the INDUSTRIAL ENVIRONMENT — its EVALUATION & CONTROL

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service
Center for Disease Control
National Institute for Occupational Safety and Health
1973

For sale by the Superintendent of Documents, U.S. Government Printing Office

having a low concentration of dust are diluted as little as possible. Dense samples are diluted so that no more than about 2,000 particles/mm² will appear in the counting area of the cell. Not less than 5 ml of original or diluted sample should be taken for further dilution, and dilutions should be made in steps not exceeding 10 parts of dilution liquid to 1 part of original or diluted sample. The dust suspension must be shaken vigorously by hand for at least 30 sec. before a portion is removed for dilution.

Preparation for Counting

A. The sample to be counted is shaken to ensure a uniform suspension and a portion is transferred immediately to a clean cell by means of a clean pipette, taking care to prevent the inclusion of air bubbles.
B. Two cells are filled from each sample and from a "blank" flask.
C. Sample counting should start at the end of the settling time and should be completed in 10 min. The settling time should be 30 min/mm of cell depth.

Counting

A. Before counting, the ocular grid should be cleaned to remove dust particles.
B. The counting plane is the bottom liquid-glass interface of the cell. The microscope is focused up and down slightly with the fine focus adjustment in order to bring individual particles in and out of focus for more positive detection and counting.
C. Fields selected for counting should be uniformly distributed over the counting plane of the cell. Observation should not be made through the microscope while fields are being selected.
D. At least five fields of equal area should be counted in each of two cells. For a dust sample, when the first five fields of the first cell counted yield a total count of less than 100 particles, additional fields of known area should be counted; the total area counted is recorded and used in calculation of concentration. For each cell from the "blank" flask only five fields need be counted.
E. The same total area should be counted in the second cell as is counted in the first.
F. Total counts from the two cells of the same sample should be compared; and when the ratio of the greater to the lesser count is larger than 1.2, additional pairs of cells should be counted until a pair yields counts which satisfy this criterion. The count of this pair should be used for calculating the concentration of the sample.
G. Five fields of the same area as that used for dust sample counting should be counted in each of two ceils from a "blank" flask. The average blank count should be used in calculation of net count. If the blank count exceeds 30 particles/mm² of counted area, all the samples should be rejected.
H. Observers are cautioned that their ability to see particles probably improves during the first few minutes of counting as their eyes become accustomed to the task. A brief period of counting is suggested prior to recording data. Fatigue can cause a deterioration in counting efficacy; conservative judgment should be exercised on when to discontinue counting because of fatigue.

Membrane Filters

The membrane filter method is commonly used for assessing asbestos dust exposure.

In order to view the dust under the microscope it is necessary to use immersion oil to render the filter transparent. The refractive index of membrane filters is about 1.5, close to that of chrysotile asbestos ($N_D = 1.55$), so that under ordinary illumination the chrysotile may itself be very nearly invisible when using an immersion oil closely matched to the filter. A phase contrast microscope is therefore used to increase the visibility of the chrysotile. The method given below is based on the standardized techniques recommended by the National Institute for Occupational Safety and Health.

Sampling Procedure

Samples for evaluation of asbestos exposure are collected on Millipore AA Membrane filters (37 mm diameter, 0.8 μm pore size) by personal samplers operated by battery-powered pumps, worn by the employees. The filters are contained in plastic filter holders and are supported on thick pads which also aid in controlling the distribution of air through the filter. The face cap of the filter holder is removed and filter used open face during sampling. The sampling rate is about 2 liters/min. A minimum sampling period of 15 minutes (for evaluation of excursion limit) and several samples of up to 4 hours for evaluation of 8-hour average are normally required. Samples with a visible deposit may be too heavy to count; compare the appearance of the collected samples with a clean filter. Heavy concentrations of visible dust in the air (100 to 500 fibers/ml) may require short sampling periods of only 5 minutes, or less. The following specifications should be considered minimum for the microscope used for counting of asbestos fibers.

1. Microscope body with a binocular head and a fine focus accuracy of 0.005 mm.
2. Binocular with 10X Huygenian eyepieces
3. Porton reticle
4. Mechanical stage
5. Kohler illumination (preferably built in and having provisions for adjusting light intensity)
6. Abbe condenser with an adjustable iris
7. 40-45X (0.65-0.75 N.A.) Positive (bright field) phase-contrast objective
8. Annular ring condenser diaphragm (corresponding to the objective)
9. Phase ring centering telescope
10. Green filter 6113
11. Stage micrometer 18265