INDUSTRIAL HYGIENE SAMPLING AND ANALYSIS PROCEDURES

JOHNS-MANVILLE

Standard Impinger Sampling and Counting Technique

A. Application. For the determination of the atmospheric concentration of an insoluble inorganic dust such as that associated with the production of lung fibrosis, the particle size of which is generally below 10 microns and, from the hygienic standpoint, is not of interest below 0.5 micron. This method is not recommended for the determination of organic dust, metallic fumes, vapors and gases.

B. Equipment Assembly. Basically, the impinger sampling equipment consists of an impinger assembly unit and a suction pump unit. The impinger assembly of pyrex glass is dimensioned per Drawing 7237-4 (Modified Standard Greenburg-Smith Impinger). The suction pump unit is equivalent to the Willson #3A motor driven pump unit with calibrated vacuum gauge and V belt drive.

The impinger assembly in a 500 ml. Erlenmeyer pyrex flask is mounted in a holder on a tripod or other suitable stand so as to be in the breathing zone of employees at the operation being studied. A 1/2" ID non-collapsible rubber tubing of suitable length is connected to the exhaust elbow and to the inlet side of the pump. The pump motor operates on 110V A.C current or 220V A.C. with the series resistance. Adjustment of the bleeder valve of the pump should be made to maintain vacuum at the appropriate gauge setting.

1. Calibration. The apparatus is set up in the same manner as for sampling. The inlet of the impinger is attached to the outlet tube of a standard wet test meter. The pump valve is adjusted to a definite gauge reading (the single line on the Willson pump units), and the time for intake of 1 cubic foot of air is measured by stop watch. Five readings in hundredths

Published by AsbestosClaims.Law
asbestosclaims.law/library/25392/1

of a minute for a 1 cubic foot air intake should be taken and averaged. The average time is then divided into 1.00 to give the rate of cubic feet of air per minute for that impinger tube. The impinger should be permanently identified (letter, number, etc.) and the rate recorded.

A copy of the impinger ratings in the field will prove of value. For example:

Impinger Tube	Vacuum Gauge Reading	Cubic Foot of Air Per Minute
J	Line (2)	1.06
Z	Line (2)	1.11
L	Line (2)	1.03

Should the cubic feet of air per minute of an impinger be more or less than .15 from 1 cubic foot, a new gauge setting for that impinger should be established, identified and recorded to bring the flow within those limits.

The meter used for calibrating should be checked frequently to insure accuracy.

C. Sampling

1. Location

Sample stations should be established in the working area at all operations where health hazards are believed to exist. They should be permanently identified by photographs and station numbers, and this designation used as the sample number for all samples taken at this location. In addition to samples collected in the breathing zone of the exposed workers, samples should be taken to determine the dust concentration in the general workroom atmosphere and in special studies to determine the sources of the dust dispersion or distribution. It may be necessary to follow an operator with an extension hose on the impinger to be certain of a representative sample of

The sampling unit should be secured to the stand and placed in the breathing zone of the employees at the operation being studied. If such placement is not feasible (due to cramped quarters, etc.) the flask and impinger unit may be secured to some object which will be in the desired sampling area.

Appropriate data should be recorded on Form 50191-46.

2. Preparation

The sampling fluid should be comparatively free from suspended matter. If possible, distilled water should be prepared by one of the continuous types of water stills, and, after distillation, allowed to stand for 24 hours, the upper part being drawn off for use. To minimize the solubility of mineral dusts and inhibit bacterial growth, a mixture of distilled water and 2 propanol U.S.P. should be used.

All glassware should be thoroughly cleaned with a hot cleaning solution, rinsed several times, and finally rinsed with the fluid used as sampling medium. Rubber stoppers and corks should be cleaned by scrubbing with a brush in warm, pure soap solution. These should be rinsed thoroughly and rinsed finally in the sampling medium.

250 ml. of sampling fluid should be placed in cleaned flasks and the flask stoppered with solid rubber stopper and capped with paper over the top held by a rubber band. Cleaned impinger assemblies should be stoppered and wrapped pending use. Prior to entry into the sampling field, the cleaned stoppered impinger assemblies should be inserted in place of the solid stopper.

Published by AsbestosClaims.Law
asbestosclaims.law/library/25392/3

The impinger outlet elbow is connected by appropriate lengths of rubber hose to the inlet connection of the pump. A 110 V A.C. 25 or 60 cycle (220V with resistance) current supply is necessary for the pump motor.

Start the motor, noting the starting time and adjust the pump valve to obtain the appropriate gauge reading. This gauge reading should be maintained throughout the sampling.

The number and spacing of the samples at a given station, the locating of the sampling point, and the length of each sampling period shall be so chosen as to yield a representqative measure of the exposure throughout the cycle of operation, and also to indicate the peak or low concentration.

