document for glutaraldehyde. In addition to a REL, a criteria document contains recommendations for minimizing safety and health risks including medical monitoring, exposure assessment, worker training, control technology, personal protective equipment, and recordkeeping.

Bioaerosols Papers 313–317

313

CAN FUNGAL INFESTED CARPET BE SAVED? P. Ellringer, S. Hendrickson, Tamarack Environmental Inc., St. Paul, MN; N. Carlson, University of Minnesota, Minneapolis, MN.

An elementary school had numerous indoor air quality complaints. The complaints included musty smells, allergic reactions, and headaches. Visible fungal growth was observed on about 1% of the carpet area in fifteen of the classrooms. The fungal growth was the result of excessive moisture in the concrete floor below the carpet wicking up into the carpet. The excessive moisture in the floor was a combination of inadequate landscaping and floor design. Because of budget problems, the design problems could not be corrected. A carpet cleaning firm convinced the school that with the use of proper cleaning and the use of sanitizers on the carpet that the fungal contamination in the carpet could be controlled. Micro-vacuum dust samples were collected before and after two different cleaning protocols were followed in six classrooms and these results were compared to two reference classrooms where the carpet was not cleaned. These dust samples were serially diluted and plated on 2% malt extract and DG-19 agar plates. The average fungal population from 12 samples collected in the two reference rooms increased from 5.2 million colony forming units per gram of debris collected (CFU/g) to 5.9 million, an increase of 13%. The average fungal populations from 18 samples collected in three classrooms where the carpet was hot water extracted using detergents decreased from 11.1 million to 9.6 million CFU/g, a decrease of 14%. The average fungal populations from 18 samples collected in three classrooms where the carpet was hot water extracted using detergents followed by sanitizer decreased from 3.8 million to 2.1 million CFU/g a decrease of 46%. Although, some reductions in fungal population were observed in the carpets that were cleaned verus carpet not cleaned, the reductions were not adequate to lower the fungal population to within normal levels found in carpet. All the carpet in this school had to be removed to solve this indoor air quality problem.

314

CHARACTERIZATION AND CONTROL OF FUNGAL EXPOSURE DURING DOCUMENT RESTORATION AT THE NATIONAL ARCHIVES LABORATORY. C. Piacitelli, J. Harrison, W. Jones, NIOSH, Morgantown, WV.

In this study, we examined the exposures associated with the restoration of historical documents at the National Archives Laboratory in College Park, Maryland. When documents arrive with water damage and suspected mold growth, conservators use various mechanical means (vacuuming, brushing, wiping, and erasing) to remove contamination. This work can result in the generation of aerosols and is typically done within an exhaust hood. We examined the nature of this dust and determined ventilation hood effectiveness by light and electron microscopy analysis of air samples collected both inside and outside the ventilation hood during restoration of Civil War ship log documents. We also explored the effectiveness of treatment by microscopy examination of bulk samples of vacuumed and un-vacuumed documents. Additionally, personal and area real time dust measurements were made along with time-synchronized video in order to relate workplace dynamics to dust exposure. The predominant aerosol exposure here was confirmed to be of fungal origin. Although spores dominated, fragments of hyphae were also seen. Examination of the documents themselves revealed extensive fungal contamination. Although vacuumed documents showed markedly less surface contamination, fungal material could still be detected. Real time dust/video analysis was useful in pinpointing specific tasks which resulted in concentration spikes and this was used to recommend some rather simple changes in workstation configuration to eliminate these exposure peaks.

315

AN INVESTIGATION OF FUNGAL CONTAMINATION IN A HOSPITAL SETTING. M. Johnson, C. Rao, K. Kreiss, NIOSH, Morgantown, WV.

An investigation was conducted at an 8-story hospital due to a reported cluster of work-related asthma on the eighth floor of the facility. There has been ongoing renovation throughout the building for the past 5 years. The occupants reported occasional severe water damage from roof leaks. Although, there were no obvious signs of mold contamination, fungi were suspected because of the occupant complaints and the historical water damage. A survey for fungal contamination was conducted on the two top floors of the facility. Spore trap sampling was performed inside the wall and in the ambient indoor air. Bulk samples of the ceiling were analyzed for fungal growth. The bulk sample analyses showed extensive fungal contamination (*Cladosporium elatum* and *Geomyces pannorum*) on the ceiling material. The in-wall spore concentrations ranged from 5.3×10^2 to 5.3×10^5 spores/m^3 (primarily of the genera *Aspergillus/Penicillium*, *Geomyces* and *Cladosporium*). Ambient indoor air concentrations ranged from 1.1×10^2 to 3.6×10^3 spores/m^3 in which the genera *Cladosporium* and *Geomyces* accounted for 30 to 60% of the total spore counts. We documented inter-floor pathways for migration of fungal spores between the wall cavities, the ceiling cavities and the occupied space. Spore concentration in the elevator was 3.6×10^3 spores/m^3, the highest quiescent ambient air level found in the facility. The elevator may have been a significant fungal pathway between floors. Our findings support the need for aggressive source and pathway identification even in the absence of visible mold or water damage.

316

CHARACTERISTICS OF BIOAEROSOLS IN THE CHICKEN HOUSE. W. Lin, Chung Shan Medical & Dental College, Taichung, Taiwan Republic of China.

