubes were used for detection and monitoring of chemical contaminants and comfort parameters. Air samples for bioaerosols were collected using a single-stage Andersen impactor with Tryptic Soy Agar with 5% sheep blood for bacteria and Potato Dextrose Agar for

fungi. Resulting concentrations of bacteria and fungi were determined, as well as the biodiversity. In general, chemical contaminants and comfort parameters were statistically different between area, time periods, and location. Correlation between carbon dioxide concentration and the number of building occupants was identified, as well as a relationship between traffic density and carbon monoxide concentration. In general, bacteria and fungi were statistically different between areas, time periods, and locations. The mean concentration of bacteria for the areas ranged from 84 cfu/m^3 in the pool area to 563 cfu/m^3 in the locker room. Gram-positive cocci were the predominant bacteria found with the exception of outdoors and the pool area where Gram-positive rods were predominant. Bacteria concentrations were significantly higher indoors compared to outdoors and in all other areas compared to the pool area. The mean concentration of fungi for the areas ranged from 95 cfu/m^3 in the pool area to 580 cfu/m^3 outdoors. Fifteen different genera of fungi were identified, 10 of which were only found indoors. Predominant genera identified were *Cladosporium, Penicillium, Fusarium,* and *Rhodotorula.*

201. _____

INDOOR PAH EMISSIONS IN CHICAGO HOMES. T. Schoonover, A. Li, L. Conroy, P. Scheff, Q. Zou, University of Illinois at Chicago, Chicago, IL.

PAHs are ubiquitous multisource indoor air contaminants. Many are known or probable carcinogens. Therefore, it is important to understand indoor PAH emission sources and related source activities. Indoor and outdoor PAHs were monitored at 10 Chicago homes for 14 months. Sixteen PAHs were collected and analyzed. Home infiltration (hr^{-1}) was assessed for each sampling event using two models, a statistical and an occupant generated CO_2 tracer gas model. The statistical model is a function of indoor and outdoor temperature difference and wind speed while the CO_2 model uses the slope of the decay curve to estimate infiltration. CO_2 tracer gas infiltration results ranged from 0.03 to 0.64 hr^{-1} with a median of 0.14 hr^{-1}. Infiltration estimates were combined with simultaneous indoor and outdoor PAH concentrations to generate indoor PAH emission rates. Component PAHs were partitioned into gas and particle phases. Particle-related PAH penetration was determined to be 0.25 from the slope of the lower edge of plotted concentrations. Particle removal efficiency of 0.2 hr^{-1} was applied to particle phase PAHs based on research done on 0.3–0.5 µm particles. Resulting PAH total indoor emission rates ranged from 30 to 36,400 ng m^{-3} with a median of 3074 ng m^{-3}. Home characteristics, occupancy rates, and activities were obtained from resident surveys. Positive indoor PAH emission rates were combined with indoor occupancy rates and other reported activities to generate indoor PAH emission factors. PAH total emission factors for all sampling events were 1.2 ng m^{-3} per occupancy minute and 3.9 ng m^{-3} per cooking minute. Home indoor emission factors ranged from 0.6 to 7.6 ng m^{-3} per occupancy minute and from 5.2 to 135 ng m^{-3} per minute of cooking. PAH total emissions ranged from 0.6 ng m^{-3} for fall to 1.3 ng m^{-3} for spring per occupancy minute.

202. _____

ARE THE OSHA STANDARDS APPROPRIATE FOR ASSESSING THE TO VAPOR INTRUSION PATHWAY IN OCCUPATIONAL SETTINGS? F. Boelter, D. Podraza, M. Reese, Boelter & Yates Inc., Park Ridge, IL.

Vapor intrusion exposures have focused on evaluating and mitigating exposures in residential settings. Typically, a residential setting utilizes indoor air quality guidelines and mitigation techniques fashioned after radon venting systems. Vapor intrusion exposures in occupational settings have, in principal, been deferred to OSHA. The re-development of former industrial Brownfield sites for non-industrial uses warrants evaluation to determine the appropriateness of applying OSHA standards to vapor intrusion-related exposures. OSHA standards may be appropriate in certain occupational settings (e.g. industrial) where chemical exposures are expected and vapor intrusion contribution may be indistinguishable from background levels. However, are the OSHA standards appropriate for other non-residential settings (e.g. office or retail) where chemical exposures are not expected or normally part of the workplace. Using case studies, this paper will present a discussion of the appropriateness of applying OSHA standards to vapor intrusion exposures in occupational settings. Risk-based indoor air levels as well as soil gas and groundwater screening levels developed in accordance with the U.S. EPA Vapor Intrusion Guidance and Human Health Risk methodologies will be presented for occupational settings where OSHA standards may be inappropriate. Implications will be examined for sites where closures have already been obtained from regulatory agencies.

203. _____

MICROSCOPIC CHARACTERIZATION OF PARTICLES AND FIBERS IN AIR, TAPE, BULK, AND MICROVAC SAMPLES. D. Bissing, Health Science Associates, Los Alamitos, CA.

Indoor air quality bas become an increasing ly significant portion of industrial hygiene investigations. During investigations of homes and work environments for indoor air quality purposes, settled or airborne particulate matter including fibers is often perceived to be the irritant causing the problem. Though quantitating the amount of material present can be done gravimetrically, this does not answer the question as to the physical components of the particulate. Characterization using a variety of analytical techniques can often be problematic and cost prohibitive, the amount of bulk material may be limited, standard analytical techniques for industrial situations often don't apply, such as analysis for metals or acid fumes, and advanced microscopic techniques such as SEM or TEM can be uninformative as well as very expensive. This presentation will discuss how using standard microscopic techniques, characterization of this particulate matter can be done in a thorough, rapid, and cost effective manner. Though there are limitations to this technique, the information that can be obtained is often very useful. This technique can be applied to air, tape, bulk, and microvac samples. The basic physical components of the particulate can be identified or described. Quantitation can be a visual estimation of percentage or an actual count. Often, knowing this information can identify the problem or clarify the perception of occupants or employees as to the health effects or source of the particulate matter. In conclusion, though not applicable in every situation, this technique can be a useful tool in investigations.

204. _____

BUILDING MECHANICAL SYSTEMS: WHAT THE IH SHOULD KNOW WHEN PERFORMING IEQ ASSESSMENTS. C. Jenkins, MACTEC Engineering and Consulting Inc., Peoria, IL.

This presentation is a compendium of real-world HVAC system malfunctions, improper applications, and set points and common maintenance items that affect indoor environmental quality. Malfunctioning or improperly operated HVAC systems can result in poor fresh air exchange and thermal discomfort, known to be two of the leading causes of indoor environmental quality complaints. The case studies to be reviewed will share real-world building mechanical systems and common problems associated with these systems.

The industrial hygienist must be able to discuss HVAC system components and their operation with building engineers and facility managers to ascertain if the mechanical systems are the source of IEQ complaints. An industrial hygienist with an understanding of the systems and their operation can measure the systems efficacy at different points to determine if the air exchange rate is adequate to control bioeffluent buildup. The industrial hygienist can also measure and evaluate the system's ability to control water vapor and temperature.

The goal of this presentation is to provide industrial hygienists with an understanding of the mechanical components that comprise a facility's HVAC system; the nomenclature of the components, common problem areas encountered that affect indoor environmental quality, and different measurement methods utilized to determine the system's efficacy. These tools shall enable the industrial hygienist to

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