When the sample has been completed, the inlet and exhaust impinger tubes should be stoppered and the flask removed from the sampling area. The sample number should be indicated on the flask. The impinger assembly should be removed and washed with distilled water into the sample flask. A clean solid rubber stopper should be inserted in the flask and capped with paper and a fairly heavy rubberband or scotch tape.

A flask containing the sampling fluid only, "Blank Count", should be included with the samples to be analyzed.

a. Preparation of Sample

1. Wash all cell parts in soapy water with a fine camel's hair brush. Rinse thoroughly with distilled water.

2. Dry cell parts between filter paper and then with lens paper.

3. Make a small mark on the floor of cell with red wax crayon for care of microscope focusing.

4. The effectiveness of cleaning shall be checked by microscopic examination of each cell before being filled.

Published by AsbestosClaims.Law
asbestosclaims.law/library/25392/4

5. One cell shall be filled from each sample.

6. One cell shall be made from the blank flask.

7. The sample of known volume should be shaken vigorously and a portion transferred immediately to the cell by means of a clean pipette, taking care to prevent the inclusion of air bubbles.

8. The concentration of the suspension shall be such as to give a dust count at least 4 times the "blank" count and not greater than 150 particles in the 1/4 sq. mm. counting area. When further dilution from the initial volume of 250 cc is required to reduce the field count to the limits specified above, the dilution shall be made in steps not exceeding 1:10. Complete mixing of the suspension by vigorous agitation is required before removing a portion for dilution. Excessive dilutions are to be avoided by proper gauging of the sampling time in relation to the dust concentration. For example:

Volume Removed From Original	Original Volume	Ratio	Dilution Factor in Formula
125 cc	250 cc	1:2	X2
62.5 cc	250 cc	1:4	X4
50 cc	250 cc	1:5	X5
25 cc	250 cc	1:10	X10

b. Counting

1. Counting shall be done in a dust free room, using artificial illumination in the microscope.

2. The light and mirror shall be centered so that no shift of position of the particles is seen when focusing up and down. The condenser and diaphragm shall be adjusted to give even, moderate illumination. Each observer should determine and employ the optimim lighting for his eyes.

3. Before counting, the field of the microscope shall be examined and, if necessary, the ocular grid cleaned to remove dust particles.

4. The count shall be made in a plane just above the surface of the cell rather than throughout the depth of the liquid. The microscope may be focused up and down by means of the fine adjustment in order to bring individual particles into focus. Before making the count, the cell contents shall be carefully examined throughout the entire depth to make certain that all countable particles have settled. Allow sample cell to settle a minimum of 20 minutes before counting.

5. Five fields of 1/4 sq. mm in area shall be counted, one in the central part and the other 4 towards the edges of the cell.

6. Count and record the number of particles, 10 microns or less. Particles are defined as having a length to width ratio of less than 3 to 1.

D. Sample Counting

1. Method

Dust and fiber concentrations in the air, collected by impinger methods, are determined by calculation after light-field counting of samples under a microscope.

2. Equipment

100X Microscope (16 mm 10X Objective and 10X Eyepiece) with simple condenser; whipple disc; Micrometer; dust count cells - Plankton (Sedgwick-Rafter) or Dunn; pipette.

Published by AsbestosClaims.Law
asbestosclaims.law/library/25392/6

3. Procedure

The sample should be counted within 36 hours after collection, except that in the case of flocculating dusts, the permitted holding time shall not exceed 12 hours. Special collecting liquids may be employed to minimize the degree of flocculation for certain dusts.

4. Computation of Results

The concentration of dust shall be expressed in millions of particles per cubic foot of air (mppcf) reported to significant figures only.

Concentration is determined as follows:

$$\text{Conc. (mppcf)} = \frac{(N_s - N_c) \times \text{C.F.} \times V_w}{V_a}$$

Where:

N_s = Mean count per field for the sample (5 fields)

N_c = Mean count per field for the blank (5 fields)

C.F. = Cell Factor = 100/ (area of counting field in sq. mm)
(x depth of cell in mm)

V_w = Total water volume (equivalent total, when portion diluted, i.e. initial sample volume x dilution factor)

V_a = Air volume sampled in cu. ft.

Example:

Duration of sampling time	:	10 minutes
Rate of sampling	:	One (1) cubic foot per minute
Vol. in flask after washing	:	250 cc
Ratio of added dilution (125 cc in 250 cc flask)	:	1:2
Cell depth	:	1 mm

Dust count, light field (1 cell) particles less than 10 microns in size.

79
85
80
84
82
5)420 = 84

84 Av. Total/Field
-5 Blank Count
79 Av. Net Count

Calculations:

$$\frac{\text{Av. Net Count Per 1/4 sq mm} \times 4 \times \text{cu. mm per cc} \times \text{Flask Vol.} \times \text{extra dil. ratio}}{\text{Cu. Ft. Per Minute Sampled} \times \text{Sampling Time}}$$

$$\frac{79 \times 4 \times 1000 \times 250 \times 2}{1 \times 10} = 15.8 \text{ Million Particles Per Cubic Foot of Air}$$

Adapted with modifications from:

Transactions - Fifth Annual Meeting (1942)

National Conference of Governmental Industrial Hygienists.