The characteristics of bioaerosols in a chicken house with different chicken age were evaluated. There were 8,000 chickens in the chicken house. The bioaerosol concentrations were measured at initial, middle and final growth stages with one, three and six weeks old, respectively. Triplicate bioaerosol samples were collected by AGI-30 impingers and Nuclepore filters at the flow rates of 12.5 L/min and 2 L/min, respectively. The sampling time was 30 min. Tryptic Soy Agar and Malt Extract Agar (Difco Lab.) were selected to recover bacterial and fungal colonies, respectively. When the chickens were 1 week old, the bacterial concentrations of filter and impinger samples were 7,640±1,200 CFU/m3 and 14,000±10,000 CFU/m3, respectively. In addition, the fungal concentrations of filter and impinger samples were 1,040±550 CFU/m3 and 1,170±870 CFU/m3, respectively. In the 3-week-old chicken houses, the bacterial concentrations of filter and impinger samples were 54,000±25,000 CFU/m3 and 190,000±11,000 CFU/m3, respectively. And the fungal concentrations of filter and impinger samples were 3,750±1,370 CFU/m3 and 5,340±180 CFU/m3, respectively. In the 6-week-old chicken houses, the bacterial concentrations of filter and impinger samples were 280,000±110,000 CFU/m3 and 580,000±170,000 CFU/m3, respectively. And the fungal concentrations of filter and impinger samples were 7,360±4,590 CFU/m3 and 11,800±3,740 CFU/m3, respectively. The results demonstrated that the bioaerosol concentrations in the chicken house increased when the chickens grew up, and would be more than 100-fold times that in normal environments. Moreover, it was found that the concentrations recovered from impinger samples were higher than that from filter samples.

317

WHAT'S GROWING IN THE PACIFIC NORTHWEST? L. Swenson, GlobalTox, Portland, OR; C. Robbins, W. Geer, GlobalTox, Redmond, WA.

There has been increased media attention and public awareness about mold and mold exposures in the indoor environment. Since mold is ubiquitous and flourishes in the damp Pacific Northwest environment, there are many opportunities for industrial hygienists to assume key roles in indoor air quality and mold investigations for residential and commercial buildings. The industrial hygienist is asked to conduct sampling, to determine the presence or extent of mold, and to make recommendations for mold remediation. This paper presents the sampling methodology that we employ in indoor air quality investigations for mold. The types and quantities of fungal spores identified during sampling indoors and outdoors in the Pacific Northwest are presented. The methodology employed includes air sampling for viable and non-viable mold spores. Sampling is conducted outside, in unaffected areas (when possible), and in potentially affected areas. This combination of methods and locations provides excellent coverage in terms of maximizing information about airborne mold spores, while minimizing cost. Viable methods provide quantitative information about airborne mold spores and qualitative information concerning the species of actively growing mold. Non-viable methods provide information on total fungal particles present. This is useful because non-viable particles still retain their allergenic, irritant, and toxigenic properties. The combination of viable and non-viable sampling methods also provides clues when hidden sources of mold are suspected. Typically, in buildings without extensive water damage and mold growth, indoor mold levels have been about one-third of outdoor levels and genera/species present have been similar between indoors and outdoors. Viable counts have been about one-fourth of the total non-viable counts. Common fungal particles found in outdoor air samples include Ascospores, Basidiospores, Cladosporium, and

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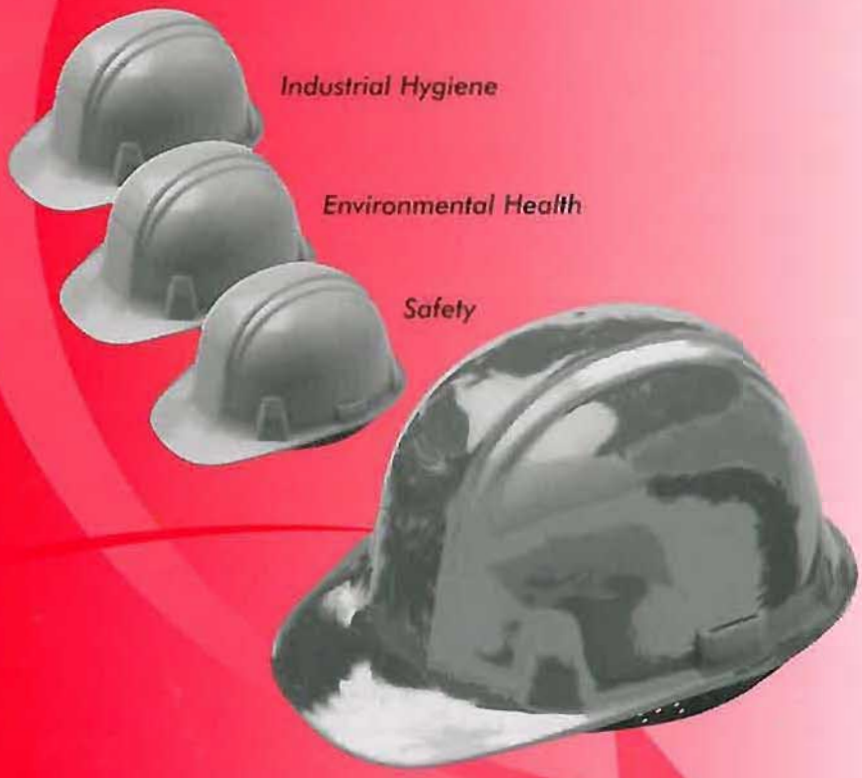

ABSTRACTS