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WIRTSCHAFTSVERBAND ASBESTZEMENT E.V.
Arbeits- und Umweltschutz

INTERNATIONAL COLLOQUIUM

ON

DUST MEASURING TECHNIQUE AND STRATEGY

Asbestos International Association colloquium

AT WARMENSTEINACH

GERMANY

ON AUGUST 29 AND 30, 1977

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II.

S U M M A R Y

According to an agreement of the Executive Committee of the Asbestos International Association Dr. Robock organized a colloquium on

DUST MEASURING TECHNIQUE AND STRATEGY

with cooperation of Professor Gibbs and Mr. Walton.

The aim of this colloquium was

- to establish the differences of dust measuring technique and strategy within the different countries
- to achieve an international standardization which enables us to compare the situations in the plants within the asbestos industry and which gives us the basis for epidemiological studies (retrospective and prospective)

The colloqium took place at Warmensteinach, a small town in the National Park Fichtelgebirge (Bavaria), on August 29 and 30, 1977.

Invited were representatives of the asbestos industry and the controlling authorities. 39 experts from 15 countries participated.

After an introduction by Dr. Robock in which he illustrated the necessity of a standardization the following topics were discussed:

- Techniques and strategies applied
- Results from scientific and practical dust measurements
- Presentation of dust measuring data
- Automation of fibre counting

A convention for the standardization of method and strategy could not be reached in the shortness of time because of numerous different opinions. Dr. Robock was asked to convene a Dust Working Group to prepare such convention.

In the following a summary of the presentations and individual contributions:

TECHNIQUES AND STRATEGIES APPLIED

MR. TEICHERT reported in his presentation

EQUIPMENT AND STRATEGY OF DUST MEASUREMENTS WITHIN THE GERMAN A/C INDUSTRY

about the functions of the German asbestos cement (A/C) industry, the measuring instruments applied and their principles and limits, kind of sampling, selection of measuring points and measuring procedures as well as about preparation, counting and calculation of average values based on individual results.

Those measuring series were reported about which demonstrate the problems connected with each complex and the measures taken (e.g. way of handling equipments) were explained on the basis of results.

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MR. WALTON mainly referred in his presentation

PROBLEMS IN THE STANDARDIZATION OF ASBESTOS DUST MEASUREMENTS

to the membrane filter method. He pointed out that it is the purpose of standardization

- to enable information from different sources to be compared and collated into one general pool of knowledge;

- to ensure that specified limits (TLV's, MAK's) can be uniformly implemented to provide the intended levels of safety.

To be effective, standardization must cover not only the evaluation (counting) of samples, but also the method and strategy of sampling, e.g. the shape and orientation of the filter holder, the sampling air velocity, when and where samples are taken, whether over a short period or over the whole shift, whether in the breathing zone or in the general environment, etc.

The hygiene standard for asbestos in Britain (2 F/ml) was derived from epidemiological evidence in an asbestos factory where environmental measurements have

been regularly made since 1953. At first sampling was by thermal precipitator and all particles (not restricted to fibres) were counted. Then a new improved form of thermal precipitator was used, and finally there was a change to membrane filter methods when fibres >5 µm were counted. All the counting of fibres on the membrane filters was by the so-called "full-field-method", i.e. with no graticule in the microscope eyepiece to define the counting area.

Methods have since changed further. The standard is applied to personal sampling whereas it was derived for fixed position sampling, and to counting with a graticule which gives much higher values than full-field counting, and to single shifts whereas the derivation was based on long-term average levels. Thus, it seems probable that the standard now being enforced is appreciably more stringent than was intended.

Mr. Walton reported about experience regarding comparative countings.

The influence of the graticule on the counting result was pointed out and a graticule specially concipated for the fibre counting was presented. This graticule allows an exact determination of countable fibres.

The relatively great divergencies in comparative countings can substantially be influenced by different detection limits of thin fibres. The limitation not only to a maximum diameter of fibres but also to a minimum diameter could be helpful.

If the ratio length to diameter would be increased from 3 : 1 to 5 : 1 the number of asbestos fibres would not be affected but all elongated mineral fibres could be excluded.