February 10, 1969

Membrane Filter Method

A. Application

The membrane Filter Method is applicable for the determination of the atmospheric concentration of asbestos fibers. This method is suited for sampling in both asbestos textile operations and mixed dust operations containing asbestos fiber. This procedure is particularly valuable in mixed dust areas since asbestos fibers alone are counted without interference from granular dusts.

B. Equipment Assembly

Basically, the membrane filter sampling equipment consists of suction pump unit and a filter holder assembly. The suction pump unit is the Casella Personal Air Sampler. This instrument will sample for 10 hours on one charge at a flow rate of 2 liters per minute (lpm). Batteries are recharged overnight.

Alternate suction pump units are the Monitaire Sampler with a suitable flow tube (0-10 CFH), and the Unico Model C110 Personnel Air Sampler.

The filter holder assembly is the Aerosal Field Monitor containing a Millipore type AA 37 mm, 0.8 micron pore size. The filters are supported on thick pads which aid in controlling the distribution of air through the filter. Rubber or plastic tubing of suitable length is connected to the inlet side of the pump and to the filter holder assembly. The pump is turned on and adjusted to the appropriate gauge setting. This gauge reading should be maintained throughout the sampling period.

C. Sampling

1. Location

Established sampling stations should be taken with the Casella Personal Air Sampler attached to the operator's belt and the filter

holder clipped to the operator's clothing. Where this is not possible and in general room samples, the filter holder assembly may be attached to a suitable stand or holder in the worker's "breathing zone". The sampling time should be gauged to obtain sufficient material on the filter for satisfactory counting under the microscope. Excessive dust deposits should be avoided since no dilution is possible.

D. Sample Counting

1. Preparation of Mounting Solution

The mounting solution used in this method is a 1:1 mixture of dimethyl phthalate and diethyl oxalate. This solution may be used when the sample is to be counted within 24 hours after preparation. If samples are to stand for longer periods of time an alternate solution may be prepared by dissolving 0.05 grams of membrane filter material per milliliter of solution. For example, in a 100 cc solution, 50 cc of dimethyl phthalate are mixed with 50 cc of diethyl oxalate. Five grams of sampling filter material are weighed up and dissolved in the 100 cc solution. The purpose of the dissolved material is to provide a solution with as high a viscosity as possible without being difficult to handle. The highly viscous solution delays the migration of particulate outward from the center of the mount. The samples will remain stable with no apparent loss in concentration for approximately 30 days.

2. Mounting Sample

To prepare a sample for microscopic examination, a drop of mounting solution is placed in the center of a freshly cleaned standard microscope slide (25 mm x 75 mm) using a dropper. A wedge-shaped piece about 1 cm x 2 cm is excised from the filter paper using a scalpel and forceps.

The piece is placed dust side up on the drop of solution. A number 1½ coverslip carefully cleaned with lens tissue is placed over the filter wedge. Apply slight pressure on the coverslip to achieve contact between it and the mounting solution. The sample may be analyzed as soon as the mount is transparent. The "clearing" of the filter requires about 15 minutes .

3. Sample Counting

Analysis of the filter sample is performed with a binocular microscope at 430 X. The phase contrast optics fitted to the microscope include an Abbe condenser, a 4 mm (43X) achromatic objective, and two 10X Huygens eyepieces. One of the eyepieces should contain a suitable grid (e.g., Porton Reticule) to define the counting field and assist in judging lengths of fibers. Phase contrast illumination is supplied with a ribbon filament illuminator. Twenty fields located at random on the sample are counted. Two counts are recorded, (1) total fibers, and (2) fibers 5 microns in length and greater. Any particle having a length to width ratio of 3:1 or greater is considered a fiber.

E. Computation of Results

In the following calculations, let

A = area of membrane sample

a = area of field of view

N = number of fibers counted

n = number of fields observed (20)

V = volume of sample in ccs.

Then the concentration (C) in fibers/cc is given by

$$C = \frac{A}{a} \times \frac{N}{n} \times \frac{1}{V}$$

Published by AsbestosClaims.Law
asbestosclaims.law/library/25392/11

Membrane Filter Method

EXAMPLE

area of membrane sample = 855 mm^2

area of field of view = 0.005 mm^2

number of fibers counted = 200

sampling rate = 2 lpm = 2000 ccs/min

sampling time = 90 minutes

Calculations

$$C = \frac{855}{0.005} \times \frac{200}{20} \times \frac{1}{2000 \times 90}$$

$$= 171{,}000 \times 10 \times \frac{1}{180{,}000}$$

= 9.5 fibers/cc

The maximum allowable concentration for counts made of fiber 5 microns in length and greater by this method is 12 fibers/cc.

Published by AsbestosClaims.Law
asbestosclaims.law/library/25392/12