evaluate particle concentrations for 24 hours at each of the locations. Fifteen size fractions were measured ranging from 0.3 micrometer to 20 micrometer. Outdoor GRIMM particle counts averaged 2.8 × 10^5 particles/liter (p/L) with 99% of the particles sized below 1 micrometer (cut point > 0.3 micrometer; min 6.5 × 10^4 p/L-max1.8 × 10^6 p/L) on the smokiest day. These coincided with indoor averages of 1.6 × 10^5 p/L (96.6% <1micrometer) on the upper floor, and 2.4 × 10^5 p/L (99.8%<1 micrometer) on the lower floor of the building. On non-smoky days, average measurements for most sites were one order of magnitude lower. However, the size distributions differed. 94% of the particles on both the upper and lower floors were less than 1 micrometer while 96% were <1 micrometer outdoors. Areas of complaints within the hospital were associated with sites that had consistently elevated particle counts in reference to the outdoor site. Size specific particle concentrations may be more relevant to indoor air quality complaints than the classical gravimetric measurements for airborne dust. They are also more useful since they can instantaneously be obtained and immediately lead investigators to problem areas in large buildings.

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A SIMPLE SURVEY METHOD FOR QUICK SCREENING OF IAQ AND ASTHMA SYMPTOMS. I. Kudla, Occupational Health Clinics for Ontario Workers Inc., Don Mills, ON, Canada; J. Oudyk, Occupational Health Clinics for Ontario Workers Inc., Hamilton, ON, Canada.

In response to symptom complaints of unionised workers, a government labor department ordered a symptom survey of occupants at a large courthouse contaminated with mold. The analysis and results of the survey were time sensitive in order to decide whether the building should remain open or closed during remediation. The English version of the Swedish "MM-040-EA Indoor Climate Work Environment Questionnaire" along with a four-item asthma screening questionnaire developed by Venables et al., were selected as investigation instruments. A one-page (double-sided) survey was distributed to 288 occupants and 82.9% responded within the one week deadline. Relative risk ratios were calculated comparing respondents' symptom prevalence with published data for buildings without air quality problems. Relative risk ratios exceeded 5.00 for cough, throat and skin symptoms experienced on at least a weekly basis. One-third (76) of the respondents satisfied a NIOSH "sick building syndrome" symptom case definition. Even more (94) screened positive to the asthma screening questions, 60 of whom reported never having been diagnosed with asthma. Comments written on the survey form indicated aggravation of pre-existing asthma and recent diagnosis of new onset asthma. The results were presented within 8 days of the survey response deadline. These survey instruments performed very well and were easily analysed in a very short time frame. It is an effective tool for validating building occupants' concerns and supplements the traditional aspects of an IAQ evaluation. These surveys are recommended to hygienists in similar situations facing tight deadlines.

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FINDINGS FROM A NIOSH IEQ INVESTIGATION. G. Burr, K. Martinez, NIOSH, Cincinnati, OH.

Background: In March 2000, NIOSH conducted an indoor environmental quality (IEQ) evaluation in a two-story office building located in South Carolina. Workers were concerned about exposure to carbon monoxide (CO), as well as mold in the building. Their symptoms included headache, sinus problems, and upper respiratory problems. Methods: Measurements of carbon dioxide (CO2), CO, temperature, and relative humidity (RH) were made and the ventilation systems were visually examined. Dust samples were collected by micro-vacuuming sections of carpet and "sticky" tape samples were collected using the adhesive side of the tape to pull spore structures and hyphae from the growth surface. Areas suspected of water damage were probed with a moisture meter. Twelve of the 115 employees volunteered for informal interviews. Results: The highest CO2 concentrations ranged from 1030 to 1190 parts per million (ppm), suggesting that parts of the building was receiving insufficient outside air (OA). Temperature and RH levels ranged from 69 to 75°F, and 35 to 53%, respectively, within the thermal comfort parameters recommended by the American Society of Heating, Refrigerating, and Air-Conditioning Engineers. CO concentrations ranged up to 2 ppm. Micro vacuum samples did not reveal high fungal concentrations, however bacterial levels ranged up to 5.9 × 10^6 colony forming units per gram of collected dust, mainly Gram negative species. Tape samples of suspect fungal colonies revealed Cladosporium, Ulocladium, and trace levels of Stachybotrys chartarum. The highest moisture readings were beneath exterior windows while carpeted areas were predominantly dry. Of the 12 employees interviewed, most reported respiratory problems, congestion, fatigue, and headache. Conclusions: There was inadequate amounts of OA provided to some offices. Localized microbial reservoirs existed and there were numerous ongoing moisture incursion conditions. It was unclear, however, how these related to the health complaints described by the interviewed employees. Recommendations were provided to further improve ventilation and eliminate the wet conditions conducive to microbial growth.

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CASE STUDY INVOLVING TEACHER SYMPTOMS AFTER SEVERE WATER DAMAGE IN A CONNECTICUT ELEMENTARY SCHOOL. K. Gilbert, G. Cormier, Occupational Risk Control Services, New Britain, CT.

An evaluation was performed at a Connecticut elementary school in response to teacher complaints that included mild headaches, nasal stuffiness, chest pain, and sinus infections. The onset of symptoms began soon after a water pipe leak occurred in a carpeted room adjacent to the Gymnasium, saturating the floors prior to the December holiday break. The number of teachers experiencing symptoms increased and the symptom severity worsened when they returned for a workshop after the holiday break.