A standardization should not only be an agreement between the evaluating people but also the biologists should be consulted to examine if the right responsible parameters are measured. Concerning this matter the biologists have still to answer a lot of open questions about relevant parameters for the different types of reaction

- fibrosis
- mesothelioma
- lung cancer
- other tumors

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The two presentations and the contributed papers have demonstrated that the membrane filter method is handled in very different ways with regard to important details. This can lead to different and not comparable results.

TECHNIQUE

- SAMPLING
  - . velocity at the suction aperture (mm/sec. - m/sec.)
  - . flow rate check
  - . pressure constancy (pulsation)
  - . time (overloaded filter)

- FILTER

  . type of material (nitrocellulose, cellulose-acetate)
  . pore width
  . diameter
  . surface (with and without grid)

- PREPARATION

  . embedding medium (refractive index)
    e.g. triacetine, US-mixture, cyclohexanone, acetone vapour and thus influence on

    .. detection limit
    .. background
    .. thickness of the layer of dust
    .. permanency

  . way of handling the medium, the filter and the cover slip and storing of the prepared slides

- COUNTING

  . microscopic equipment

    .. phase contrast device
    .. illumination
    .. filter
    .. magnification
    .. graticule

    thus influence on detection limit and size determination

- COUNTABLE FIBRES

  .. length
  .. diameter
  .. ratio length : diameter
  .. agglomerates
  .. splitted fibres

- STATISTICAL PRECISION
  - .. consideration of fibres overstepping field of counting
  - .. total number of fibres to count
  - .. number of fields of counting to evaluate
  - .. overloaded filter

STRATEGY

- FUNCTION
  - . engineering control
  - . exposure control
- SELECTION OF MEASURING POINTS
  - . some points distributed over the hall
  - . all workplaces
  - . all workplaces with dust exposure
- POSITION
  - . stationary
  - . personal
    - .. on the person
    - .. following the person
  - . consideration of influencing factors (draught, working conditions)
- DURATION
  - . short-time
  - . long-time
- STATISTICAL PRECESION
  - . number of samples
  - . repetition working cycle

- CALCULATION

  . peak concentration

  . arithmetic average

  . time-weighted average

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RESULTS FROM SCIENTIFIC AND PRACTICAL DUST MEASUREMENTS

PROFESSOR GIBBS pointed out in his presentation

RESULTS FROM SCIENTIFIC AND PRACTICAL
DUST MEASUREMENTS

that dust measurements should serve

- to prove the compliance with standards

- to identify dust sources

- to test the effectiveness of control measures

- to improve our knowledge of the relationships between asbestos dust exposure and its health effects.

Given that a standard is set, it is the responsibility of the government or agency promulgating this standard to set it out in clear terms, to describe and designate the appropriate instrumentation for collecting the sample, the calibration, its operation location and frequency of sampling, tolerances on the measurement and the way in which measurements are to interpret. To identify dust sources in recent years a number of instruments based on light scattering, piezoelectric effect, ß-ray absorption etc. have been deviced for the rapid measurement of airborne concentrations of dust. Such methods cannot distinguish between asbestos fibres and other dust, but as relative measurements they can be very helpful, for example to test the

effectiveness of control measures by checking before and after modification at a site.

Although the exposure to asbestos is related to 4 main diseases very little is known about the risks dependent on the level of exposure.

The available data on dust concentrations in the past was determined by methods which deviate from the currently applied membrane filter method. It is therefore essential

- to find methods to convert past environmental data to the equivalent fibre concentrations to determine whether standards which have been set, based on the membrane filter method, have validity in scientific terms,

- to consider carefully and determine whether this measure of airborne fibre concentration is an adequate index of environmental quality for the control of each of the diseases associated with asbestos exposure,

- to conduct more studies of exposure-response.

