248.
HOW TO MEASURE FORMALDEHYDE EXPOSURE.

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In the context of a study to estimate the health and economic impacts of lowering the current threshold limit value (TLV) ceiling of 2 ppm for formaldehyde to a TLV ceiling or time-weighted average (TWA) of 1, 0.75 or 0.3 ppm, the present exposure of Québec workers was evaluated in many economic activity sectors. Knowing the reliability and limits of the measuring methods was then of primary importance. For the TWA, two methods were used in parallel. For the first, formaldehyde was collected on XAD-2 polymer tubes impregnated with hydroxymethyl piperidine, at a flow of 0.2 L/min. The analysis was done by gas chromatography. For the second, formaldehyde was sampled on a passive diffusion badge impregnated with 2,4-dinitrophenylhydrazine (2,4-DNPH) and analyzed by liquid chromatography. More than 200 samples were collected for each method, both in the workers' breathing zone and ambient air, for periods of 1 to 6 hours. The results showed that both methods were equivalent for a concentration range from 0.07 to 2.0 ppm. For the ceiling exposure, three direct-reading instruments were used in the workplaces. The first one was an infrared analyzer equipped with a photoacoustic detector. The second one was based on a colorimetric reaction with a chemical read by an optical sensor. The third one was an electrochemical cell analyzer. Considering the results together or sector by sector, no correlation can be found between instruments. The presence of other compounds, namely phenol, toluene, and organic solvents, may influence the readings. To verify this fact, a study was done in a test chamber where instruments were exposed to formaldehyde in the presence of chemicals suspected to interfere with the readings. A fourth instrument, another type of infrared analyzer, was also tested. This study showed that potential bias can occur in measuring ceiling exposure.

249.
EFFECTS OF STORAGE CONDITIONS ON RECOVERING CULTURABLE FUNGI FROM DUST SAMPLES.

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We examined the effects of storage time, temperature, and humidity on levels of culturable fungi from office building floor dust samples. Four bulk dusts were pooled, homogenized with a 360-degree rotation shaker for two hours, and made into 152 aliquots. For a total of 144 aliquots, four were assigned into 36 combinations of time (two, four, six, and eight weeks; six months; and one year), temperature (room temperature, 4° C refrigerator, and -80°C freezer), and humidity conditions (with and without desiccant). We additionally analyzed eight aliquots two days after sampling to obtain baseline data. The samples were cultured with MEA, DG-18, and cellulose agar at room temperature for seven to 10 days. A total of 44 species were identified with *Penicillium aurantiogriseum, Epicoccum nigrum, Cladosporium cladosporioides*, yeasts, and *Alternaria alternata* recovered from at least 70% of the aliquots. Total fungi from all aliquots ranged from 3,500 to 165,400 colony-forming units per gram dust (cfu/g), showing that effects of storage conditions were within two orders of magnitude. We analyzed cfu/g with analysis of variance. Compared with baseline, *Penicillium* levels generally increased over time up to six months for all temperature conditions, and then dropped at one year. *Cladosporium* levels generally declined at all temperature and time conditions. Yeasts generally declined up to eight weeks; after that, levels differed by temperature conditions. We found interaction effects between time and temperature that differed by species. At the two-week-long storage, *Cladosporium* and yeast levels were

closest to the baseline values for -80°C storage, while for *Penicillium*, all three temperature conditions gave similar results. The presence of desiccant kept the levels of *Cladosporium* and *Penicillium* species closer to the baseline, but this effect was not found for other species. Our results imply a complicated relationship between storage conditions and levels of culturable fungal species.

250.
A STUDY OF AIRBORNE PARTICLE MORPHOLOGY IN PAPER-MAKING OPERATIONS.

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This study was conducted to evaluate worker exposures in consumer tissue manufacture in terms of fibrous dust. The morphology assessment looked at the size and shape of dust particles at the microscopic level to determine specific parameters that will help estimate how the paper dust may behave in the high Reynolds flow encountered in the upper respiratory tract. The fiber composition of the airborne paper dust is minor as determined by analysis of 60 inhalable dust samples collected on personnel. Isometric platelets are 83.8% of the airborne particles. Fibrous particles accounted for only 15.6% of the total particle count. From the microscopic analysis, the isometric particles appear to be formed by the cross-sectional diminution of the ribbon-like cellulose particles used in the process. Many of the particles are curved platelet structures. The sizes of the platelets range from 10 µm ´ 10 µm to 50 µm ´ 50 µm. The ICRP generally defines rigid fibers with a diameter of > 3.5 µm as having a low potential for respirability. It may be inferred that aerodynamically, a nonrigid or nonlinear fiber with a diameter of > 3.5 µm would be even more likely to deposit in the upper regions of the respiratory tract. The mean diameter of the aggregate of fibers from all samples analyzed was 6.5 µm (range, 1 µm–50 µm). The air samples collected in this study were submitted for analysis using three fiber counting methods. The mean fiber counts for the samples as determined by NIOSH Method 7400 A, NIOSH Method 7400 B, and MDHS Method 59, were 0.017 fibers/cc, 0.024 fiber/cc, and 0.011 fibers/cc. This data also demonstrates that the fibrous component of the inhalable dust is small and supports continued application of inhalable dust nuisance exposure criteria for paper-making operations.

251.
"MINI-BULK" SAMPLING: A METHOD TO MAXIMIZE DATA COLLECTED WHEN SURFACE SAMPLING AND AN AID IN DETERMINING THE SOURCE OF LOW-LEVEL BERYLLIUM CONTAMINATION.

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The DOE beryllium rule (10 CFR 850) has led to an increased demand for measuring beryllium surface contamination. As more and more aging facilities are scheduled for D&D, industrial hygienists may have to evaluate the extent of and determine the source of beryllium contamination. Identifying sources can be challenging when contamination is at low levels. Is it naturally occurring beryllium from soils, or an indicator of a possibly greater underlying legacy contamination problem? A method has been developed that provides the concentration of beryllium in the material collected from the surface (ppm), the amount of beryllium on the surface per area (µg/100 cm2), and elemental ratio data that can aid in determining the source of the beryllium. With this method, the filter papers used to collect surface wipe samples are pre-weighed in plastic Petri dishes. Sample are collected and allowed to dry. The filter/Petri

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