Our hypothesis was that occupant symptoms were caused by fungal growth and amplification and migration of bioaerosols from the water-damaged areas into adjacent classrooms in the school. Cultureable fungal air samples using an Anderson N-6 sampler and MEA agar were taken outside and in eight locations of the school. Air sampling results indicated that specific species of fungi were found in the water-damaged and adjacent areas but were not found in the samples taken outside or in classrooms away from the water-damaged area.

Monitoring for carbon dioxide, carbon monoxide, temperature, and relative humidity was also conducted. Carbon dioxide levels exceeded the American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE) recommendation in six (6) of the 26 locations monitored.

This evaluation concluded that the cause of the occupant symptoms was the microbial growth and amplification in the water-damaged areas and a lack of fresh outside air. Recommendations were made to remove the hardwood floor and cork base in the Gymnasium and carpets in the two adjacent rooms under full containment and negative pressure and increase the amount of fresh air brought into the building by opening windows during occupied hours.

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RADON SORPTION OF BUILDING MATERIALS. C. Lungu, M. Kingsley, University of Minnesota, Minneapolis, MN.

This study investigates the influence of building material sorption on the concentration dynamics of a radon surrogate gas. An important factor in the radon dynamics which can change significantly its indoor concentration and persistence is its adsorption and subsequent desorbtion onto/from various building materials. Because of the difficulties encountered in creating constant radon emission sources as well as in measurement of radon concentration, due to its short-life and daughter products, radioactive xenon (Xe-133) has been chosen as a radon surrogate in this study, xenon having similar physical and chemical characteristics with radon. To test the ability of building materials to act as radon sinks, a 45 × 35 × 35 stainless steel small environmental test chamber was constructed in which three types of building materials were tested. The insulated, temperature controlled chamber allowed the injection of xenon into a clean air stream creating various xenon concentrations inside the chamber. The xenon activity-concentration was monitored using a flow-through ionizing chamber connected at the test chamber outlet. After the steady state was reached, the gas flow was interrupted and the building material samples were left inside the closed chamber for at least 12 hours. The airflow through the chamber was then reinstated and the output activity-concentration continuously monitored until undetectable levels were reached. The area under the desorption curve was obtained and the amount of xenon retained into the building material was calculated. Among the three building materials tested: carpet, ceiling tile and gypsum wallboard the most significant sink effect was exhibited by the ceiling tile (1.5 to 3.2 mg/m2) followed by the carpet (0.7 to 1.8 mg/m2) and by the almost insignificant sorption characteristics of wallboard (0 to 0.4 mg/m2). The tests were conducted at 23°C and at a relative humidity of 45%.

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CARDIOVASCULAR RESPONSE OF WEARING AN INDUSTRIAL BACK BELT. J. Davis, R. Thomas, Auburn University, Auburn, AL.

The purpose of this preliminary investigation was to determine the effects of two conditions: Belted

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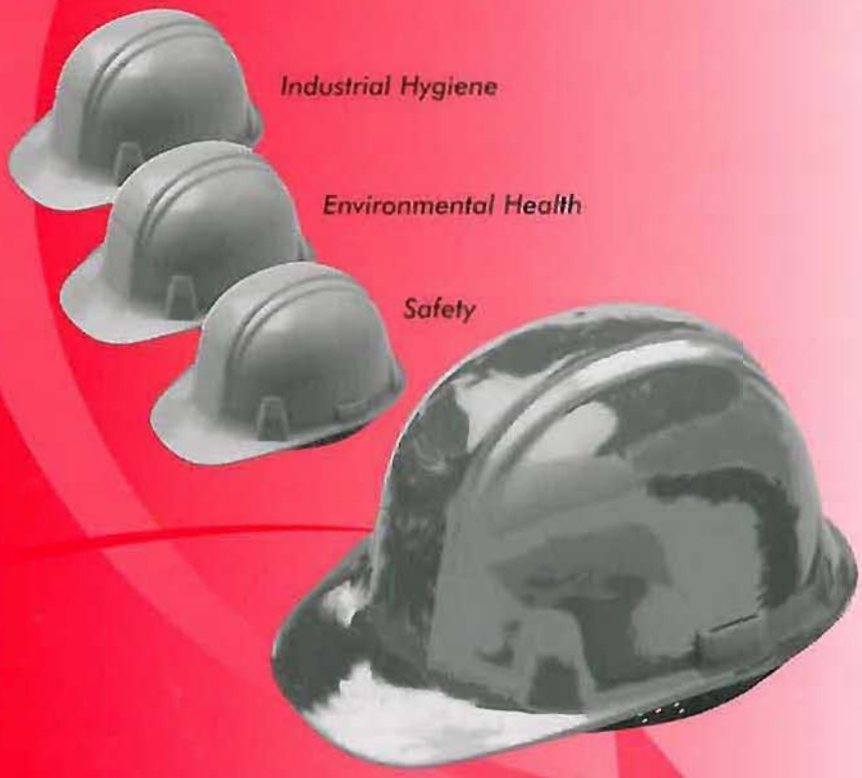

ABSTRACTS