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The participants contributed data from the past and present for the various branches of the asbestos industry. Since in many countries they have only just began with measurements in the last few years a very limited amount of data was presented. In most of the cases values could only be indicated to some striking workplaces. This does not enable us to derive a representative cross-section for the whole industrial branch but it gives a rough idea of the order of magnitude of the

fibre concentrations in the past and at present in the different industrial branches:

FIBRE CONCENTRATIONS (F/CM^3)

MINES

	former	today
minimum	-	0.1
maximum	-	1
majority	-	0.5

MILLS

	former	today
minimum	10	1.5
maximum	200	100
majority	20 - 100	5 - 10

INSULATION INDUSTRY (production and application)

	former	today
minimum	5	2
maximum	1000	200
majority	40 - 100	5 - 50

TEXTILE INDUSTRY

	former	today
minimum	5	0.5
maximum	300	18
majority	50 - 200	1 - 5

A/C INDUSTRY

	former	today
minimum	4	0.1
maximum	150	5
majority	10 - 50	0.5 - 2

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PRESENTATION OF DUST MEASURING DATA

MR. THIELE reported in his presentation

PRESENTATION OF DUST MEASURING DATA

about the way of proceeding in the Danks Eternit-Fabrik A/S.

The results of measurements serve to inform the worker and the management. In order to be able to discuss the situation with the worker the results must quickly be available, i.e. as long as the worker can still clearly remember the working situation in question.

For the management a general survey is provided indicating the number of employees exposed to dust. 4 groups with different exposure levels are formed

- > 1 f/cm³
- > 2 f/cm³
- > 3 f/cm³
- > 5 f/cm³

The remaining employees are exposed to a dust concentration of < 1 f/cm³. If this survey is kept over a longer period the positive development of the dust situation can be realized at once.

MR. A.A. CROSS (10)

Example of group of factories and operations comprising

Asbestos Cement Manufacture
(sheets, pipes, fabrications - not pressure pipes)

Asbestos Insulating Board

Friction Materials

Thermal Insulation Materials

Application of Asbestos and other Insulating Materials (including spray)

Stripping and repair of Insulation

1. Programme of Asbestos Dust Concentration Measurement.

1.1. Method - Membrane filter method in accordance with ARC Technical Notes 1 and 2.

1.2. Sampling Period - 10 minute periods covering period of maximum dust emission.
Multiple samples (usually two) when significant variation from expected (from previous records).
Longer periods (representative of continuous shift operators) up to 4 hours are carried out when 10 min. samples indicate concentration < 2 f/ml.

1.3. Sampling Locations -

Operator's breathing zone (OBZ). Normally by lapel mounted sampling head. Alternatively, with sampling head on probe, held in OBZ by sampler following operator's movements.
Machine Counts(MC). Measurements at point of emission (dust emission source) by static sampler.
Background Counts (BG). Measurement at predetermined locations in workshop area to determine condition of general working environment.

2. Responsibility. (1) Continuous programme of monitoring carried out by local technical staff of

operating company, often associated also with quality control. Reports monthly to local mangement and to headquarters service chief.
All measurements exceeding 2 f/ml subject of immediate special report to plant management for investigation and remedy. Monthly summary of such reports presented to senior mangement (board of directors) by director responsible, with information on action taken or planned.
In cases of sustained excess dust level, sampler has authority (through workshop management) to stop the offending process.

(2) Central Environmental Service (responsible to parent company board) makes twice yearly visit to carry out parallel dust measurement. This ensures continuous correlation of sampling and evaluation techniques, and confirms reliability and consistency of reports. It also provides opportunity for advice and communication on control techniques.

(3) Central Environmental Service is responsible for establishing techniques of sampling, for specifying equipment, for training, and for supplying emergency and investigatory facilities within and outside the organisation.

(4) By liaison with associated members of ARC and with the technical branch of the Factory Inspectorate, the Central Environmental Service endeavouring to maintain consistency of measurement with other experts.

Results.

The effect of constant and planned monitoring in reduction of excessive dust concentration is demonstrated by the following comparison.

Percentage of Measurements in different Levels of Concentration

	1971	1976
< 2 f/ml	52.3	88.3
2-4 f/ml	22.1	9.5
4-12 f/ml	18.9	2.2
> 12 f/ml	6.7	-